The Trickle Up Effect

A collection of economic and scientific papers

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CRC Press

The Trickle Up Effect:

A collection of economic and scientific papers

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2013

CRC Press

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ISBN:

The Trickle Up Effect: a collection of economic and scientific papers

Preface

This book consists of a number of economic, mathematic, and scientific papers, covering different subjects, from global corporate control to cosmology issues. Hopefully the readers will find some interesting discussions in this collection.

The trickle-up effect is defined here as a reverse process from the 'expected' trickle-down effect, a well known effect which is supposed to happen during development process. According to an article in the Center of Progressive Economics: "Libertarians contend that the prosperity generated at the top of the economic latter will trickle down to everyone else."[1] But the problem with pure laissez-faire economics is that the wealth generated at the top does not trickle down to the rest of society to a sufficient extent. The creative redistribution theory of Keynes and its implementation by FDR and World War II started to solve this problem, and made recirculation of wealth from the bottom to the top, which can be called as "the trickle up." One can argue therefore that trickle up effect is more realistic, that is by helping the poor then the effect will be spiraling up to the wealthy and the affluent people.

The same situation apparently also happens in development economics. For example it is common to assume that the development of a country will need foreign loan to trigger effects, and then the good effects of economic development will trickle down from the affluent to the less affluent people. But as shown by a number of economists, it is often the reverse that occurs: the money flowing from the poor to the affluent is much more than the money flowing from the affluent to the poor.

And for the debt caused by foreign loan, it can create a massive poor society which becomes more dependent to other countries. See for instance a book by John Perkins, with title *Confessions of an Economic Hit Man*:[2]

> "Like our counterparts in the Mafia, we provide favors. These take the form of loans to develop infrastructure—electric generating plants, highways, ports, airports, or industrial parks. One condition of such loans is that engineering and construction companies from our

[1] http://cpe.us.com/22/trickle-up-vs-trickle-down-economics; see also http://iea.org.uk/blog/in-praise-of-trickle-economics

[2] Perkins, J. (2004) Confessions of an Economic Hit Man, Berrett-Koehler Publishers, Inc, San Fransisco, p.5, 7

> own country must build all these projects. In essence, most of the money never leaves the United States; it is simply transferred from banking offices in Washington to engineering offices in New York, Houston, or San Francisco…Indeed, one of the reasons the EHMs set their sights on Ecuador in the first place was because the sea of oil beneath its Amazon region is believed to rival the oil fields of the Middle East. The global empire demands its pound of flesh in the form of oil concessions."

At first sight the trickle up effect term may sound a bit delusional, but you can read the veracity memo written by the publisher of John Perkins's books, which suggest that all that he wrote in his book is telling the truth.[3]

Therefore we begin this book with a paper discussing Global corporate control and its relation with the Federal Reserve Bank's fraud of around 16 trillion of dollars between 2007-2010. Now you can find that the world is dominated by a handful of financial companies who have the privilege to get secret loan while they were in trouble.

We hope that this book will trigger further thinking and discussions concerning how the reality of economic development process - governed by World Bank and its allies - makes developing countries become even poorer. And how some countries which don't follow the so-called Washington Consensus have become countries with strong economy, for example BRIC (Brazil, Russia, India, and China). Therefore, apparently now is the right time to questioning the basic idea concerning trickle down economy, and returning to the trickle up economy.

If you have any thought and comment on this book, especially on the idea of the trickling up effect, please take your time to send us email, either to victorchristianto@gmail.com or to fsmarandache@gmail.com.

Version 1.0: August 28th, 2013

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[3] The veracity memo was written by Mr. Steven Piersanti, available from: http://www.economichitman.com/pix/veracitymemo.pdf

Contents

On Global corporate control, Federal Reserve, and the Great Theft 2007-2010

By Victor Christianto[1] & Florentin Smarandache[2]

Abstract

A common intuition among scholars and in the media sees the global economy as being dominated by a handful of powerful transnational corporations (TNCs). However, such an assumption has not been confirmed by numerical data until recently, in a report by Vitali, Glattfelder, and Battiston [1]. They gave a list of 50 most elite TNCs, which were called "super-entity", along with other 97 TNCs which were not mentioned in their list. This super-entity is supposed to be more powerful than the core, consisting of 1,318 corporations. In this paper we expose for the first time that Vitali et al.'s finding on these super-entity TNCs apparently does not match exactly with recipients of secret funds given by the Federal Reserve Bank of USA (the Fed) during 2007-2010. Therefore, it seems that more investigations are needed on the nature of the financial corporate which received secret funds from the Fed, because those recipients of fund from Fed appear to be more powerful than the 147 super-entity TNCs. Although we give references on several papers which outlined the implications of this finding to global economy, in this paper we give no prescription on how to improve the global economy architecture. We reserve this issue for a future paper.

Introduction

In a series of papers based on network analysis, Vitali, Glattfelder and Battiston [1][2] described their findings of the network of global corporate that controls about 80% of the world profits. Vitali, Glattfelder, and Battiston gave a list of 50 most elite TNCs, which were called 'super-entity', along with other 97 TNCs which were not mentioned in their list. This super-entity is supposed to be more powerful than the 'core', consisting of 1,318 corporations.

In this paper we expose for the first time that Vitali et al.'s finding on these super-entity TNCs apparently does not match exactly with recipients of secret fund which was given by the Federal Reserve Bank (Fed) during 2007-2010. Therefore, it seems that more investigations are needed on the nature of the financial corporate which received secret fund from the Fed, because those recipients of funds from the Fed appear to be more powerful than the 147 super-entity TNCs discovered by Vitali et al. [1].

Although we give references on several papers which outlined the implications of such a finding from network analysis to global economy [5][6], in this paper we give no

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prescription concerning how to improve the global economy architecture. We reserve that issue for a future paper.

The Network of Global Corporate control

Vitali et al. begin their paper with a remark as follows: [1]

> "We present the first investigation of the architecture of the international ownership network, along with the computation of the control held by each global player. We find that transnational corporations form a giant bow-tie structure and that a large portion of control flows to a small tightly-knit core of financial institutions. This core can be seen as an economic "super-entity" that raises new important issues both for researchers and policy makers."

Then they conclude their paper as follows: [1, p.6]

> "In contrast, we find that only 737 top holders accumulate 80% of the control over the value of all TNCs (see also the list of the top 50 holders in Tbl. S1 of SI Appendix, Sec. 8.3). This means that network control is much more unequally distributed than wealth. In particular, the top ranked actors hold a control ten times bigger than what could be expected based on their wealth."

Previously, Glattfelder and Battiston remarked in a separate paper [2, p.20], as follows:

> "However, in contrast to such intuition, our main finding is that a local dispersion of control is associated with a global concentration of control and value. This means that only a small elite of shareholders controls a large fraction of the stock market, without ever having been previously systematically reported on. Some authors have suggested such a result by observing that a few big US mutual funds managing personal pension plans have become the biggest owners of corporate America since the 1990s."

David Wilcock [3] summarizes Vitali et al's finding about the network of Global Corporate control as follows:

> "To review, 80 percent of the world's profits are being earned by a 'core' group of 1,318 corporations. As we look even deeper, we find this 'core' is mostly run by a "super-entity" of 147 companies that are totally interlocked. 75 percent of them are financial institutions. The top 20 companies in the "super-entity" include Barclays Bank, JP Morgan Chase & Co., Merrill Lynch, UBS, Bank of New York, Deutsche Bank and Goldman Sachs. The 147-part "super-entity" has controlling interest in the 1318-part "core", which in turn has controlling interest in 80 percent of the world's wealth."

Therefore it appears that 80% of the world's profit are being earned by a core group of 1,318 TNCs, which in turn these core TNCs are run by a super-entity of 147 companies. The Table S1 of S1 Appendix Sec. 8.3. in Vitali et al's paper consists of 50 top TNCs which are mostly financial corporate, as follows [1, p.33]:

1 BARCLAYS PLC GB 6512 SCC 4.05
2 CAPITAL GROUP COMPANIES INC, THE US 6713 IN 6.66
3 FMR CORP US 6713 IN 8.94
4 AXA FR 6712 SCC 11.21
5 STATE STREET CORPORATION US 6713 SCC 13.02
6 JPMORGAN CHASE & CO. US 6512 SCC 14.55
7 LEGAL & GENERAL GROUP PLC GB 6603 SCC 16.02
8 VANGUARD GROUP, INC., THE US 7415 IN 17.25
9 UBS AG CH 6512 SCC 18.46
10 MERRILL LYNCH & CO., INC. US 6712 SCC 19.45
11 WELLINGTON MANAGEMENT CO. L.L.P. US 6713 IN 20.33
12 DEUTSCHE BANK AG DE 6512 SCC 21.17
13 FRANKLIN RESOURCES, INC. US 6512 SCC 21.99
14 CREDIT SUISSE GROUP CH 6512 SCC 22.81
15 WALTON ENTERPRISES LLC US 2923 T&T 23.56
16 BANK OF NEW YORK MELLON CORP. US 6512 IN 24.28
17 NATIXIS FR 6512 SCC 24.98
18 GOLDMAN SACHS GROUP, INC., THE US 6712 SCC 25.64
19 T. ROWE PRICE GROUP, INC. US 6713 SCC 26.29
20 LEGG MASON, INC. US 6712 SCC 26.92
21 MORGAN STANLEY US 6712 SCC 27.56
22 MITSUBISHI UFJ FINANCIAL GROUP, INC. JP 6512 SCC 28.16
23 NORTHERN TRUST CORPORATION US 6512 SCC 28.72
24 SOCIÉTÉ GÉNÉRALE FR 6512 SCC 29.26
25 BANK OF AMERICA CORPORATION US 6512 SCC 29.79
26 LLOYDS TSB GROUP PLC GB 6512 SCC 30.30
27 INVESCO PLC GB 6523 SCC 30.82
28 ALLIANZ SE DE 7415 SCC 31.32
29 TIAA US 6601 IN 32.24
30 OLD MUTUAL PUBLIC LIMITED COMPANY GB 6601 SCC 32.69
31 AVIVA PLC GB 6601 SCC 33.14
32 SCHRODERS PLC GB 6712 SCC 33.57
33 DODGE & COX US 7415 IN 34.00
34 LEHMAN BROTHERS HOLDINGS, INC. US 6712 SCC 34.43
35 SUN LIFE FINANCIAL, INC. CA 6601 SCC 34.82
36 STANDARD LIFE PLC GB 6601 SCC 35.2
37 CNCE FR 6512 SCC 35.57
38 NOMURA HOLDINGS, INC. JP 6512 SCC 35.92
39 THE DEPOSITORY TRUST COMPANY US 6512 IN 36.28
40 MASSACHUSETTS MUTUAL LIFE INSUR. US 6601 IN 36.63
41 ING GROEP N.V. NL 6603 SCC 36.96

42 BRANDES INVESTMENT PARTNERS, L.P. US 6713 IN 37.29
43 UNICREDITO ITALIANO SPA IT 6512 SCC 37.61
44 DEPOSIT INSURANCE CORPORATION OF JP JP 6511 IN 37.93
45 VERENIGING AEGON NL 6512 IN 38.25
46 BNP PARIBAS FR 6512 SCC 38.56
47 AFFILIATED MANAGERS GROUP, INC. US 6713 SCC 38.88
48 RESONA HOLDINGS, INC. JP 6512 SCC 39.18
49 CAPITAL GROUP INTERNATIONAL, INC. US 7414 IN 39.48
50 CHINA PETROCHEMICAL GROUP CO. CN 6511 T&T 39.78

Next we will see whether there is connection between the above 50 top TNCs and the recipients of the Fed's secret funds during 2007-2010.

The Great Theft by the Fed between 2007-2010

It is discovered after being audited by GAO, that the Fed secretly gave fund to a very short list of financial corporate both inside USA and from foreign countries, in a spectacular amount, i.e. about $16,000,000,000,000 (sixteen trillions of US dollar). We propose to call that event as the Great Theft, because it is basically a massive theft of US tax payers' wealth during the financial crisis, when many middle-income families suffered.

According to O'Leary [4, p.13]:

> "A partial audit of a limited period of time - the first audit of any kind in its near 100 year history - took place in July 2011 when, as part of the Dodd-Frank reform legislation, the Fed was forced to reveal whom it had lent money to during the financial debacle beginning in late 2007. The audit was carried out by the General Accounting Office (GAO) and is available on-line. To say that its shocking findings have been under-reported by the media is a gross understatement."
>
> "During the period December 1, 2007 through July 21, 2010 the Fed created sixteen trillion ($16,000,000,000,000) dollars worth of credit (loans) to US banks and corporations and (notwithstanding its supposed jurisdiction as an agency of the United States) to foreign banks. These were secret bailouts engineered to prevent the borrowers from insolvency or bankruptcy; the money was loaned at nearly zero percent (.01%) interest."

The recipients of the Fed's secret loan during 2007-2010 are as follows [4, p.14]:

Citigroup, Inc (Citibank): $2.5 trillion
*Morgan Stanley: $2.04 trillion
*Merrill Lynch & Co.: $1.949 trillion
*Bank of America Corporation: $1.344 trillion
*Barclays PLC (United Kingdom): $868 billion
Bear Sterns Companies, Inc.: $853 billion
*Goldman Sachs Group, Inc.: $814 billion

Royal Bank of Scotland PLC (UK): 541 billion
*JPMorgan Chase: $391 billion
*Deutsche Bank AG (Germany): $354 billion
United Bank of Switzerland AG: $287 billion
*Credit Suisse Group AG (Switzerland): $262 billion
*Lehman Brothers Holdings, Inc. - NYC: $183 billion
Bank of Scotland PLC (UK): $181 billion
*BNP Paribas SA (France): $175 billion
Dexia SA (Belgium): $105 billion
Wachovia Corporation: $142 billion
Dresdner Bank AG (Germany): $123 billion
*Societe Generale SA (France): $124 billion

The asterisks (*) are intended to mark companies which also appear in the list of top 50 TNCs of Vitali et al. [1, p.33].

From the two lists above, we can conclude that there are 11 (eleven) out of 19 (nineteen) recipients of the Fed's money between 2007-2010, which also appear in the Vitali et al.'s list of top 50 TNCs. Therefore we can also conclude that apparently the Fed is behind almost all of the top 50 TNCs. That is why some people think that the Fed is one of the most powerful private entities all over the world.

Discussion

The owners of the Fed remains mystery, although from history it is known that the Fed was formed after a Jekyll Island meeting .

> "The Federal Reserve System was allegedly conceived at a secretive, confidential "duck hunting" Jekyll Island meeting of people related to J. P. Morgan, Kuhn, Loeb & Company, the Rothschilds, the Rockefellers, and the Warburgs." [7, p.22]

However in recent years, there have been enough leaks to confirm the identities of the key banking families who founded the Federal Reserve [3, p.37]. J. W. McCallister, an oil industry insider with House of Saud connections, wrote in The Grim Reaper that information he acquired from Saudi bankers cited 80% ownership of the New York Federal Reserve Bank- by far the most powerful Fed branch- by just eight families, four of which reside in the US.

- They are the Goldman Sachs, Rockefellers, Lehmans and Kuhn Loebs of New York; the Rothschilds of Paris and London; the Warburgs of Hamburg; the Lazards of Paris; and the Israel Moses Seifs of Rome.

CPA Thomas D. Schauf corroborates McCallister's claims, adding that ten banks control all twelve Federal Reserve Bank branches.

- He names N.M. Rothschild of London, Rothschild Bank of Berlin, Warburg Bank of Hamburg, Warburg Bank of Amsterdam, Lehman Brothers of New York, Lazard

> Brothers of Paris, Kuhn Loeb Bank of New York, Israel Moses Seif Bank of Italy, Goldman Sachs of New York and JP Morgan Chase Bank of New York.

Schauf lists William Rockefeller, Paul Warburg, Jacob Schiff and James Stillman as individuals who own large shares of the Fed. The Schiffs are insiders at Kuhn Loeb. The Stillmans are Citigroup insiders, who married into the Rockefeller clan at the turn of the century.

According to O'Leary [4, p.5]:

> "To begin with, the Federal Reserve system is neither Federal nor does hold its own capital as bank "reserves". The Federal Reserve is a private institution owned by private bankers which has no reserves other than what it creates for itself . . . *out of nothing*."

O'Leary continues [4, p.6]:

> "The Federal Reserve Act, passed by Congress just prior to its annual Christmas recess on December 22, 1913, was signed into law the very next day by President Woodrow Wilson. It transferred the right to print currency from the United States sovereign government to a bank which is quasi-federal in form but private in operation. The Fed was created by the powers of international capital, known in the 19th century as The Money Trust, and given a clever but deceptive name which disguises the fact that it is a private money monopoly owned by its member banks but controlled by a handful of super-banks which are conveniently described as "too big to fail"."

Furthermore he writes [4, p.7]:

> "The larger the member bank, the more Federal Reserve corporate stock it owns, the greater degree of control it exercises over the Fed's policies. The major New York banks own a majority share of the Fed. Since Federal Reserve Banks are not governmental agencies, their employees do not fall under Federal Civil Service."

Now we know that it is possible that the Fed is owned by a handful of very powerful international banks, which also may form the 'super-entity' group, as reported by Vitali et al. [1].

O'Leary also explains why the Fed was never audited.

> "The secrecy surrounding the operations of the Federal Reserve is phenomenal. Its actions are even more secret than the CIA's. The Federal Reserve System has never been audited. This bears repetition: the Federal Reserve has never been subject to a full and complete independent audit. No government official has the power to require the Fed to open up its books to public scrutiny. The only power the government has is to modify the Fed's charter by an act of Congress. Attempts to

legislate a full and complete audit have always been vehemently opposed by the "powers that be"." [4, p.13]

Since money created by the Fed is not backed up by anything except by the US Government and all US citizens, they are called 'fiat money'. According to Hoppe [8, p.64]:

> "Since abolishing the last remnants of the gold commodity money standard, he realizes, inflationary tendencies have dramatically increased on a world-wide scale; the predictability of future price movements has sharply decreased; the market for long-term bonds (such as consols) has been largely wiped out; the number of investment and "hard money" advisors and the resources bound up in such businesses have drastically increased; money market funds and currency futures markets have developed and absorbed significant amounts of real resources which otherwise-without the increased inflation and unpredictability-would not have come into existence at all or at least would never have assumed the same importance that they now have; and finally, it appears that even the direct resource costs devoted to the production of gold accumulated in private hoards as a hedge against inflation have increased."

In the last analysis, if money is created by the Fed without permission of US Congress, then it can be called as an act of theft.

> "In history, sovereigns and states have stolen the wealth of their subordinates and citizens a zillion of times, and they will do so again and again if they consider it necessary. Often monetary policy and instruments effectively amount to more or less obvious ways to plunder the public."[7]

Now we can conclude that not only 11 out of 19 TNCs are recipients of the Fed's secret loans between 2007-2010, but they also belong to the top 50 'super-entity' list of Vitali et al'[1]. Therefore we can conclude that they participate in the Great Theft act of the Fed, and the Fed is at the center of this massive fraud of US economy. Now it seems that this discovery demands thorough investigations on the Fed's part and also on the nineteen recipients of secret loans from the Fed between 2007-2010.

One thing should be kept in mind, that the Fed has become the center of the problem, that is why it will lead to financial crises in the future, especially if the financial integration will be implemented. As concluded by Stiglitz [12], a full financial integration may be not desirable. Stiglitz also writes that the "centralized" lending architecture may be more vulnerable to shocks to the "centers" (illustrated by the global impact of the US credit crisis) [12]. The apparent concentration of massive power in a handful of private financial corporate could mean that the risks are increasing, for instance read a Testimony of Wallace C. Turbeville at May 9, 2012: "A recent research piece by the Dallas Fed provides a window on this process. The study observes that in 1970 the top 5 banks in terms of assets held 17% of aggregate bank assets. By 2010, the top 5 banks held 52% of aggregate assets."[14] This testimony seems to support the conclusion of Vitali et al. that there is concentration of massive wealth in the hand of super-entity.[1] Therefore it could mean that the global economy is increasingly exposed to risks of financial crises.

Concluding remarks

In accordance with David Wilcock [3] and O'Leary [4], there was the Great Theft event, when the Fed secretly gave funds to US and foreign financial companies, at breathtaking amount of trillions of US dollar.

The fiat money created by the Fed is deeply flawed [7][8][10][11]. Another flaw is the fractional reserve banking (FRB) practice all over the world, which only leads to great business cycles and crises. The fractional reserve banking system is defined as one in which only a fraction of the demand deposits are held in reserve; the remainder is in the form of long term loans, or illiquid assets [10, p.46]. There is a singular group of economists who concede that all FRB systems that have ever existed may have been equivalent to theft [10, [p.47].

This problem of FRB has been discussed by many economists especially from Austrian school; see for instance [9], [10] and [11]. The crises in Cyprus can be tracked to this FRB practice (see [13] or the Appendix). If this tendency of FRB practice continues, it only leads to hyperinflation. According to Hoppe [8, p.59]:

> "The result would be hyperinflation. No one would accept paper money anymore, and a flight into real values would set in. The monetary economy would break down completely and society would revert back to a primitive, highly inefficient barter economy. Out of barter then, once again a new (most likely a gold) commodity money would emerge (and the note producers once again, so as to gain acceptability for their notes, would begin backing them by this money)."

A number of solutions have been offered by economists in order to find a way out of the many crises and business cycles; to mention a few of them:

- Applying theories of complex systems into economics, especially in order to assist decision makers[6].
- Going back to gold-backed currency, which is perhaps not so realistic; see [7][11]. According to Hoppe [8,p.74]: "*Only a system of universal commodity money (gold), competitive banks, and 100 percent reserve deposit banking with a strict functional separation of loan and deposit banking is in accordance with justice, can assure economic stability and represents a genuine answer to the current monetarist fiasco*."
- Going to full-reserve banking, this appears to be quite realistic. For an argument supporting the idea of full-reserve banking, read as follows: "*Most recently, in late 2010, two British MP's, Douglas Carswell and Steven Baker, sought to introduce legislation into the British Parliament that would allow depositors to decide if their money should be lent out and for what period. If this legislative reform were to pass, British depositors would have the option to elect to save their money in full reserve bank accounts. In early 2013, the idea of full reserve banking began to reappear in*

mainstream circles, after other "remedies" appeared to fail or only defer the next crisis, but not solve the banking "problem". Full reserve banking would require banks to retain in reserve all deposits that are legally available for immediate withdrawal, and permit lending only from longer-term deposits." [11]

- Accepting the nature of business cycles and repeated financial crises, as promoted by Svozil [7]. This means that someday there will be a Great Crash as a consequence: "*Given these repeated financial crises arising from the fiat monetary system, many monetary reformers predict that there will inevitably be widespread default or hyperinflation or depression - or most likely all three simultaneously in what Ludwig von Mises predicted would be a "final and total catastrophe" of our unsustainable, Ponzi-like, fiat monetary system*."[11].
- According to some analysts, there is no solution to the present problems of the world economy; see [11]. This seems to support Svozil's argument that there is no alternative to present situation of the fiat money and fractional reserve banking: "*Thus, for pragmatic reasons, the only remaining alternative appears to be fiat money not directly backed by any commodity… The liquidity supplied to an economy by such a money volume expansion may result in a positive feedback loop of ever increasing production and prosperity. However, by the same negative feedback, it may also result in (hyper-)inflation by the restless production of additional money. For instance, it is a mathematical fact that the compound interest requires excessive (actually exponential) money quantities. In the long run, no such excessive growth of liquidity can be counterbalanced by the traded assets, goods and services*." [7, p.4]

However, this paper is not intended to give a prescription on how to improve the global economy architecture. We leave this issue to a future paper.

VC & FS, Version 1.0: July 20th, 2013. Version 1.1: July 25th, 2013.

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Appendix:

Source: http://www.zerohedge.com/news/2013-03-31/visualization-modern-fractional-reserve-banking-and-how-cyprus-fits

How Cyprus Exposed The Fundamental Flaw Of Fractional Reserve Banking

Submitted by Tyler Durden on 03/31/2013 18:03 -0400

In the past week much has been written about the emerging distinction between the Cypriot Euro and the currency of the Eurozone proper, even though the two are (or were) identical. The argument goes that all €'s are equal, but those that are found elsewhere than on the doomed island in the eastern Mediterranean are more equal than the Cypriot euros, or something along those lines. This of course, while superficially right, is woefully inaccurate as it misses the core of the problem, which is a distinction between electronic currency and hard, tangible banknotes. Which is why the capital controls imposed in Cyprus do little to limit the distribution and dissemination of electronic payments within the confines of the island (when it comes to payments leaving the island to other jurisdictions it is a different matter entirely), and are focused exclusively at limiting the procurement and allowance of paper banknotes in the hands of Cypriots (hence the limits on ATM and bank branch withdrawals, as well as the hard limit on currency exiting the island).

In other words, what the Cyprus fiasco should have taught those lucky enough to be in a net equity position vis-a-vis wealth (i.e., have cash savings greater than debts) is that suddenly a €100 banknote is worth far more than €100 in the bank, especially if the €100 is over the insured €100,000 limit, and especially in a time of ZIRP when said €100 collects no interest but is certainly an impairable liability if and when the bank goes tits up.

Said otherwise, there is now a very distinct premium to the value of hard cash over electronic cash.

And while this is true for Euros, it is just as true for US Dollars, Mexican Pesos, Iranian Rials and all other currencies in a fiat regime.

Which brings us to the crux of the issue, namely fractional reserve banking, or a system in which one currency unit in hard fiat currency can be redeposited with the bank that created it (as a reminder in a fiat system currency is created at the commercial bank level: as the Fed itself has made quite clear, "The actual process of money creation takes place primarily in banks") to be lent out and re-re-deposited an (un)limited number of times, until there is a literal pyramid of liabilities and obligations lying on top of every dollar, euro, or whatever other currency, is in circulation. The issue is that the bulk of such obligations are electronic, and in its purest form, a bank run such as that seen in Cyprus, and preempted with the imposition of the first capital controls in the history of the Eurozone, seeks to convert electronic deposits into hard currency.

Alas, as the very name "fractional reserve banking" implies, there is a very big problem with this, and is why every bank run ultimately would end in absolute disaster and the collapse of a fiat regime, hyperinflation, and systemic bank and sovereign defaults, war, and other unpleasantries, if not halted while in process.

Why?

One look at the chart below should be sufficient to explain this rather problematic issue of a broken banking system in which trust is evaporating faster than Ice Cubes in the circle of hell reserved for economist PhD's.

Notes on Utility: Some Factors which Contribute to Individual Achievement and Plausible Relation to Welfare

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Written: 27th Oct. 2009, ver.1.0, 28th Oct. 2009, ver.1b

Introduction

It is prescribed in economics textbooks that people wants to maximize their utility, and Equilibrium is described as the result of maximizing utility U subject to budget constraint [1]. But the definition of the utility U as a measurable quantity remains not conclusive in literature, see for example discussion by McCauley [1] and Tubaro [3].

Therefore we think that it is more useful to find direct relation between Welfare and actual factors that contribute to individual achievement, rather than relying on non-empirical term of utility. In the present paper, we study a number of factors that contribute to individual achievement, based on small experiment with pigeon sample.

We consider that it is very essential to base economics theory on *measurable quantity* from the beginning, because optimization at individual and aggregate levels is the very hallmark of modern economics theory (Tubaro, 2006, p.1 [3]). That measurable quantity can be observed by virtue of experiment or field observation. Indeed, we think that such an experimental approach is new and original in economics thinking, especially from the viewpoint of *grounded approach*, because after all in studying economics we consider human social behavior and their social interactions. In *grounded approach*, theory building should be based on actual field observation.

We begin with highlight of some basic thoughts on utility U in modern economics literature, and then proceed with experimental result. We draw some sketches on some factors which contribute to wealth achievement based on individual behavior. Implications of this small experiment are discussed briefly throughout the present paper.

The present report is very preliminary in nature, therefore further works are recommended in order to extend further to economics context.

Highlight of modern thinking on Utility

There are extensive literatures on this subject, ranging from mathematical analysis [1], historical study [3], to philosophical consideration [2], but here we limit our review to a few definitions on utility U, highlighting some basic thoughts in modern economics literature, because in this work we would like to emphasize the necessity to study *experimentally* the direct relation between wealth achievement based on actual factors which contribute to individual achievement. In other words, we would like to find factors which contribute to wealth achievement based on individual behavior.

It is normally prescribed in economics textbooks that people wants to maximize their utility, in other words Wealth is often defined as a function of maximizing utility; and therefore Equilibrium is described as the result of maximizing the utility U subject to budget constraint [1], which yields:

$$p_i = \lambda \frac{\partial U}{\partial x_i}, \quad (1)$$

where λ is a Lagrange multiplier. In other words, it is postulated that a scalar utility function U does exist such that its gradient is assumed to be proportional to the price covector [1, p.8]. While the above proposition is quite analogous to a basic potential equation in physics: p=grad U [1, p.12], the definition of utility U term itself is not clearly defined as a measurable quantity.

But the definition of the utility U as a measurable quantity remains not conclusive as described by McCauley [1], see also Rothbard [2]. In fact, econometrics is based on the *non-empiric* notion of utility [1, p.1].

Furthermore, utility maximization was not clearly related to actual individual achievement; indeed it is merely a normative prescription (i.e. something that people should somehow learn to or conform to), rather than as a possible interpretation of the observed behavior of individuals (Tubaro, 2006, p.5 [3]).

From philosophical consideration, Rothbard [2, p.12] concludes that there is no such thing as total utility; because all utilities are marginal.

Therefore we think it would be more useful to find direct relation between Wealth and actual factors that contribute to individual achievement, rather than relying solely on abstract but non-empirical notion like ‘utility’. Nonetheless we should mention that the actual relation between individual achievement and aggregate result (Welfare) is a very complicated subject and it is beyond the scope of this article.

Experimental Result and Discussion

The present paper is written based on small experiment made by the writer for a few days during study period in last summer (around June 2009). From the experiment, the writer obtains new results which are worthy to be communicated. By feeding a small number of pigeons and changing the location of feeding, we observe some factors which contribute to the individual achievement of the pigeons. These factors correspond to the pigeons activities at given resources. Spatial distribution of resources is found to be very important factor too to the individual achievement.

The assumption in this experiment is that the amount of resources is quite limited if we compare to the amount needed by the pigeons; and the location of feeding is scattered around the pigeons (the feeding is given by throwing it to the pigeons). The exact number of pigeons is not counted. The purpose of this small experiment is to observe qualitatively some factors which affect the individual achievement of the pigeons. The limitation of this experiment is in its serendipity nature, and also we did not carry out the same experiment with other type of animals. Actually this experiment was not planned before hand, but by serendipity during feeding the pigeons on the street, this is why the exact number of pigeons is not counted.

Based on this small experiment, we obtain new finding in the form of a number of factors which contribute to individual achievement of the pigeons, including:

a. The pigeons get the feeding as far as they move with speed of response. Acceleration of their speed appears to be very important too and it affects their result.

b. The pigeons get the feeding at the nearest distance to them. They tend to neglect the food which is too far from them. This may imply that the pigeons tend to minimize the energy required to get the feeding they need.

c. (*Spatial*) distribution of resources also determines which groups of the pigeons will get more (or less) foods. If the distribution of resources is more evenly, then more pigeons will get equal amount of food. But if the spatial distribution of resources follows normal distribution (*bell shaped*), then the welfare tends to be distributed unequally. The *'sunshine distribution'* can be considered as better spatial distribution to achieve equal welfare.

d. Cooperation does not apply to animals, but we can conclude that cooperation is very important for human, because of their social behavior.

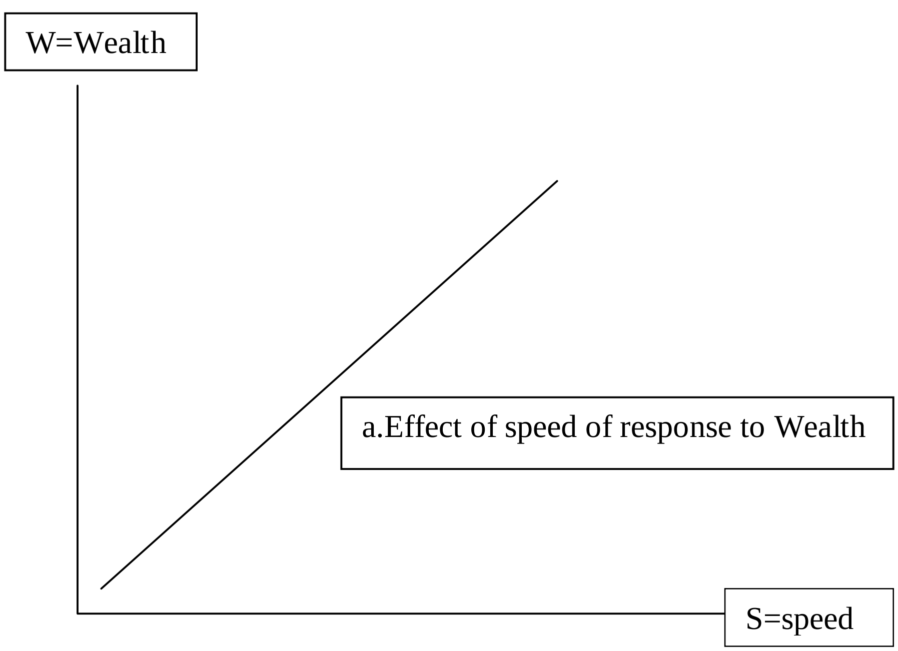
e. There are other factors which determine how the pigeons fulfill their needs, such as their eyes, noises, and crowdity (i.e. if there are more pigeons in one small location, then the resources tend to be distributed unevenly).

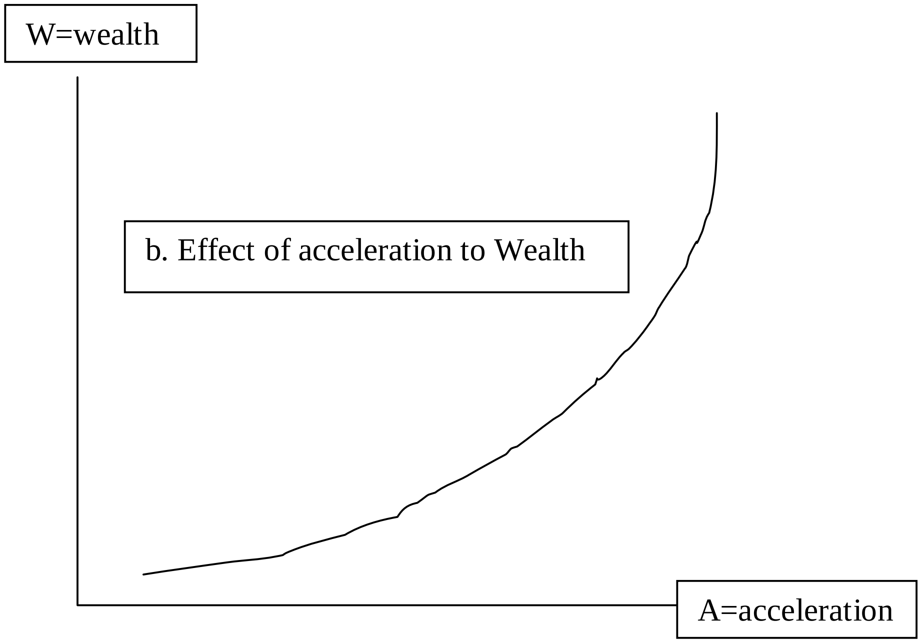
f. Based on this experiment then we can summarize that actually the individual wealth, i.e. based on individual achievement, is a function of speed, acceleration, distance, distribution of resources, cooperation, and other factors. There could be other factors which may be neglected or unobserved in this small experiment. Therefore, we can express Wealth W as function of a number of factors, as follows:

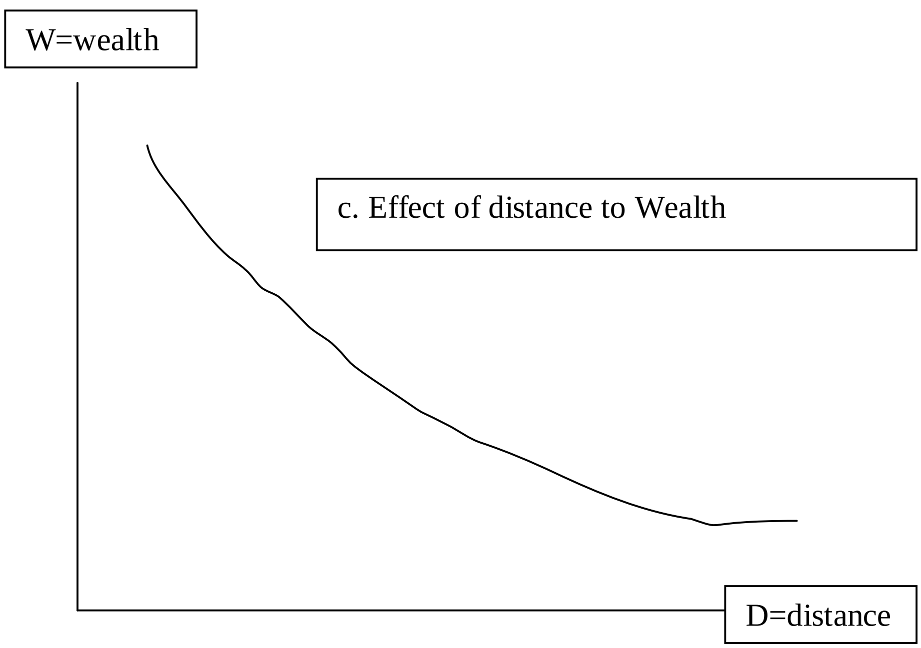
$$W = f(\text{speed, acceleration, distance, distribution of resource, cooperation, other factors}). \quad (2)$$

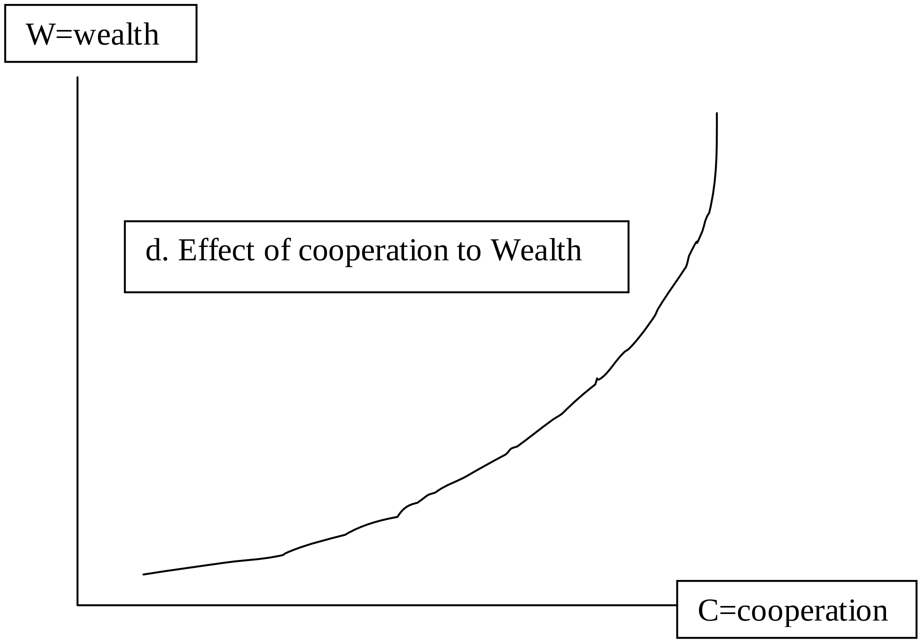
It is our conjecture here that Welfare is the aggregate accumulation of individual achievement to their society. To put it in simple words: Welfare equals to the average Wealth achieved by a society, i.e. distribution of wealth among the entire society members also determines how well the Welfare is achieved.

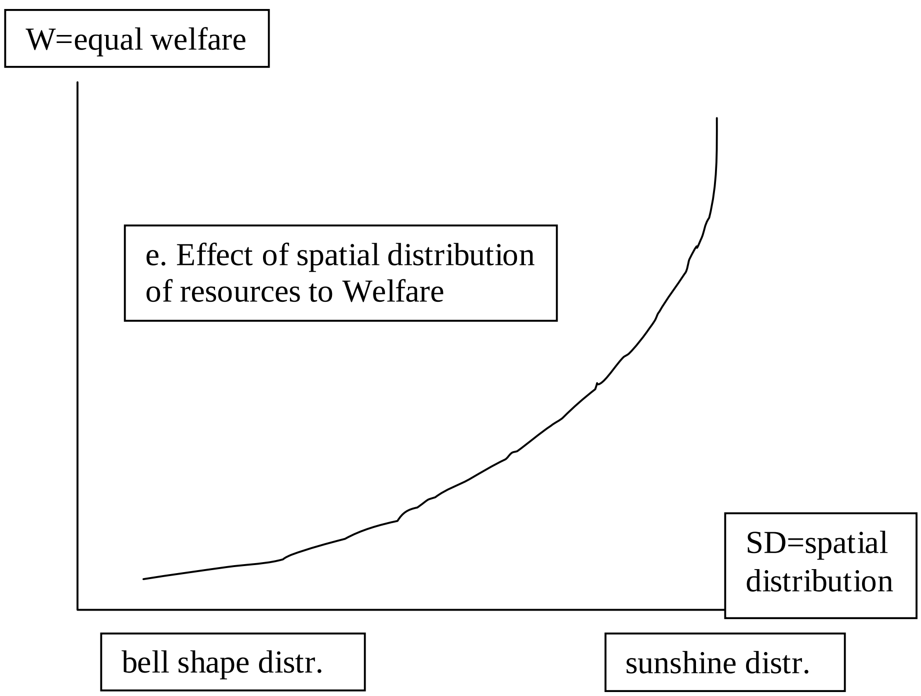
The effect of each factor to individual achievement or Wealth (and also Welfare, if we think of the aggregate impact of individual achievement to their society) can be drawn in sketches as follows:




W=wealth
b. Effect of acceleration to Wealth
A=acceleration


W=wealth
c. Effect of distance to Wealth
D=distance





Please note here, that by bell-shape distribution, we mean that distribution of resources is mostly concentrated in small area surrounding the center; therefore the pigeons located in the perimeter (far from the center) cannot access the resources. This type of distribution of resources will make the aggregate welfare less equally distributed among all members, and therefore this type will increase the problems which are caused by inequality.

On the other side, by sunshine distribution, we mean that in order to achieve equal welfare for all society members, resources shall be distributed spatially equal covering all the area, just like the sunshine covers all people in all area in equal amount per square meter. This type of distribution can be difficult to achieve but it will enable all people in perimeter (far from the centre) to access the resources more or less equally.

f. Effect of other factors should be determined based on field observation, and the observation should consider specific circumstances and condition. Therefore, the effect of these factors is not sketched here.

There could be other factors which may be neglected or unobserved in this small experiment. There are some questions we leave for further research, including how these factors actually contribute to the wealth of individual member of society and also how it affects the aggregate achievement of society. It would need further works to explore further these questions.

Concluding remarks

In this paper, we describe a number of factors which affect individual achievement based on small experiment with pigeons in the street.

We can conclude that actually Welfare (in aggregate level) is a function of individual achievement. In return, the individual achievement is a function of speed, acceleration, distance, cooperation, distribution of resources, and other factors. To simplify, we can express it as follows:

$$W = f(\text{speed, acceleration, distance, distribution of resource, cooperation, other factors}).$$

There is limitation of this experiment, including the assumption that individual achievement automatically affects the aggregate results. This assumption is taken as is, and we do not explore it further because it is beyond the scope of this paper. There are other questions we do not explore here, for example how to define price without expressing it as a gradient of utility U. It is possible to think that price actually corresponds to the total possible Welfare which can be created, and this amount is divided by the number of total players.

Cooperation does not apply to animals, but we can conclude that cooperation is very important for human being, because of their social behavior and their ability to interact, communicate and love each other. There could be other factors which may be neglected or unobserved in this small experiment.

To conclude, the concept of utility shall be re-considered accordingly, see McCauley, 1999 [1]. We agree with McCauley [1, p.2] that Adam Smith's stabilizing hand cannot be found inside the market dynamics itself, i.e. equilibrium cannot be found from internal dynamics. But, in contrary to his pessimistic conclusion, we accept that market nonlinear dynamics can only be stabilized by God's intervention.

This report is very preliminary in nature, therefore further works are recommended in order to extend further to economics context.

Acknowledgement
The writer would like to thank to Jesus Christ who has inspired this article, including the experiment. He always guides the writer throughout his life, including in difficult circumstances. He is the Good Shepherd (Psalm 23).

About the writer
The writer completed his five year engineering course in 1992, and since then he worked according to engineering profession. After that he continued his career as a webdeveloper until 2008. In his spare time he learned and read some physics and economics literature. During 2005-2009 he co-authored and edited several books on physics subject in his spare time. The books were written with other scientists.
This year he was granted scholarship to take master course in Physics Science from January until June 2009 in PFUR, but did not complete the program. And then by end of June he went back to his country (Indonesia) to continue working. In August 2009 he repented and recently he stopped working as webdeveloper.
Now he actively speaks about how Jesus Christ and God love the world; he loves to tell what Jesus Christ has done with his life, and what Jesus Christ can do with your life too. The writer is happy to respond phone call or email concerning this subject; you can send your email to victorchristianto@gmail.com.

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Applications of Neutrosophic Logic to Robotics

An Introduction

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***Abstract*— In this paper we present the N-norms/N-conorms in neutrosophic logic and set as extensions of T-norms/T-conorms in fuzzy logic and set.**
Then we show some applications of the neutrosophic logic to robotics.

Keywords: N-norm, N-conorm, N-pseudonorm, N-pseudoconorm, Neutrosophic set, Neutrosophic logic, Robotics

I. DEFINITION OF NEUTROSOPHIC SET

Let T, I, F be real standard or non-standard subsets of $]^-0, 1^+[$,
with sup T = t_sup, inf T = t_inf,
sup I = i_sup, inf I = i_inf,
sup F = f_sup, inf F = f_inf,
and n_sup = t_sup+i_sup+f_sup,
n_inf = t_inf+i_inf+f_inf.

Let U be a universe of discourse, and M a set included in U. An element x from U is noted with respect to the set M as x(T, I, F) and belongs to M in the following way: it is t% true in the set, i% indeterminate (unknown if it is or not) in the set, and f% false, where t varies in T, i varies in I, f varies in F ([1], [3]).

Statically T, I, F are subsets, but dynamically T, I, F are functions/operators depending on many known or unknown parameters.

II. DEFINITION OF NEUTROSOPHIC LOGIC

In a similar way we define the Neutrosophic Logic:
A logic in which each proposition x is T% true, I% indeterminate, and F% false, and we write it x(T,I,F), where T, I, F are defined above.

III. PARTIAL ORDER

We define a *partial order relationship* on the neutrosophic set/logic in the following way:

$x(T_1, I_1, F_1) \le y(T_2, I_2, F_2)$ iff (if and only if)
$T_1 \le T_2$, $I_1 \ge I_2$, $F_1 \ge F_2$ for crisp components.

And, in general, for subunitary set components:

$x(T_1, I_1, F_1) \le y(T_2, I_2, F_2)$ iff
$\inf T_1 \le \inf T_2$, $\sup T_1 \le \sup T_2$,
$\inf I_1 \ge \inf I_2$, $\sup I_1 \ge \sup I_2$,
$\inf F_1 \ge \inf F_2$, $\sup F_1 \ge \sup F_2$.

If we have mixed - crisp and subunitary - components, or only crisp components, we can transform any crisp component, say "a" with $a \in [0,1]$ or $a \in]^-0, 1^+[$, into a subunitary set [a, a]. So, the definitions for subunitary set components should work in any case.

IV. N-NORM AND N-CONORM

As a generalization of T-norm and T-conorm from the Fuzzy Logic and Set, we now introduce the N-norms and N-conorms for the Neutrosophic Logic and Set.

A. N-norm

N_n: $( ]^-0,1^+[\times]^-0,1^+[\times]^-0,1^+[ )^2 \to]^-0,1^+[\times]^-0,1^+[\times]^-0,1^+[$
$N_n (x(T_1,I_1,F_1), y(T_2,I_2,F_2)) = (N_nT(x,y), N_nI(x,y), N_nF(x,y))$,
where $N_nT(.,.)$, $N_nI(.,.)$, $N_nF(.,.)$ are the truth/membership, indeterminacy, and respectively falsehood/nonmembership components.

N_n have to satisfy, for any x, y, z in the neutrosophic logic/set M of the universe of discourse U, the following axioms:
a) Boundary Conditions: $N_n(x, \mathbf{0}) = \mathbf{0}$, $N_n(x, \mathbf{1}) = x$.
b) Commutativity: $N_n(x, y) = N_n(y, x)$.
c) Monotonicity: If $x \le y$, then $N_n(x, z) \le N_n(y, z)$.
d) Associativity: $N_n(N_n (x, y), z) = N_n(x, N_n(y, z))$.

There are cases when not all these axioms are satisfied, for example the associativity when dealing with the neutrosophic normalization after each neutrosophic operation. But, since we work with approximations, we can call these N-pseudo-norms, which still give good results in practice.

N_n represent the *and* operator in neutrosophic logic, and respectively the *intersection* operator in neutrosophic set theory.

Let $J \in \{T, I, F\}$ be a component.
Most known N-norms, as in fuzzy logic and set the T-norms, are:
• The Algebraic Product N-norm: $N_{n-algebraic}J(x, y) = x \cdot y$
• The Bounded N-Norm: $N_{n-bounded}J(x, y) = \max\{0, x + y - 1\}$
• The Default (min) N-norm: $N_{n-min}J(x, y) = \min\{x, y\}$.

A general example of N-norm would be this.
Let $x(T_1, I_1, F_1)$ and $y(T_2, I_2, F_2)$ be in the neutrosophic set/logic M. Then:

$$N_n(x, y) = (T_1 \wedge T_2, I_1 \vee I_2, F_1 \vee F_2)$$

where the "$\wedge$" operator, acting on two (standard or non-standard) subunitary sets, is a N-norm (verifying the above N-norms axioms); while the "$\vee$" operator, also acting on two (standard or non-standard) subunitary sets, is a N-conorm (verifying the below N-conorms axioms).

For example, $\wedge$ can be the Algebraic Product T-norm/N-norm, so $T_1 \wedge T_2 = T_1 \cdot T_2$ (herein we have a product of two subunitary sets – using simplified notation); and $\vee$ can be the Algebraic Product T-conorm/N-conorm, so $T_1 \vee T_2 = T_1+T_2-T_1 \cdot T_2$ (herein we have a sum, then a product, and afterwards a subtraction of two subunitary sets).

Or $\wedge$ can be any T-norm/N-norm, and $\vee$ any T-conorm/N-conorm from the above and below; for example the easiest way would be to consider the *min* for crisp components (or *inf* for subset components) and respectively *max* for crisp components (or *sup* for subset components).

If we have crisp numbers, we can at the end neutrosophically normalize.

B. N-conorm

N_c: $( ]^-0,1^+[\times]^-0,1^+[\times]^-0,1^+[ )^2 \rightarrow]^-0,1^+[\times]^-0,1^+[\times]^-0,1^+[$

$N_c (x(T_1,I_1,F_1), y(T_2,I_2,F_2)) = (N_cT(x,y), N_cI(x,y), N_cF(x,y))$, where $N_nT(.,.)$, $N_nI(.,.)$, $N_nF(.,.)$ are the truth/membership, indeterminacy, and respectively falsehood/nonmembership components.

N_c have to satisfy, for any x, y, z in the neutrosophic logic/set M of universe of discourse U, the following axioms:

a) Boundary Conditions: $N_c(x, 1) = 1$, $N_c(x, 0) = x$.
b) Commutativity: $N_c (x, y) = N_c(y, x)$.
c) Monotonicity: if $x \leq y$, then $N_c(x, z) \leq N_c(y, z)$.
d) Associativity: $N_c (N_c(x, y), z) = N_c(x, N_c(y, z))$.

There are cases when not all these axioms are satisfied, for example the associativity when dealing with the neutrosophic normalization after each neutrosophic operation. But, since we work with approximations, we can call these N-pseudo-conorms, which still give good results in practice.

N_c represent the *or* operator in neutrosophic logic, and respectively the *union* operator in neutrosophic set theory.

Let $J \in \{T, I, F\}$ be a component.
Most known N-conorms, as in fuzzy logic and set the T-conorms, are:

• The Algebraic Product N-conorm: $N_{c-algebraic}J(x, y) = x + y - x \cdot y$
• The Bounded N-conorm: $N_{c-bounded}J(x, y) = \min\{1, x + y\}$
• The Default (max) N-conorm: $N_{c-max}J(x, y) = \max\{x, y\}$.

A general example of N-conorm would be this.
Let $x(T_1, I_1, F_1)$ and $y(T_2, I_2, F_2)$ be in the neutrosophic set/logic M. Then:

$$N_n(x, y) = (T_1 \vee T_2, I_1 \wedge I_2, F_1 \wedge F_2)$$

Where – as above - the "$\wedge$" operator, acting on two (standard or non-standard) subunitary sets, is a N-norm (verifying the above N-norms axioms); while the "$\vee$" operator, also acting on two (standard or non-standard) subunitary sets, is a N-conorm (verifying the above N-conorms axioms).

For example, $\wedge$ can be the Algebraic Product T-norm/N-norm, so $T_1 \wedge T_2 = T_1 \cdot T_2$ (herein we have a product of two subunitary sets); and $\vee$ can be the Algebraic Product T-conorm/N-conorm, so $T_1 \vee T_2 = T_1+T_2-T_1 \cdot T_2$ (herein we have a sum, then a product, and afterwards a subtraction of two subunitary sets).

Or $\wedge$ can be any T-norm/N-norm, and $\vee$ any T-conorm/N-conorm from the above; for example the easiest way would be to consider the *min* for crisp components (or *inf* for subset components) and respectively *max* for crisp components (or *sup* for subset components).

If we have crisp numbers, we can at the end neutrosophically normalize.

Since the min/max (or inf/sup) operators work the best for subunitary set components, let's present their definitions below. They are extensions from subunitary intervals {defined in [3]} to any subunitary sets. Analogously we can do for all neutrosophic operators defined in [3].

Let $x(T_1, I_1, F_1)$ and $y(T_2, I_2, F_2)$ be in the neutrosophic set/logic M.

C. More Neutrosophic Operators

Neutrosophic Conjunction/Intersection:

$x \wedge y=(T_\wedge,I_\wedge,F_\wedge)$,
where $\inf T_\wedge = \min\{\inf T_1, \inf T_2\}$
$\sup T_\wedge = \min\{\sup T_1, \sup T_2\}$
$\inf I_\wedge = \max\{\inf I_1, \inf I_2\}$
$\sup I_\wedge = \max\{\sup I_1, \sup I_2\}$
$\inf F_\wedge = \max\{\inf F_1, \inf F_2\}$
$\sup F_\wedge = \max\{\sup F_1, \sup F_2\}$

Neutrosophic Disjunction/Union:

$x \vee y=(T_\vee,I_\vee,F_\vee)$,
where $\inf T_\vee = \max\{\inf T_1, \inf T_2\}$
$\sup T_\vee = \max\{\sup T_1, \sup T_2\}$
$\inf I_\vee = \min\{\inf I_1, \inf I_2\}$
$\sup I_\vee = \min\{\sup I_1, \sup I_2\}$
$\inf F_\vee = \min\{\inf F_1, \inf F_2\}$
$\sup F_\vee = \min\{\sup F_1, \sup F_2\}$

Neutrosophic Negation/Complement:

$C(x) = (T_C,I_C,F_C)$,
where $T_C = F_1$
$\inf I_C = 1-\sup I_1$

$$\sup I_C = 1\text{-}\inf I_1$$
$$F_C = T_1$$

Upon the above Neutrosophic Conjunction/Intersection, we can define the

Neutrosophic Containment:

We say that the neutrosophic set A is included in the neutrosophic set B of the universe of discourse U, iff for any $x(T_A, I_A, F_A) \in A$ with $x(T_B, I_B, F_B) \in B$ we have:

$\inf T_A \leq \inf T_B$; $\sup T_A \leq \sup T_B$;
$\inf I_A \geq \inf I_B$; $\sup I_A \geq \sup I_B$;
$\inf F_A \geq \inf F_B$; $\sup F_A \geq \sup F_B$.

D. Remarks

a) The non-standard unit interval $]^-0, 1^+[$ is merely used for philosophical applications, especially when we want to make a distinction between relative truth (truth in at least one world) and absolute truth (truth in all possible worlds), and similarly for distinction between relative or absolute falsehood, and between relative or absolute indeterminacy.

But, for technical applications of neutrosophic logic and set, the domain of definition and range of the N-norm and N-conorm can be restrained to the normal standard real unit interval [0, 1], which is easier to use, therefore:

$$N_n: ([0,1] \times [0,1] \times [0,1])^2 \rightarrow [0,1] \times [0,1] \times [0,1]$$
and
$$N_c: ([0,1] \times [0,1] \times [0,1])^2 \rightarrow [0,1] \times [0,1] \times [0,1].$$

b) Since in NL and NS the sum of the components (in the case when T, I, F are crisp numbers, not sets) is not necessary equal to 1 (so the normalization is not required), we can keep the final result un-normalized.
But, if the normalization is needed for special applications, we can normalize at the end by dividing each component by the sum all components.
If we work with intuitionistic logic/set (when the information is incomplete, i.e. the sum of the crisp components is less than 1, i.e. *sub-normalized*), or with paraconsistent logic/set (when the information overlaps and it is contradictory, i.e. the sum of crisp components is greater than 1, i.e. *over-normalized*), we need to define the neutrosophic measure of a proposition/set.
If x(T,I,F) is a NL/NS, and T,I,F are crisp numbers in [0,1], then the neutrosophic vector norm of variable/set x is the sum of its components:
$$N_{vector\text{-}norm}(x) = T+I+F.$$

Now, if we apply the N_n and N_c to two propositions/sets which maybe intuitionistic or paraconsistent or normalized (i.e. the sum of components less than 1, bigger than 1, or equal to 1), x and y, what should be the neutrosophic measure of the results $N_n(x,y)$ and $N_c(x,y)$?
Herein again we have more possibilities:

- either the product of neutrosophic measures of x and y:
  $N_{vector\text{-}norm}(N_n(x,y)) = N_{vector\text{-}norm}(x) \cdot N_{vector\text{-}norm}(y)$,
- or their average:
  $N_{vector\text{-}norm}(N_n(x,y)) = (N_{vector\text{-}norm}(x) + N_{vector\text{-}norm}(y))/2$,
- or other function of the initial neutrosophic measures:

$N_{vector\text{-}norm}(N_n(x,y)) = f(N_{vector\text{-}norm}(x), N_{vector\text{-}norm}(y))$, where f(.,.) is a function to be determined according to each application.

Similarly for $N_{vector\text{-}norm}(N_c(x,y))$.
Depending on the adopted neutrosophic vector norm, after applying each neutrosophic operator the result is neutrosophically normalized. We'd like to mention that "neutrosophically normalizing" doesn't mean that the sum of the resulting crisp components should be 1 as in fuzzy logic/set or intuitionistic fuzzy logic/set, but the sum of the components should be as above: either equal to the product of neutrosophic vector norms of the initial propositions/sets, or equal to the neutrosophic average of the initial propositions/sets vector norms, etc.
In conclusion, we neutrosophically normalize the resulting crisp components T`,I`,F` by multiplying each neutrosophic component T`,I`,F` with S/(T`+I`+F`), where
$S = N_{vector\text{-}norm}(N_n(x,y))$ for a N-norm or $S = N_{vector\text{-}norm}(N_c(x,y))$ for a N-conorm - as defined above.

c) If T, I, F are subsets of [0, 1] the problem of neutrosophic normalization is more difficult.
   i) If sup(T)+sup(I)+sup(F) < 1, we have an *intuitionistic proposition/set*.
   ii) If inf(T)+inf(I)+inf(F) > 1, we have a *paraconsistent proposition/set*.
   iii) If there exist the crisp numbers $t \in T$, $i \in I$, and $f \in F$ such that t+i+f =1, then we can say that we have a *plausible normalized proposition/set*.
   But in many such cases, besides the normalized particular case showed herein, we also have crisp numbers, say $t_1 \in T$, $i_1 \in I$, and $f_1 \in F$ such that $t_1+i_1+f_1 < 1$ (incomplete

information) and $t_2 \in T$, $i_2 \in I$, and $f_2 \in F$ such that $t_2+i_2+f_2 > 1$ (paraconsistent information).

E. Examples of Neutrosophic Operators which are N-norms or N-pseudonorms or, respectively N-conorms or N-pseudoconorms

We define a binary neutrosophic conjunction (intersection) operator, which is a particular case of a N-norm (neutrosophic norm, a generalization of the fuzzy T-norm):

$$c_N^{TIF}:([0,1]\times[0,1]\times[0,1])^2 \to [0,1]\times[0,1]\times[0,1]$$

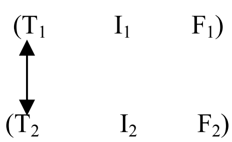
$$c_N^{TIF}(x,y)=(T_1T_2, I_1I_2+I_1T_2+T_1I_2, F_1F_2+F_1I_2+F_1T_2+F_2T_1+F_2I_1)$$

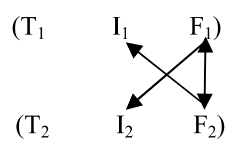
.

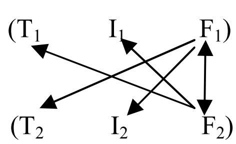
The neutrosophic conjunction (intersection) operator $x \wedge_N y$ component truth, indeterminacy, and falsehood values result from the multiplication

$$(T_1+I_1+F_1)\cdot(T_2+I_2+F_2)$$

since we consider in a prudent way $T \prec I \prec F$, where "$\prec$" is a neutrosophic relationship and means "weaker", i.e. the products T_iI_j will go to I, T_iF_j will go to F, and I_iF_j will go to F for all i, j $\in \{1,2\}$, $i \neq j$, while of course the product T_1T_2 will go to T, I_1I_2 will go to I, and F_1F_2 will go to F (or reciprocally we can say that F prevails in front of I which prevails in front of T, and this neutrosophic relationship is transitive):







So, the truth value is T_1T_2, the indeterminacy value is $I_1I_2+I_1T_2+T_1I_2$ and the false value is $F_1F_2+F_1I_2+F_1T_2+F_2T_1+F_2I_1$. The norm of $x \wedge_N y$ is $(T_1+I_1+F_1)\cdot(T_2+I_2+F_2)$. Thus, if x and y are normalized, then $x \wedge_N y$ is also normalized. Of course, the reader can redefine the neutrosophic conjunction operator, depending on application, in a different way, for example in a more optimistic way, i.e. $I \prec T \prec F$ or T prevails with respect to I, then we get:

$$c_N^{ITF}(x,y)=(T_1T_2+T_1I_2+T_2I_1, I_1I_2, F_1F_2+F_1I_2+F_1T_2+F_2T_1+F_2I_1)$$

Or, the reader can consider the order $T \prec F \prec I$, etc.

V. ROBOT POSITION CONTROL BASED ON KINEMATICS EQUATIONS

A robot can be considered as a mathematical relation of actuated joints which ensures coordinate transformation from one axis to the other connected as a serial link manipulator where the links sequence exists. Considering the case of revolute-geometry robot all joints are rotational around the freedom ax [4, 5]. In general having a six degrees of freedom the manipulator mathematical analysis becomes very complicated. There are two dominant coordinate systems: Cartesian coordinates and joints coordinates. Joint coordinates represent angles between links and link extensions. They form the coordinates where the robot links are moving with direct control by the actuators.

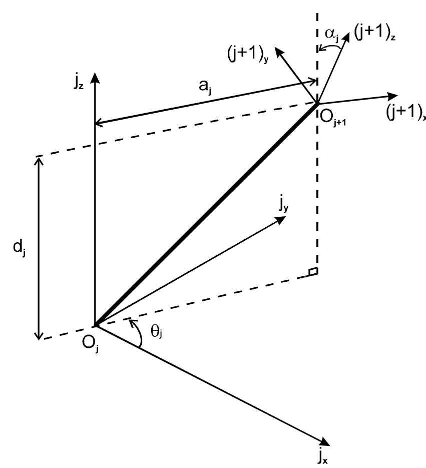


Fig.1. The robot control through DH transformation.

The position and orientation of each segment of the linkage structure can be described using Denavit-Hartenberg [DH] transformation [6]. To determine the D-H transformation matrix (Fig. 1) it is assumed that the *Z*-axis (which is the system's axis in relation to the motion surface) is the axis of rotation in each frame, with the following notations: θ_j - joint angled is the joint angle positive in the right hand sense about j_Z; a_j - link length is the length of the common normal, positive in the direction of $(j+1)_X$; α_j - twist angled is the angle between j_Z and $(j+1)_Z$, positive in the right hand sense about the common normal; d_j - offset distance is the value of j_Z at which the common normal intersects j_Z; as well if j_X and $(j+1)_X$ are parallel and in the same direction, then $\theta_j = 0$; $(j+1)_X$ - is chosen to be collinear with the common normal between j_Z and $(j+1)_Z$ [7, 8] . Figure 1 illustrates a robot position control based on the Denavit-Hartenberg transformation. The robot joint angles, θ_c, are transformed in X_c - Cartesian coordinates with D-H transformation. Considering that a point in j, respectively j+1 is given by:

$$\begin{vmatrix} X \\ Y \\ Z \\ 1 \end{vmatrix}_j = {}^jP \quad \text{and} \quad \begin{vmatrix} X \\ Y \\ Z \\ 1 \end{vmatrix}_{j+1} = {}^{j+1}P' \tag{1}$$

then ${}^jP$ can be determined in relation to ${}^{j+1}P$ through the equation :

$$ {}^jP = {}^jA_{j+1} \cdot {}^{j+1}P, \tag{2}$$

where the transformation matrix ${}^jA_{j+1}$ is:

$$ {}^jA_{j+1} = \begin{bmatrix} \cos\theta_j & -\sin\theta_j \cdot \cos\alpha_j & +\sin\theta_j \cdot \sin\alpha_j & a_j \cdot \cos\alpha_j \\ \sin\theta_j & -\cos\theta_j \cdot \cos\alpha_j & -\cos\theta_j \cdot \sin\alpha_j & a_j \cdot \sin\alpha_j \\ 0 & \sin\theta_j & \cos\theta_j & d_j \\ 0 & 0 & 0 & 1 \end{bmatrix}.$$

Control through forward kinematics consists of the transformation of robot coordinates at any given moment, resulting directly from the measurement transducers of each axis, to Cartesian coordinates and comparing to the desired target's Cartesian coordinates (reference point). The resulting error is the difference of position, represented in Cartesian coordinates, which requires changing. Using the inverted Jacobean matrix ensures the transformation into robot coordinates of the position error from Cartesian coordinates, which allows the generating of angle errors for the direct control of the actuator on each axis.

The control using forward kinematics consists of transforming the actual joint coordinates, resulting from transducers, to Cartesian coordinates and comparing them with the desired Cartesian coordinates. The resulted error is a required position change, which must be obtained on every axis. Using the Jacobean matrix inverting it will manage to transform the change in joint coordinates that will generate angle errors for the motor axis control.

Figure 2 illustrates a robot position control system based on the Denavit-Hartenberg transformation. The robot joint angles, θ_c, are transformed in X_c - Cartesian coordinates with D-H transformation, where a matrix results from (1) and (2) with θ_j -joint angle, d_j -offset distance, a_j - link length, α_j - twist.

Position and orientation of the end effector with respect to the base coordinate frame is given by X_C :

$$X_C = A_1 \cdot A_2 \cdot A_3 \cdot \ldots\ldots\ldots \cdot A_6 \tag{3}$$

Position error ΔX is obtained as a difference between desired and current position. There is difficulty in controlling robot trajectory, if the desired conditions are specified using position difference ΔX with continuously measurement of current position $\theta_{1,2,\ldots\ldots6}$.

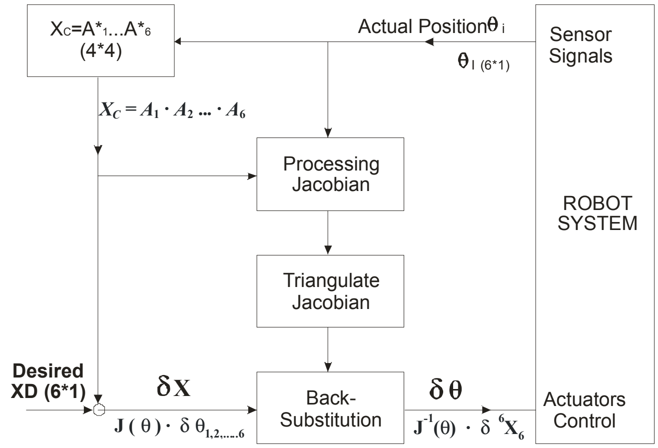


Fig. 2. Robot position control system based on the Denavit-Hartenberg transformation

The relation, between given by end-effector's position and orientation considered in Cartesian coordinates and the robot joint angles $\theta_{1,2,\ldots\ldots6}$, it is :

$$x_i = f_i(\theta) \tag{4}$$

where θ is vector representing the degrees of freedom of robot. By differentiating we will have: $\delta\, {}^6X_6 = J(\theta) \cdot \delta\theta_{1,2,\ldots\ldots6}$, where $\delta\, {}^6X_6$ represents differential linear and angular changes in the end effector at the currently values of X_6 and $\delta\theta_{1,2,\ldots\ldots6}$ represents the differential change of the set of joint angles. J (θ) is the Jacobean matrix in which the elements a_{ij} satisfy the relation: $a_{ij} = \delta f_{i-1} / \delta\theta_{j-1}$, (x.6) where i, j are corresponding to the dimensions of x respectively θ. The inverse Jacobian transforms the Cartesian position δ^6X_6 respectively ΔX in joint angle error $(\Delta\theta)$: $\delta\theta_{1,2,\ldots6} = J^{-1}(\theta) \cdot \delta\, {}^6X_6$.

VI. HYBRID POSITION AND FORCE CONTROL OF ROBOTS

Hybrid position and force control of industrial robots equipped with compliant joints must take into consideration the passive compliance of the system. The generalized area where a robot works can be defined in a constraint space with six degrees of freedom (DOF), with position constrains along the normal force of this area and force constrains along the tangents. On the basis of these two constrains there is described the general scheme of hybrid position and force control in figure 3. Variables X_C and F_C represent the Cartesian position and the Cartesian force exerted onto the environment. Considering X_C and F_C expressed in specific frame of coordinates, its can be determinate selection matrices S_x and S_f, which are diagonal matrices with 0 and 1 diagonal elements, and which satisfy relation: $S_x + S_f = I_d$, where S_x and S_f are methodically deduced from kinematics constrains imposed by the working environment [9, 10].

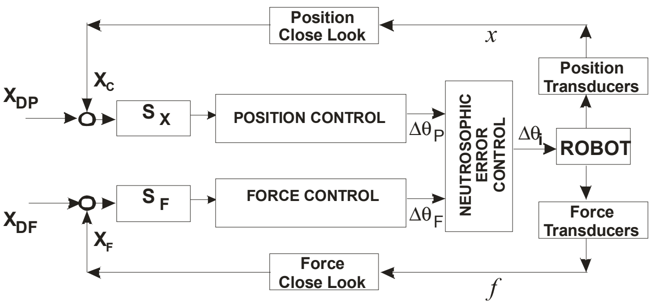


Fig. 3. General structure of hybrid control.

Mathematical equations for the hybrid position-force control**.** A system of hybrid position–force control normally achieves the simultaneous position–force control. In order to determine the control relations in this situation, ΔX_P – the measured deviation of Cartesian coordinate command system is split in two sets: ΔX^F corresponds to force controlled component and ΔX^P corresponds to position control with axis actuating in accordance with the selected matrixes S_f and S_x. If there is considered only positional control on the directions established by the selection matrix S_x there can be determined the desired end - effector differential motions that correspond to position control in the relation: $\Delta X_P = K_P \; \Delta X^P$, where K_P is the gain matrix, respectively desired motion joint on position controlled axis: $\Delta\theta_P = J^{-1}(\theta) \cdot \Delta X_P$ [11, 12].

Now taking into consideration the force control on the other directions left, the relation between the desired joint motion of end-effector and the force error ΔX_F is given by the relation: $\Delta\theta_F = J^{-1}(\theta) \cdot \Delta X_F$, where the position error due to force ΔX_F is the motion difference between ΔX^F– current position deviation measured by the control system that generates position deviation for force controlled axis and ΔX_D – position deviation because of desired residual force. Noting the given desired residual force as F_D and the physical rigidity K_W there is obtained the relation: $\Delta X_D = K_W^{-1} \cdot F_D$.

Thus, ΔX_F can be calculated from the relation: $\Delta X_F = K_F (\Delta X^F - \Delta X_D)$, where K_F is the dimensionless ratio of the stiffness matrix. Finally, the motion variation on the robot axis matched to the motion variation of the end-effectors is obtained through the relation: $\Delta\theta = J^{-1}(\theta) \; \Delta X_F + J^{-1}(\theta) \; \Delta X_P$. Starting from this representation the architecture of the hybrid position – force control system was developed with the corresponding coordinate transformations applicable to systems with open architecture and a distributed and decentralized structure.

For the fusion of information received from various sensors, information that can be conflicting in a certain degree, the robot uses the fuzzy and neutrosophic logic or set [3]. In a real time it is used a neutrosophic dynamic fusion, so an autonomous robot can take a decision at any moment.

CONCLUSION

In this paper we have provided in the first part an introduction to the neutrosophic logic and set operators and in the second part a short description of mathematical dynamics of a robot and then a way of applying neutrosophic science to robotics. Further study would be done in this direction in order to develop a robot neutrosophic control.

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The Navigation Mobile Robot Systems Using Bayesian Approach through the Virtual Projection Method

Luige Vladareanu, Gabriela Tont, Victor Vladareanu, Florentin Smarandache, Lucian Capitanu

***Abstract*. The paper presents the navigation mobile walking robot systems for movement in non-stationary and non-structured environments, using a Bayesian approach of Simultaneous Localization and Mapping (SLAM) for avoiding obstacles and dynamical stability control for motion on rough terrain. By processing inertial information of force, torque, tilting and wireless sensor networks (WSN) an intelligent high level algorithm is implementing using the virtual projection method. The control system architecture for the dynamic robot walking is presented in correlation with a stochastic model of assessing system probability of unidirectional or bidirectional transition states, applying the non-homogeneous/non-stationary Markov chains. The rationality and validity of the proposed model are demonstrated via an example of quantitative assessment of states probabilities of an autonomous robot. The results show that the proposed new navigation strategy of the mobile robot using Bayesian approach walking robot control systems for going around obstacles has increased the robot's mobility and stability in workspace.**

I. Introduction

Walking robots, unlike other types of robots such as those with wheels or tracks, use similar devices for moving on the field like human or animal feet. A desirable characteristic a mobile robot must have the skills needed to recognize the landmarks and objects that surround it, and to be able to localize itself relative to its workspace. This knowledge is crucial for the successful completion of intelligent navigation tasks. But, for such interaction to take place, a model or description of the environment needs to be specified beforehand. If a global description or measurement of the elements present in the environment is available, the problem consists on the interpretation and matching of sensor readings to such previously stored object models. Moreover, if we know that the recognized objects are fixed and persist in the scene, they can be regarded as landmarks, and can be used as reference points for self localization. If on the other hand, a global description or measurement of the elements in the environment is not available, at least the descriptors and methods that will be used for the autonomous building of one are required [1].

The approach of the localization and navigation problems of a mobile robot which uses a WSN which comprises of a large number of distributed nodes with low-cost cameras as main sensor, have the main advantage of require no collaboration from the object being tracked.
The main advantages of using WSN multi-camera localization and tracking are:

1) the exploit of the distributed sensing capabilities of the WSN;

2) the benefit from the parallel computing capabilities of the distributed nodes. Even though each node have finite battery lifetime by cooperating with each other, they can perform tasks that are difficult to handle by traditional centralized sensing system.;

3) the employ of the communication infrastructure of the WSN to overcome multi-camera network issues. Also, camera-based WSN have easier deployment and higher re-configurability than traditional camera networks making them particularly interesting in applications such as security and search and rescue, where pre-existing infrastructure might be damaged [2].

Robots have to know where in the map they are in order to perform any task involving navigation. Probabilistic algorithms have proved very successful in many robotic environments. They calculate the probability of each possible position given some sensor readings and movement data provided by the robot [5]. The localization of a mobile robot is made using a particle filter that updates the belief of localization which, and estimates the maximal posterior probability density for localization. The causal and contextual relations of the sensing results and global localization in a Bayesian network, and a sensor planning approach based on Bayesian network inference to solve the dynamic environment is presented. In the study is proposed a mobile robot sensor planning approach based on a top-down decision tree algorithm. Since the system has to compute the utility values of all possible sensor selections in every planning step, the planning process is very complex.

The paper first presents the position force control and dynamic control using ZMP and inertial information with the aim of improving robot stability for movement in non-structured environments. The next chapter presents the mobile walking robot control system architecture for movement in non-stationary environments by applying

Manuscript received April 9, 2012. This work was supported in part by the Romanian Academy and the Romanian Scientific Research National Authority under Grant 005/2007-2010 (sponsor and financial support acknowledgment goes here).

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Wireless Sensor Networks (WSN) methods. Finally, there are presented the results obtained in implementing the interface for sensor networks used to avoid obstacles and in improving the performance of dynamic stability control for motion on rough terrain, through a Bayesian approach of Simultaneous Localization and Mapping (SLAM).

II. DYNAMICAL STABILITY CONTROL

The research evidences that stable gaits can be achieved by employing simple control approaches which take advantage of the dynamics of compliant systems. This allows a decentralization of the control system, through which a central command establishes the general movement trajectory and local control laws presented in the paper solve the motion stability problems, such as: damping control, ZMP compensation control, landing orientation control, gait timing control, walking pattern control, predictable motion control (see ICAMechS 2011, Zhengzhou [3]).

In order to carry out new capabilities for walking robots, such as walking down the slope, going by overcoming or avoiding obstacles, it is necessary to develop high-level intelligent algorithms, because the mechanism of walking robots stepping on a road with bumps is a complicated process to understand, being a repetitive process of tilting or unstable movements that can lead to the overthrow of the robot. The chosen method that adapts well to walking robots is the ZMP (Zero Moment Point) method. A new strategy is developed for the dynamic control for walking robot stepping using ZMP and inertial information. This, includes pattern generation of compliant walking, real-time ZMP compensation in one phase - support phase, the leg joint damping control, stable stepping control and stepping position control based on angular velocity of the platform. In this way, the walking robot is able to adapt on uneven ground, through real time control, without losing its stability during walking [13].

Based on studies and analysis, the compliant control system architecture was completed with tracking functions for HFPC walking robots, which through the implementation of many control loops in different phase of the walking robot, led to the development of new technological capabilities, to adapt the robot walking on sloping land, with obstacles and bumps. In this sense, a new control algorithm has been studied and analyzed for dynamic walking of robots based on sensory tools such as force / torque and inertial sensors [3,13]. Distributed control system architecture was integrated into the HFPC architecture so that it can be controlled with high efficiency and high performance.

III. SIMULTANEOUS LOCALIZATION AND MAPING

A precise position error compensation and low-cost relative localization method is studied in [5] for structured environments using magnetic landmarks and hall sensors [6]. The proposed methodology can solve the problem of fine localization as well as global localization by tacking landmarks or by utilizing various patterns of magnetic landmark arrangement. The research in localization and tracking methods using Wireless Sensor Networks (WSN have been developed based on Radio Signal Strength Intensity (RSSI) [7] and ultrasound time of flight (TOF) [8]. Localization based on Radio Frequency Identification (RFID) systems have been used in fields such as logistics and transportation [9] but the constraints in terms of range between transmitter and reader limits its potential applications. Many efforts have been devoted to the development of cooperative perception strategies exploiting the complementarities among distributed static cameras at ground locations [10], among cameras mounted on mobile robotic platforms [11], and among static cameras and cameras onboard mobile robots [12]. Computation-based closed-loop controllers put most of the decision burden on the planning task. In hazardous and populated environments mobile robots utilize motion planning which relies on accurate, static models of the environments, and therefore they often fail their mission if humans or other unpredictable obstacles block their path. Autonomous mobile robots systems that can perceive their environments, react to unforeseen circumstances, and plan dynamically in order to achieve their mission have the objective of the motion planning and control problem [4, 9].

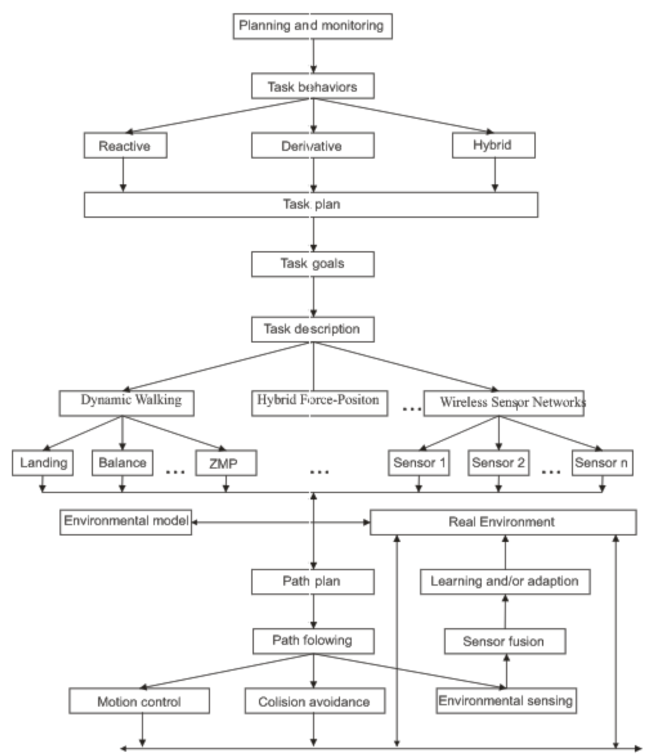

Figure 1 Mobile robot control system architecture

To find collision-free trajectories, in static or dynamic environments containing some obstacles, between a start and a goal configuration, the navigation of a mobile robot comprises localization, motion control, motion planning and collision avoidance. Its task is also the online real-time re-planning of trajectories in the case of obstacles blocking the pre-planned path or another unexpected event occurring. Inherent in any navigation scheme is the desire to reach a destination without getting lost or crashing into anything. The responsibility for making this decision is shared by the process that creates the knowledge representation and the process that constructs a plan of action based on this knowledge representation. The choice of which representation is used and what knowledge is stored helps to decide the division of this responsibility. Very complex reasoning may be required to condense all of the available information into this single measure [4, 14]. The techniques include computation-based closed-loop control, cost-based search strategies, finite state machines, and rule-based systems [17].

Computation-based closed-loop controllers put most of the decision burden on the planning task. In hazardous and populated environments mobile robots utilize motion planning which relies on accurate, static models of the environments, and therefore they often fail their mission if humans or other unpredictable obstacles block their path. Autonomous mobile robots systems that can perceive their environments, react to unforeseen circumstances, and plan dynamically in order to achieve their mission have the objective of the motion planning and control problem. To find collision-free trajectories, in static or dynamic environments containing some obstacles, between a start and a goal configuration, the navigation of a mobile robot comprises localization, motion control, motion planning and collision avoidance [15, 16]. A higher-level process, a task planner, specifies the destination and any constraints on the course, such as time. Most mobile robot algorithms abort, when they encounter situations that make the navigation difficult. Set simply, the navigation problem is to find a path from start (S) to goal (G) and traverse it without collision. The relationship between the subtasks mapping and modeling of the environment; path planning and selection; path traversal and collision avoidance into which the navigation problem is decomposed, is shown in Figure 1.

Motion planning of mobile walking robots in uncertain dynamic environments based on the behavior dynamics of collision-avoidance is transformed into an optimization problem. Applying constraints based on control of the behavior dynamics, the decision-making space of this optimization.

IV. VIRTUAL PROJECTION METHOD

A virtual projection architecture system was designed which allows improvement and verification of the performance of dynamic force-position control of walking robots by integrating the multi-stage fuzzy method with acceleration solved in position-force control and dynamic control loops through the ZMP method for movement in non-structured environments and a bayesian approach of simultaneous localization and mapping (SLAM) for avoiding obstacles in non-stationary environments. By processing inertial information of force, torque, tilting and wireless sensor networks (WSN) an intelligent high level algorithm is implementing using the virtual projection method.

The virtual projection method, presented in Figure 2, patented by the research team, tests the performance of dynamic position-force control by integrating dynamic control loops and a bayesian interface for the sensor network. The CMC classical mechatronic control directly actions the MS1, MSm servomotors, where m is the numbber of the robot's degrees of freedom. These signals are sent to a virtual control interface (VCI), which processes them and genrates the necessary signals for graphical representation in 3D on a graphical terminal CGD. A number of n control interface functions ICF1-ICFn ensure the development of an open architecture control system by intergrating n control functions in addition to those supplied by the CMC mechatronic control system. With the help of these, new control methods can be implemented, such as: contour tracking functions, control schemes for tripod walking, centre of gravity control, orientation control through image processing and Bayesian interface for sensor networks. Priority control real time control and information exchange management between the n interfaces is ensured by the multifunctional control interface MCI, interconnected through a high speed data bus.

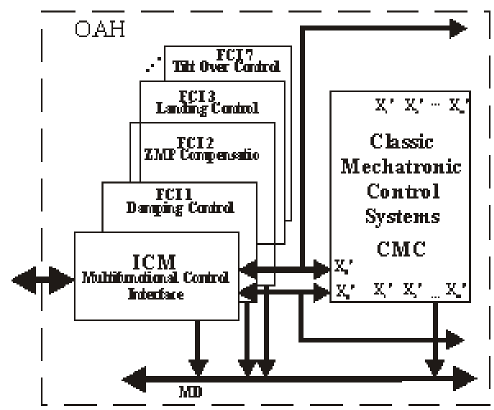

Fig. 2. The virtual projection method

Bayesian Interface for sensor networks.

To determine the priors for the model parameters and to calculate likelihood function (joint probability) we define a given random variable *x* whose probability distribution depends on a set of parameters $P = (P_1, P_2, \ldots P_p)$. Exact values of the parameters are not known with certainty, Bayesian reasoning assigns a probability distribution of the various possible values of these parameters that are considered as random variables. Bayes' theory is generally expressed through probabilistic statements as following:

$$P(A \mid B) = P(A) \times \frac{P(B \mid A)}{P(B)} \qquad (1)$$

P (A | B) is the probability of A given the event B occurs or the posteriori probability. Using Bayes' theory may be recurring, that if exist an a priori distribution (P (A) and a series of tests with experimental results B_1, B_2,…,B_n..., expressed according to successive equations:

$$P(A \mid B_1) = P(A) \frac{P(B_1 \mid A)}{P(B_1)}$$
$$P(A \mid B_1, B_2) = P(A) \frac{P(B_1 \mid A)}{P(B_1)} \frac{P(B_2 \mid A)}{P(B_2)} \qquad (2)$$

$$P(A \mid B_1, B_2, ...B_n) = P(A \mid B_1, B_2, ...B_{n-1}) - \frac{P(B_n \mid A)}{P(B_n)}$$

A posteriori distribution called also belief, is used when the test results are known, being obtained as a new function a priori. The start of operations sequences in the Bayesian method regards the transformation γ. Recursive Bayesian updating is made under the Markov assumption: z_n is independent of $z_1,...,z_{n-1}$ if we know x.

$$\begin{aligned} P(x \mid z_1,\ldots,z_n) &= \frac{P(z_n \mid x)\, P(x \mid z_1,\ldots,z_{n-1})}{P(z_n \mid z_1,\ldots,z_{n-1})} \\ &= \eta\, P(z_n \mid x)\, P(x \mid z_1,\ldots,z_{n-1}) \quad (3) \\ &= \eta_{1\ldots n} \prod_{i=1\ldots n} P(z_i \mid x)\, P(x) \end{aligned}$$

When there are no missing data or hidden variables the method for calculating $P(B_{si}, D)$ for some belief-network structure B_{Si} and database D is presented in [12].Let Q be the set of all those belief-network structures that have a non-zero prior probability. We can derive the posterior probability of B_{Si} given D as:

$$P(B_{Si} \mid D) = P(B_{Si}, D) / \sum B_{Si} \in QP(B_{Si}, D) \quad (4)$$

The ratio of the posterior probabilities of two belief-network structures can be calculated as a ratio for belief-network structures B_{si} and B_{sj}, using the equivalence:

$$P(B_{Si} \mid D) / P(B_{Sj} \mid D) = P(B_{Si}, D) / P(B_{Sj}, D) \quad (5)$$

which we can derive that:

$$P(B_{Si}, D) = P(D \mid B_{Si}) P(B_{Si}) \quad (6)$$

Term $P(B_{si})$ represents prior probability that a process with belief-network structure B_{Si}. To designate the possible values of *h*, ca be used the Markov blanket method, *MB(h)* [12, 13]. Suppose that among the *m* cases in *D* there are *u* unique instantiations of the variables in *MB(h)*. Given these conditions it follows that:

$$P(D \mid B_S) = \sum_{G_t} ... \sum_{G_u} f(G_1, ..., G_u) \int_{B_p} [\prod_{t=1}^{m} P(C_t h_t \mid B_S, B_P)] f(B_S \mid B_P) dB_P \quad (7)$$

where G_i is a given group contains c_i case-specific hidden variables. Recall that u denotes only the number of unique instantiations *actually realized* in database D of the variables in the Markov blanket of hidden variable h. The number of such unique instantiations significantly influences the efficiency with which we can compute Equation 7.

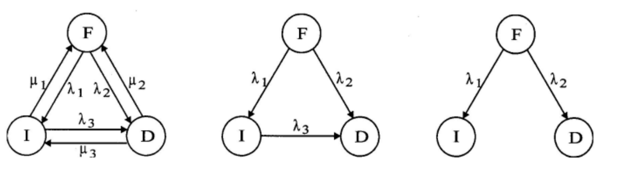

Fig.3 The model with three states for the robotic system

For any finite belief network, the number of such unique instantiations reaches a maximum regardless of how many cases there are in the database. That r denotes the maximum number of possible values for any variable in the database. If u and r are bounded from above, then the time to solve Equation 7 is bounded from above by a function that is polynomial in the number of variables n and the number of cases m. If u or r is large, however, the polynomial will be of high degree [12].

To model a robotic system requires considering in-between the two states of operating and faulting one or more intermediate states of partial success. In figure 3 is considered a robotic system characterized by three states: operating at full capacity (F), defect (D) and intermediate (I).

A generalized diagram of states is shown in figure 4, which included three intermediate states.

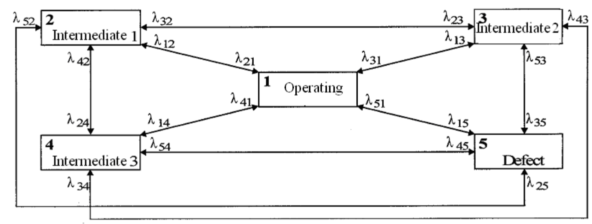

Fig. 4. Generalized diagram of states with three intermediate states

The Markov modeling technique requires to identify each intermediate state (in practice, more neighboring levels can be grouped together), to know the occupancy status of each component (Ti) and the number of transitions between states (Nij), which can calculate as follows:

- occupancy probability of "i"state: $P_i = \frac{T_i}{T_A}$

- transition intensity from state *"i"* in *"j"*: $\lambda_{ij} = \frac{N_{ij}}{T_i}$,

where: $T_A = \sum_i T_i$ is analyzed time interval.

The number of intermediate states to be modeled in order to obtain a more accurate assessment of the reliability group is necessary to consider more than one intermediate state. Figure 5 presents a model with six states to assess the predictable transitions in a robotic system. The six states of the system are:

1 - operational state of robot;
2 - landing control
3 - balance control
4 - advance control
5 - wireless sensor networks (WSN) control
6 - unpredict event

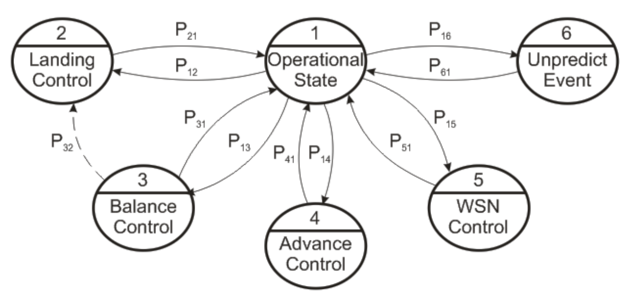

Fig.5. Modeling the states with possible transitions for robot

Based on the surveillance data in operation regime of robot were determined transition probabilities using of the relationship: $\hat{p}_{ij} = \frac{n_{ij}}{n_i}$, where n_{ij} is the transition from state

"i" in "j" in the analysis time interval; n_i is the number of all transitions from state "i" in any other states.

Values of these transition probabilities are: $\hat{p}_{12} = 0,247$; $\hat{p}_{13} = 0,32$; $\hat{p}_{14} = 0,125$; $\hat{p}_{15} = 0,205$; $\hat{p}_{16} = 0,103$; By applying the method Markov chains are obtain the occupancy probability of the sates for the robot: P_1=0,31; P_2=0,208; P_3=0,115; P_4=0,205; P_5=0,102; P_6=0,06.

The working diagram of the Petri network is presented in figure 6 (http://www-dssz.informatik.tu-cottbus.de). A token is assigned to P_3, and is assumed that the localizer initially knows its position. The Warning event t_5 fires when the localizer fails in estimating robot's accurate position for several steps. Two navigation primitives can be modeled as P_1, P_2, respectively. Initially, the robot selects its motion by a random switch comprising the transitions t_1 and t_2 with corresponds to probabilities P_1' and P'_2, respectively. The transition between them takes place according to the change of localizer states. The immediate transition t_3 means that the robot takes Contour tracking as soon as the localizer Warning event fires.

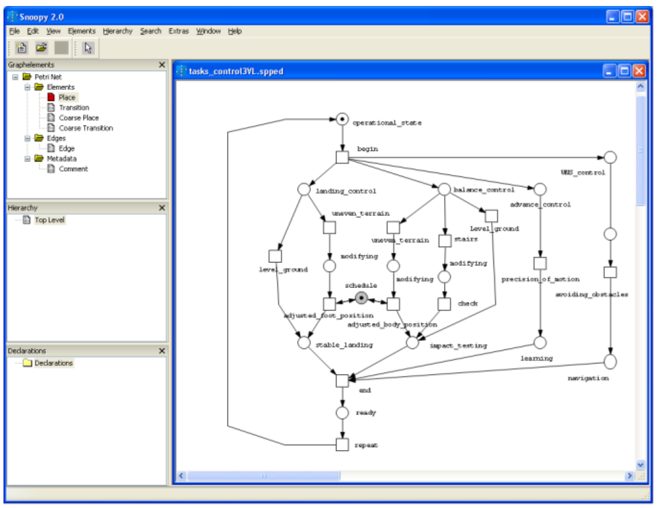

Fig.6. The Petri network diagram

The other transition between two primitives, t_2 and t_4, are modeled as timed transitions in order to express that the robot can change its current navigation primitive during the localizer Success state, if necessary.

V. Results and Conclusion

The control for walking robots is achieved by a control system with three levels. The first level is to produce control signals for motor drive mounted on leg joints, ensuring the robot moving in the direction required with a given speed. The language for this level is that of differential equations. The second level controls the walking, respectively it coordinates the movements, provides the data necessary to achieve progress. At this level, work is described in the language of algorithms types of walking. The third level of command defines the type of walking, speed and orientation.

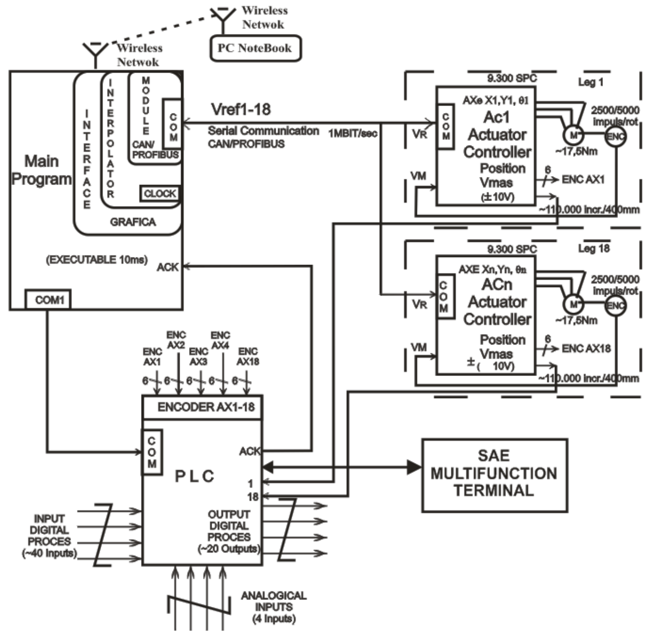

Fig.7. Open architecture system of the walking robot

At this level, the command may be provided by an operator who can use the control panel, in pursuit of its link with the robot, to specify the type of running and passing special orders (for the definition of the vector speed of movement).

To maintain the platform in a horizontal position, the information provided by the horizontality transducers (or verticality) is used, that sense walking robots deviation platform to the horizontal position. Restoring the horizontal position of the platform is achieved at the expense of vertical movement of different legs of support, as decided by the block to maintain balance. Returning to the fixed height of the platform is achieved by using information provided by the height transducer of the platform and by simultaneous control of vertical movement of all legs in support phase. From the analysis performed results the effectiveness of the proposed control strategy for a walking robot. The position of each actuator is controlled by a PD feedback loop, using encoder like transducers.

In HFPC control system, the PC system sends the reference positions to all actuators controllers simultaneously at an interval of 10 ms (100 Hz). Reference positions for the control of 18 actuators and actual positions on each axis robot obtained through interpolation are processed at an interval of 1 ms (1 kHz). Figure 1 shows the general configuration of the HFPC system for ZMP control method. The control system is distributive with multi-processor devices for joint control, data reception from transducers mounted on the robot, peripheral devices connected through a wireless LAN for off-line communications and CAN fast communication network for real time control. The HFPC system was designed in a distributed and decentralized structure to enable development of new applications easily and to add new modules for new hardware or software control functions. Moreover, the short time execution will ensure a faster feedback, allowing other programs to be performed in real time as well, like the apprehension force control, objects recognition, making it possible that the control system have a human flexible and friendly interface.

ACKNOWLEDGMENT

This work was supported in part by the Romanian Academy and the Romanian Scientific Research National Authority under Grant 005/2007-2010 (sponsor and financial support acknowledgment goes here).

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Neutrosophic Masses & Indeterminate Models.

Applications to Information Fusion

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***Abstract*—In this paper we introduce the *indeterminate models* in information fusion, which are due either to the existence of some *indeterminate elements* in the fusion space or to some *indeterminate masses*. The best approach for dealing with such models is the neutrosophic logic.**

Keywords: neutrosophic logic; indeterminacy; indeterminate model; indeterminate element; indeterminate mass; indeterminate fusion rules; DSmT; DST; TBM;

I. INTRODUCTION

In this paper we introduce for the first time the notions of indeterminate mass (bba), indeterminate element, indeterminate intersection, and so on. We give an example of neutrosophic dynamic fusion using two classical masses, defined on a determinate frame of discernment, but having indeterminate intersections in the super-power set S^{Θ} (the fusion space). We also adjust several classical fusion rules (*PCR5* and *DSmH*) to work for indeterminate intersections instead of empty intersections.

References [3]-[13] show a wide variety of applications of the neutrosophic logic and set, based on indeterminacy, in information technology.

Let Θ be a frame of discernment, defined as:

$$\Theta = \{\phi_1, \phi_2, \ldots, \phi_n\}, n \geq 2, \tag{1}$$

and its Super-Power Set (or fusion space):

$$S^{\Theta} = (\Theta, \cup, \cap, \mathcal{C}) \tag{2}$$

which means the set Θ closed under union, intersection, and respectively complement.

This paper is organized as follows: we present the neutrosophic logic, the indeterminate masses, elements and models, and give an example of indeterminate intersection.

II. INDETERMINATE MASS

A. Neutrosophic Logic

Neutrosophic Logic (NL) [1] started in 1995 as a generalization of the fuzzy logic, especially of the intuitionistic fuzzy logic. A logical proposition P is characterized by three neutrosophic components:

$$NL(P) = (T, I, F) \tag{3}$$

where T is the degree of truth, F the degree of falsehood, and I the degree of indeterminacy (or neutral, where the name "neutro-sophic" comes from, i.e. neither truth nor falsehood but in between – or included-middle principle), and with:

$$T, I, F \subseteq \,]^-0, 1^+[\tag{4}$$

where $]^-0, 1^+[$ is a non-standard interval.

In this paper, for technical proposal, we can reduce this interval to the standard interval $[0, 1]$.

The main distinction between neutrosophic logic and intuitionistic fuzzy logic (IFL) is that in NL the sum $T+I+F$ of the components, when T, I, and F are crisp numbers, does not need to necessarily be 1 as in IFL, but it can also be less than 1 (for incomplete/missing information), equal to 1 (for complete information), or greater than 1 (for paraconsistent/contradictory information).

The combination of neutrosophic propositions is done using the neutrosophic operators (especially $\wedge$, $\vee$).

B. Neutrosophic Mass

We recall that a classical mass $m(.)$ is defined as:

$$m : S^{\Theta} \to [0,1] \tag{5}$$

such that

$$\sum_{X \in S^{\Theta}} m(X) = 1 \tag{6}$$

We extend this classical basic belief assignment (mass) *m(.)* to a neutrosophic basic belief assignment (nbba) (or neutrosophic mass) $m_n(.)$ in the following way.

$$m_n : S^\Theta \to [0,1]^3 \quad (7)$$

with

$$m_n(A) = (T(A), I(A), F(A)) \quad (8)$$

where *T(A)* means the (local) chance that hypothesis *A* occurs, *F(A)* means the (local) chance that hypothesis *A* does not occur (nonchance), while *I(A)* means the (local) indeterminate chance of *A* (i.e. knowing neither if *A* occurs nor if *A* doesn't occur),

such that:

$$\sum_{X \in S^\Theta} [T(X) + I(X) + F(X)] = 1. \quad (9)$$

In a more general way, the summation (9) can be less than 1 (for incomplete neutrosophic information), equal to 1 (for complete neutrosophic information), or greater than 1 (for paraconsistent/conflicting neutrosophic information). But in this paper we only present the case when summation (9) is equal to 1.

Of course,

$$0 \le T(A), I(A), F(A) \le 1. \quad (10)$$

A *basic belief assignment* (or *mass*) is considered *indeterminate* if there exist at least an element $A \in S^\Theta$ such that $I(A) > 0$, i.e. there exists some indeterminacy in the chance of at least an element *A* for occurring or for not occurring. Therefore, a neutrosophic mass which has at least one element *A* with $I(A) > 0$ is an indeterminate mass.

A classical mass *m(.)* as defined in equations (5) and (6) can be extended under the form of a neutrosophic mass $m_n'(.)$ in the following way:

$$m_n' : S^\Theta \to [0,1]^3 \quad (11)$$

with

$$m_n'(A) = (m(A), 0, 0) \quad (12)$$

but reciprocally it does not work since *I(A)* has no correspondence in the definition of the classical mass.

We just have $T(A) = m(A)$ and $F(A) = m(C(A))$, where *C(A)* is the complement of *A*. The non-null *I(A)* can, for example, be roughly approximated by the total ignorance mass $m(\Theta)$, or better by the partial ignorance mass $m(\Theta_I)$ where Θ_I is the union of all singletons that have some non-zero indeterminacy, but these mean less accuracy and less refinement in the fusion.

If $I(X) = 0$ for all $X \in S^\Theta$, then the neutrosophic mass is simply reduced to a classical mass.

III. INDETERMINATE ELEMENT

We have two types of elements in the fusion space S^Θ, *determinate elements* (which are well-defined), and *indeterminate elements* (which are not well-defined; for example: a geographical area whose frontiers are vague; or let's say in a murder case there are two suspects, *John* – who is known/determinate element – but he acted together with another man *X* (since the information source saw *John* together with an unknown/unidentified person) – therefore *X* is an indeterminate element).

Herein we gave examples of singletons as indeterminate elements just in the frame of discernment Θ, but indeterminate elements can also result from the combinations (unions, intersections, and/or complements) of determinate elements that form the super-power set S^Θ. For example, *A* and *B* can be determinate singletons (we call the elements in Θ as singletons), but their intersection $A \cap B$ can be an indeterminate (unknown) element, in the sense that we might not know if $A \cap B = \phi$ or $A \cap B \neq \phi$.

Or *A* can be a determinate element, but its complement *C(A)* can be indeterminate element (not well-known), and similarly for determinate elements *A* and *B*, but their $A \cup B$ might be indeterminate.

Indeterminate elements in S^Θ can, of course, result from the combination of indeterminate singletons too. All depends on the problem that is studied.

A frame of discernment which has at least an indeterminate element is called *indeterminate frame of discernment*. Otherwise, it is called *determinate frame of discernment*. Similarly we call an *indeterminate fusion space* (S^Θ) that fusion space which has at least one indeterminate element. Of course an indeterminate frame of discernment spans an indeterminate fusion space.

An *indeterminate source of information* is a source which provides an indeterminate mass or an indeterminate fusion space. Otherwise it is called a *determinate source of information*.

IV. INDETERMINATE MODEL

An *indeterminate model* is a model whose fusion space is indeterminate, or a mass that characterizes it is indeterminate.

Such case has not been studied in the information fusion literature so far. In the next sections we'll present some examples of indeterminate models.

V. CLASSIFICATION OF MODELS

In the classical fusion theories all elements are considered determinate in the Closed World, except in Smets' Open World where there is some room (i.e. mass assigned to the empty set) for a possible unknown missing singleton in the frame of discernment. So, the Open World has a probable indeterminate element, and thus its frame of discernment is indeterminate. While the Closed World frame of discernment is determinate.

In the Closed World in Dezert-Smarandache Theory there are three models classified upon the types of singleton intersections: Shafer's Model (where all intersections are empty), Hybrid Model (where some intersections are empty, while others are non-empty), and Free Model (where all intersections are non-empty).

We now introduce a fourth category, called *Indeterminate Model* (where at least one intersection is indeterminate/unknown, and in general at least one element of the fusion space is indeterminate). We do this because in practical problems we don't always know if an intersection is empty or nonempty. As we still have to solve the problem in the real time, we have to work with what we have, i.e. with indeterminate models.

The *indeterminate intersection* cannot be refined (because not knowing if $A \cap B$ is empty or nonempty, we'd get two different refinements: $\{A, B\}$ when intersection is empty, and $\{A \setminus B, B \setminus A, A \cap B\}$ when intersection is nonempty).

The *percentage of indeterminacy* of a model depends on the number of indeterminate elements and indeterminate masses.

By default: the sources, the masses, the elements, the frames of discernment, the fusion spaces, and the models are supposed determinate.

VI. AN EXAMPLE OF INFORMATION FUSION WITH AN INDETERMINATE MODEL

We present the below example.

Suppose we have two sources, $m_1(.)$ and $m_2(.)$, such that:

	A	B	C	$A \cup B \cup C$	$A \cap B$ = Ind.	$A \cap C$ = ϕ	$B \cap C$ = Ind.
m_1	0.4	0.2	0.3	0.1			
m_2	0.1	0.3	0.2	0.4			
m_{12}	.21	.17	.20	.04	.14	.11	.13

Table 1

Applying the conjunction rule to m_1 and m_2 we get $m_{12}(.)$ as shown in Table 1.

The frame of discernment is $\Theta = \{A, B, C\}$. We know that $A \cap C$ is empty, but we don't know the other two intersections: we note them as $A \cap B$ = *ind.* and $B \cap C$ = *ind,.* where *ind.* means indeterminate.

Using the Conjunctive Rule to fusion m_1 and m_2, we get $m_{12}(.)$:

$$\forall A \in S^{\Theta} \setminus \phi, m_{12}(A) = \sum_{\substack{X,Y \in S^{\Theta} \\ A = X \cap Y}} m_1(X) m_2(Y) . \quad (13)$$

Whence: $m_{12}(A)=0.21$, $m_{12}(B)=0.17$, $m_{12}(C)=0.20$, $m_{12}(A \cup B \cup C)=0.04$, and for the intersections:

$m_{12}(A \cap B)=0.14$, $m_{12}(A \cap C)=0.11$, $m_{12}(B \cap C)=0.13$.

We then use the *PCR5* fusion rule style to redistribute the masses of these three intersections. We recall *PCR5* for two sources:

$$\forall A \in S^{\Theta} \setminus \phi,$$
$$m_{12PCR5}(A) = m_{12}(A) + \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A = \phi}} \left[\frac{m_1(A)^2 m_2(X)}{m_1(A) + m_2(X)} + \frac{m_2(A)^2 m_1(X)}{m_2(A) + m_1(X)}\right] \quad (14)$$

a) $m_{12}(A \cap C)=0.11$ is redistributed back to A and C because $A \cap C = \phi$, according to the PCR5 style.

Let $\alpha 1$ and $\alpha 2$ be the parts of mass *0.11* redistributed back to *A*, and $\gamma 1$ and $\gamma 2$ be the parts of mass *0.11* redistributed back to *C*.
We have the following proportionalizations:

$$\frac{\alpha 1}{0.4} = \frac{\gamma 1}{0.2} = \frac{0.4 \cdot 0.2}{0.4 + 0.2} = 0.133333,$$

whence $\alpha 1 = 0.4(0.133333) \approx 0.053333$
and $\gamma 1 = 0.2(0.13333) \approx 0.026667$.
Similarly:

$$\frac{\alpha 2}{0.1} = \frac{\gamma 2}{0.3} = \frac{0.1 \cdot 0.3}{0.1 + 0.3} = 0.075,$$

whence $\alpha 2 = 0.1(0.075) = 0.0075$
and $\gamma 2 = 0.3(0.075) = 0.0225$.
Therefore the mass of *A*, which can also be noted as *T(A)* in a neutrosophic mass form, receives from 0.11 back:
$\alpha 1 + \alpha 2 = 0.053333+0.0075 = 0.060833$,
while the mass of *C*, or *T(C)* in a neutrosophic form, receives from 0.11 back:
$\gamma 1 + \gamma 2 = 0.026667+0.0225= 0.049167$.
We verify our calculations: 0.060833+0.049167=0.11.

b) $m_{12}(A \cap B)=0.14$ is redistributed back to the indeterminate parts of the masses of *A* and *B* respectively, namely *I(A)* and *I(B)* as noted in the neutrosophic mass form, because $A \cap B$=*Ind.* We follow the same PCR5 style as done in classical PCR5 for empty intersections (as above).

Let $\alpha 3$ and $\alpha 4$ be the parts of mass *0.14* redistributed back to *I(A)*, and $\beta 1$ and $\beta 2$ be the parts of mass *0.14* redistributed back to *I(B)*.
We have the following proportionalizations:

$$\frac{\alpha 3}{0.4} = \frac{\beta 1}{0.3} = \frac{0.4 \cdot 0.3}{0.4 + 0.3} = 0.171429,$$

whence $\alpha 3 = 0.4(0.171429) \approx 0.068572$
and $\beta 1 = 0.3(0.171429) \approx 0.051428$.
Similarly:

$$\frac{\alpha 4}{0.1} = \frac{\beta 2}{0.2} = \frac{0.1 \cdot 0.2}{0.1 + 0.2} = 0.066667$$

whence $\alpha 4 = 0.1(0.066667) \approx 0.006667$
and $\beta 2 = 0.2(0.066667) \approx 0.013333$.

Therefore, the indeterminate mass of *A*, *I(A)* receives from 0.14 back:

$\alpha 3 + \alpha 4 = 0.068572+0.006667=0.075239$

and the indeterminate mass of *B*, *I(B)*, receives from 0.14 back:

$\beta 1 + \beta 2 = 0.051428 + 0.013333 = 0.064761.$

c) Analougously, $m_{12}(B \cap C) = 0.13$ is redistributed back to the indeterminate parts of the masses of *B* and *C* respectively, namely *I(B)* and *I(C)* as noted in the neutrosophic mass form, because $B \cap C = Ind.$ also following the PCR5 style. Whence *I(B)* gets back 0.065 and *I(C)* also gets back 0.065.

Finally we sum all results obtained from firstly using the Conjunctive Rule [Table 1] and secondly redistributing the intersections masses with PCR5 [sections a), b), and c) from above]:

	T(A)	T(B)	T(C)	T(Θ)	I(A)	I(B)	I(C)
m_{12}	.21	.17	.20	.04			
addi- tions	.0075 .053 333		.022 5 .026 667		.068 572 .006 667	.051 428 .013 333 .02 .045	.04 .045
$m_{12PCR5I}$	.270 833	.17	.249 167	.04	.075 239	.129 761	.065

Table 2

where $\Theta = A \cup B \cup C$ is the total ignorance.

VII. BELIEF, DISBELIEF, AND UNCERTAINTY

In classical fusion theory there exist the following functions:

Belief in *A* with respect to the bba *m(.)* is:

$$Bel(A) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \subseteq A}} m(X) \tag{15}$$

Disbelief in *A* with respect to the bba *m(.)* is:

$$Dis(A) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A = \phi}} m(X) \tag{16}$$

Uncertainty in *A* with respect to the bba *m(.)* is:

$$U(A) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A \neq \phi \\ X \cap C(A) \neq \phi}} m(X), \tag{17}$$

where *C(A)* is the complement of A with respect to the total ignorance Θ.

Plausability of *A* with respect to the bba *m(.)* is:

$$Pl(A) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A \neq \phi}} m(X) \tag{18}$$

VIII. NEUTROSOPHIC BELIEF, NEUTROSOPHIC DISBELIEF, AND NEUTROSOPHIC UNDECIDABILITY

Let's consider a neutrosophic mass $m_n(.)$ as defined in formulas (7) and (8), $m_n(X) = (T(X), I(X), F(X))$ for all $X \in S^{\Theta}$.

We extend formulas (15)-(18) from *m(.)* to $m_n(.)$:

Neutrosophic Belief in *A* with respect to the nbba $m_n(.)$ is:

$$NeutBel(A) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \subseteq A}} T(X) + \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A = \phi}} F(X) \tag{19}$$

Neutrosophic Disbelief in *A* with respect to the nbba $m_n(.)$ is:

$$NeutDis(A) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A = \phi}} T(X) + \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \subseteq A}} F(X) \tag{20}$$

Neutrosophic Uncertainty in *A* with respect to the nbba $m_n(.)$ is

$$NeutU(A) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A \neq \phi \\ X \cap C(A) \neq \phi}} T(X) + \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A \neq \phi \\ X \cap C(A) \neq \phi}} F(X) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A \neq \phi \\ X \cap C(A) \neq \phi}} [T(X) + F(X)] \tag{21}$$

We now introduce the **Neutrosophic Global Indeterminacy in *A*** with respect to the nbba $m_n(.)$ as a sum of local indeterminacies of the elements included in *A*:

$$NeutGlobInd(A) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \subseteq A}} I(X) \tag{22}$$

And afterwards we define another function called **Neutrosophic Undecidability about *A*** with respect to the nbba $m_n(.)$:

$$NeutUnd(A) = NeutU(A) + NeutGlobInd(A) \tag{23}$$

or

$$NeutUnd(A) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A \neq \phi \\ X \cap C(A) \neq \phi}} [T(X) + F(X)] + \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \subseteq A}} I(X) \tag{24}$$

Neutrosophic Plausability of A with respect to the nbba $m_n(.)$ is:

$$NeutPl(A) = \sum_{\substack{X \in S^{\Theta} \setminus \{\phi\} \\ X \cap A \neq \phi}} T(X) + \sum_{\substack{Y \in S^{\Theta} \setminus \{\phi\} \\ C(Y) \cap A \neq \phi}} F(Y) \tag{25}$$

In the previous example let's compute *NeutBel(.)*, *NeutDis(.)*, and *NeutUnd(.)*:

	A	*B*	*C*	$A \cup B \cup C$
NeutBel	*0.270833*	*0.17*	*0.249167*	*0.73*
NeutDis	*0.419167*	*0.52*	*0.440833*	*0*
NeutGlobInd	*0.115239*	*0.169761*	*0.105*	*0*
Total	*0.805239* ≠ *1*	*0.859761* ≠ *1*	*0.795* ≠ *1*	*0.73* ≠ *1*

Table 3

As we see, for indeterminate model we cannot use the intuitionistic fuzzy set or intuitionistic fuzzy logic since the sum *NeutBel(X)+NeutDis(X)+NeutGlobInd(X)* is less than 1. In this case we use the neutrosophic set or logic which can deal with incomplete information.
The sum is less than 1 because there is missing information (we don't know if some intersections are empty or not).

For example:
NeutBel(A)+NeutDis(A)+NeutGlobInd(A)=0.805239 =1-I(B)-I(C).
Similarly,
NeutBel(B)+NeutDis(B)+NeutGlobInd(B)=0.859761 =1-I(A)-I(C).
NeutBel(C)+NeutDis(C)+NeutGlobInd(C)=0.795 =1-I(A)-I(B)
and
NeutBel($A \cup B \cup C$)+*NeutDis*($A \cup B \cup C$)+*NeutGlobInd*($A \cup B \cup C$)*=0.73=1-I(A)-I(B)-I(C).*

IX. Neutrosophic dynamic fusion

A Neutrosophic Dynamic Fusion is a dynamic fusion where some indeterminacy occurs: with respect to the mass or with respect to some elements.

The solution of the above indeterminate model which has missing information, using the neutrosophic set, is consistent in the classical dynamic fusion in the case we receive part (or total) of the missing information.

In the above example, let's say we find out later in the fusion process that $A \cap B = \phi$. That means that the mass of indeterminacy of *A, I(A)=0.075239*, is transferred to *A*, and the masses of indeterminacy of *B* (resulted from $A \cap B$ only) - i.e. *0.051428* and *0.13333* - are transferred to *B*. We get:

	A	B	C	Θ	I(A)	I(B)	I(C)	$A\cap B$	$A\cap C$
m	.270833	.17	.249167	.04	0	.065	.065	0	0
+	.075239	.051428 .013333							
m_N	.346072	.234761	.249167	.04	0	.065	.065	0	0

Table 4

where $\Theta = A \cup B \cup C$ is the total ignorance.

The sum *NeutBel(X)+NeutDis(X)+NeutBlogInd(X)* increases towards 1, as indeterminacy *I(X)* decreases towards 0, and reciprocally.

When we have complete information we get *NeutBel(X)+NeutDis(X)+NeutGlobInd(X)=1* and in this case we have an intuitionistic fuzzy set, which is a particular case of the neutrosophic set.

Let's suppose once more, considering the neutrosophic dynamic fusion, that afterwards we find out that $B \cap C \neq \phi$. Then, from *Table 4* the masses of indeterminacies of *B, I(B)* (0.065 = 0.02 + 0.045, resulted from $B \cap C$ which was considered indeterminate at the beginning of the neutrosophic dynamic fusion), and that of *C, I(C)=0.065*, go now to $B \cap C$. Thus, we get:

	A	B	C	Θ	I(A)	I(B)	I(C)	$A\cap B$	$A\cap C$	$B\cap C$
m_N	.346072	.234761	.249167	.04	0	.065	.065	0	0	0
-/+						-.065	-.065			+.065 +.065
m_{NN}	.346072	.234761	.249167	.04	0	0	0	0	0	.13

Table 5

X. More redistribution versions for indeterminate intersections of determinate elements

Besides *PCR5*, it is also possible to employ other fusion rules for the redistribution, such as follows:

a. For the masses of the empty intersections we can use *PCR1-PCR4, URR, PURR, Dempster's Rule*, etc. (in general any fusion rule that first uses the conjunctive rule, and then a redistribution of the masses of empty intersections).
b. For the masses of the indeterminate intersections we can use *DSm Hybrid (DSmH)* rule to transfer the mass $m_{12}(X \cap Y = ind.)$ to $X \cup Y$, since $X \cup Y$ is a kind of uncertainty related to X, Y. In our opinion, a better approach in this case would be to redistributing the empty intersection masses using the *PCR5* and the indeterminate intersection masses using the *DSmH*, so we can combine two fusion rules into one:

Let $m_1(.)$ and $m_2(.)$ be two masses. Then:

$$m_{12PCR5/DSmH}(A) = \sum_{\substack{X,Y\in S^{\Theta}\setminus\{\phi\} \\ X\cap Y=A}} m_1(X)m_2(Y)$$

$$+ \sum_{\substack{X\in S^{\Theta}\setminus\{\phi\} \\ X\cap A=\phi}} [\frac{m_1(A)^2 m_2(X)}{m_1(A)+m_2(X)} + \frac{m_2(A)^2 m_1(X)}{m_2(A)+m_1(X)}]$$

$$+ \sum_{\substack{X,Y\in S^{\Theta}\setminus\{\phi\} \\ X\cap Y=ind. \\ X\cup Y=A}} m_1(X)m_2(Y)$$

$$= \sum_{\substack{X,Y\in S^{\Theta}\setminus\{\phi\} \\ \{X\cap Y=A\}\vee\{(X\cap Y=ind.)\wedge(X\cup Y=A)\}}} m_1(X)m_2(Y)$$

$$+ \sum_{\substack{X\in S^{\Theta}\setminus\{\phi\} \\ X\cap A=\phi}} [\frac{m_1(A)^2 m_2(X)}{m_1(A)+m_2(X)} + \frac{m_2(A)^2 m_1(X)}{m_2(A)+m_1(X)}]$$

(26)

Yet, the best approach, for an indeterminate intersection resulted from the combination of two classical masses $m_1(.)$ and $m_2(.)$ defined on a determinate frame of discernment, is the first one:

- Use the *PCR5* to combine the two sources: formula (14).
- Use the *PCR5-ind* [adjusted from classical *PCR5* formula (14)] in order to compute the indeterminacies of each element involved in indeterminate intersections :

$$\forall A\in S^{\Theta}\setminus\phi,$$

$$m_{12PCR5Ind}(I(A)) = \sum_{\substack{X\in S^{\Theta}\setminus\{\phi\} \\ X\cap A=ind.}} [\frac{m_1(A)^2 m_2(X)}{m_1(A)+m_2(X)} + \frac{m_2(A)^2 m_1(X)}{m_2(A)+m_1(X)}]$$

(27)

- Compute *NeutBel(.), NeutDis(.), NeutGlobInd(.)* of each element.

CONCLUSION

In this paper we introduced for the first time the notions of indeterminate mass (bba), indeterminate element, indeterminate intersection, and so on. We gave an example of neutrosophic dynamic fusion using two classical masses, defined on a determinate frame of discernment, but having indeterminate intersections in the super-power set S^{Θ} (the fusion space). We adjusted several classical fusion rules (*PCR5* and *DSmH*) to work for indeterminate intersections instead of empty intersections.

Then we extended the classical *Bel(.), Dis(.)* {also called *Dou(.)*, i.e Dough} and the uncertainty *U(.)* functions to their respectively neutrosophic correspondent functions that use the neutrosophic masses, i.e. to the *NeutBel(.), NeutDis(.), NeutU(.)* and to the undecidability function *NeutUnd(.)* . We have also introduced the Neutrosophic Global Indeterminacy function, *NeutGlobInd(.)*, which together with *NeutU(.)* form the Neut*Und(.)* function.

In our first example the mass of $A\cap B$ is determined (it is equal to *0.14*), but the element $A\cap B$ is indeterminate (we don't know if it empty or not).

But there are cases when the element is determinate (let's say a suspect John), but its mass could be indeterminate as given by a source of information {for example $m_n(John) = (0.4, 0.1, 0.2)$, i.e. there is some mass indeterminacy: $I(John) = 0.2 > 0$}.

These are the distinctions between the indeterminacy of an element, and the indeterminacy of a mass.

ACKNOWLEDGMENT

The author would like to thank Dr. Jean Dezert for his comments related to the indeterminate models from our Fall 2011 email correspondence.

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Motto: ”The science wouldn’t be so good today,
if yesterday we hadn’t thought about today”
Grigore C. Moisil

ECCENTRICITY,
SPACE BENDING, DIMMENSION

Marian Niţu, Florentin Smarandache, Mircea Eugen Şelariu

0.1. ABSTRACT

This work’s central idea is to present new transformations, previously non-existent in Ordinary mathematics, named centric mathematics (CM) but that became possible due to new born eccentric mathematics, and, implicit, to supermathematics.

As shown in this work, the new geometric transformations, named conversion or transfiguration, wipes the boundaries between discrete and continuous geometric forms, showing that the first ones are also continuous, being just apparently discontinuous.

0.2 ABBREVIATIONS AND ANNOTATIONS

**C → Circular and Centric, E→ Eccentric and Eccentrics, F→Function, M→Mathematics,
Circular Eccentric →CE, FCE →FCE, centric M →CM, eccentric M → EM,
Super M →SM, F CM →FCM, F EM→FEM, F SM → FSM**

1. INTRODUCTION: CONVERSION or TRANSFIGURATION

In linguistics a **word** is the fundamental unit to communicate a meaning. It can be composed by one or more morphemes. Usually, a word is composed by a basic part, named root, where one can attach affixes. To define some concepts and to express the domain where they are available, sometimes more words are needed; two, in our case.

SUPERMATHEMATICAL CONVERSION

The concept is the easiest and methodical idea which reflect a finite of one or more/(a series)of attributes where these attributes are essentials.

The concept is a minimal coherent and usable information, relative to an object, action, property or a defined event.

According the Explicatory Dictionary, **THE CONVERSION** is, among many other definitions / meanings, defined as “ changing the nature of an object”. Next, we will talk about this thing, about transforming / changing / converting, previously impossible in the ordinary classic mathematics, now named also **CENTRIC (CM)**, of some forms in others, and that became possible due to the new born mathematics, named **ECCENTRIC (EM)** and to the new built-in mathematical complements, named temporarily also **SUPERMATHEMATICS**

(SM). We talk about the conversion of a circle into a square, of a sphere into a cube, of a circle into a triangle, of a cone into a pyramid, of a cylinder into a prism, of a circular torus in section and shape into a square torus in section and/or form, etc. (**Fig. 1**).

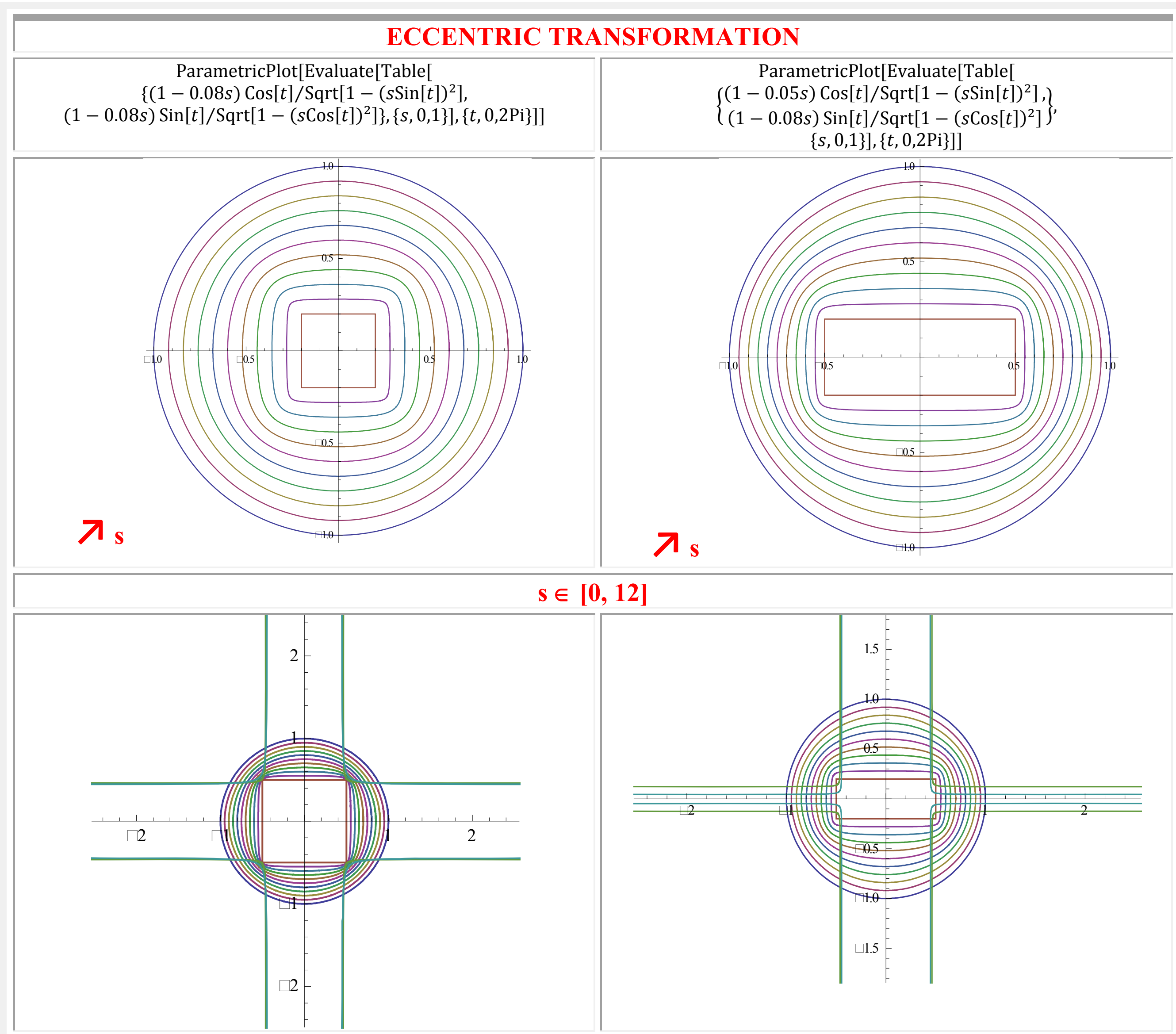

Fig.1,a Conversion or transfiguration in **2D**
of a circle into a square and/or into a rectangle → ECCENTRIC TRANSFORMATION

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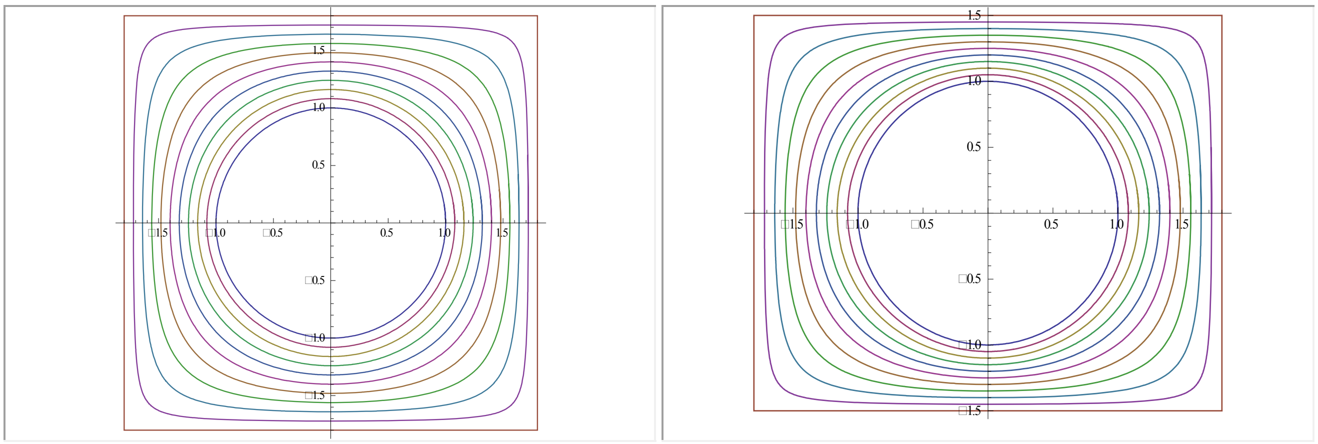
SUPERMATHEMATICAL CONVERSION (SMC) is an internal pry for the mathematical dictionary enrichment, which consist in building-up of a new denomination, with one or more new terms, two in our case, by assimilating some words from the current language in a specialized domain, as Mathematics, with the intention to name, adequate, the new operations that became possible only due to the new born eccentric mathematics, and implicit, to supermathematics. Because previously mentioned conversions could not be made until today, in **MC**, but only in **SM**, we need to call them **SUPERMATHEMATICAL conversion** (SMC)

In [14] work, the continuous transformation of a circle into a square was named also **eccentric transformation**, because, in that case, the linear numeric eccentricity s varies/grows from 0 to 1, being a slide from centric mathematics domain **MC** → s = 0 to the eccentric mathematics, **ME** (s ≠ 0) → s ∈ (0, 1] where the circular form draws away more and more from the circular form until reach a perfect square (s = ± 1).

CENTERING TRANSFORMATION

ParametricPlot[Evaluate[Table[{(1 + 0.08s) Cos[t]/Sqrt[1 − (sSin[t])^2], (1 + 0.08s) Sin[t]/Sqrt[1 − (sCos[t])^2]}, {s, 0,1}], {t, 0,2.05Pi}]]	ParametricPlot[Evaluate[Table[{(1 + 0.08s) Cos[t]/Sqrt[1 − (sSin[t])^2], (1 + 0.05s) Sin[t]/Sqrt[1 − (sCos[t])^2]}, {s, 0,1}], {t, 0,2.05Pi}]]



s ∈ [0, 12]

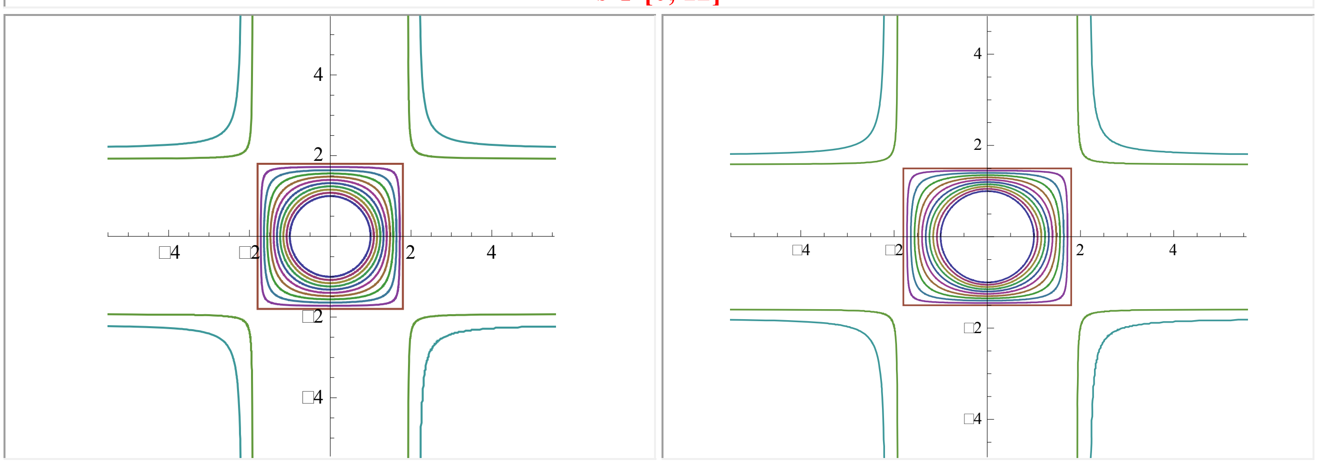
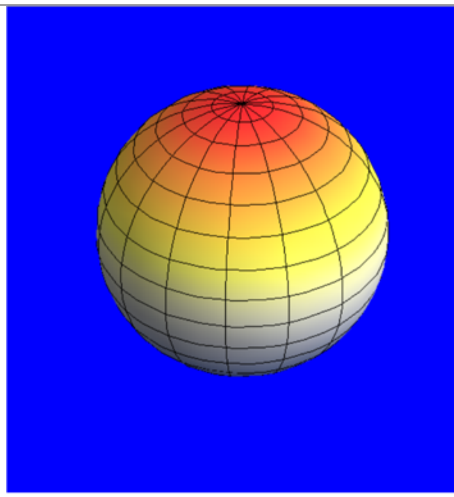
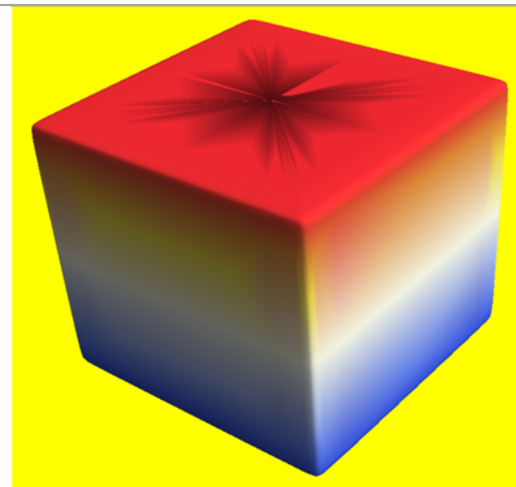
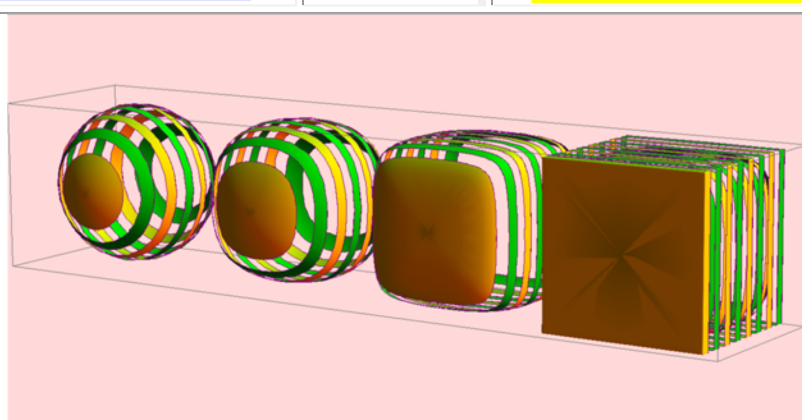


Fig.1,b Conversion or transfiguration in 2D **of a square and/or a rectangle into a circle**
→ CENTERING TRANSFORMATION

In the same work, the reverse transformation, of a square into a circle, was named as **centering transformation**, by easy to understand means. Same remarks are valid also for transforming a circle into a rectangle and a rectangle into a circle (Fig. **1**).

Most modern physicists and mathematicians consider that the numbers represent the reality's language. The truth is that the forms are those who generate all physical laws.

$S(s = 0, \varepsilon = 0), R = 1$		$S(s = \pm 1, \varepsilon = 0), R = 1$
ParametricPlot3D[{Cos[u]Cos[v], Sin[u]Cos[v], Sin[v]}, {u, 0,2Pi}, {v, $-$Pi/2, Pi/2}]		ParametricPlot3D[{{Cos[t] Cos[u]/(Sqrt[1 − (Sin[t])^2] Sqrt[1 − (Sin[u])^2]) Sin[t] Cos[u]/(Sqrt[1 − $(\text{Cos}[t])^2$]Sqrt[1 − $(\text{Sin}[u])^2$]), Sin[u]/Sqrt[1 − (Cos[u])^2]}}, {t, 0,2Pi}, {u, −Pi, Pi}]
	**CSM** **S→C**	



s = 0 ▲ 0,4 ▲ 0,7 ▲ ▲ ε = 0

Fig.2,a The conversion of a **sphere** into a **cube**

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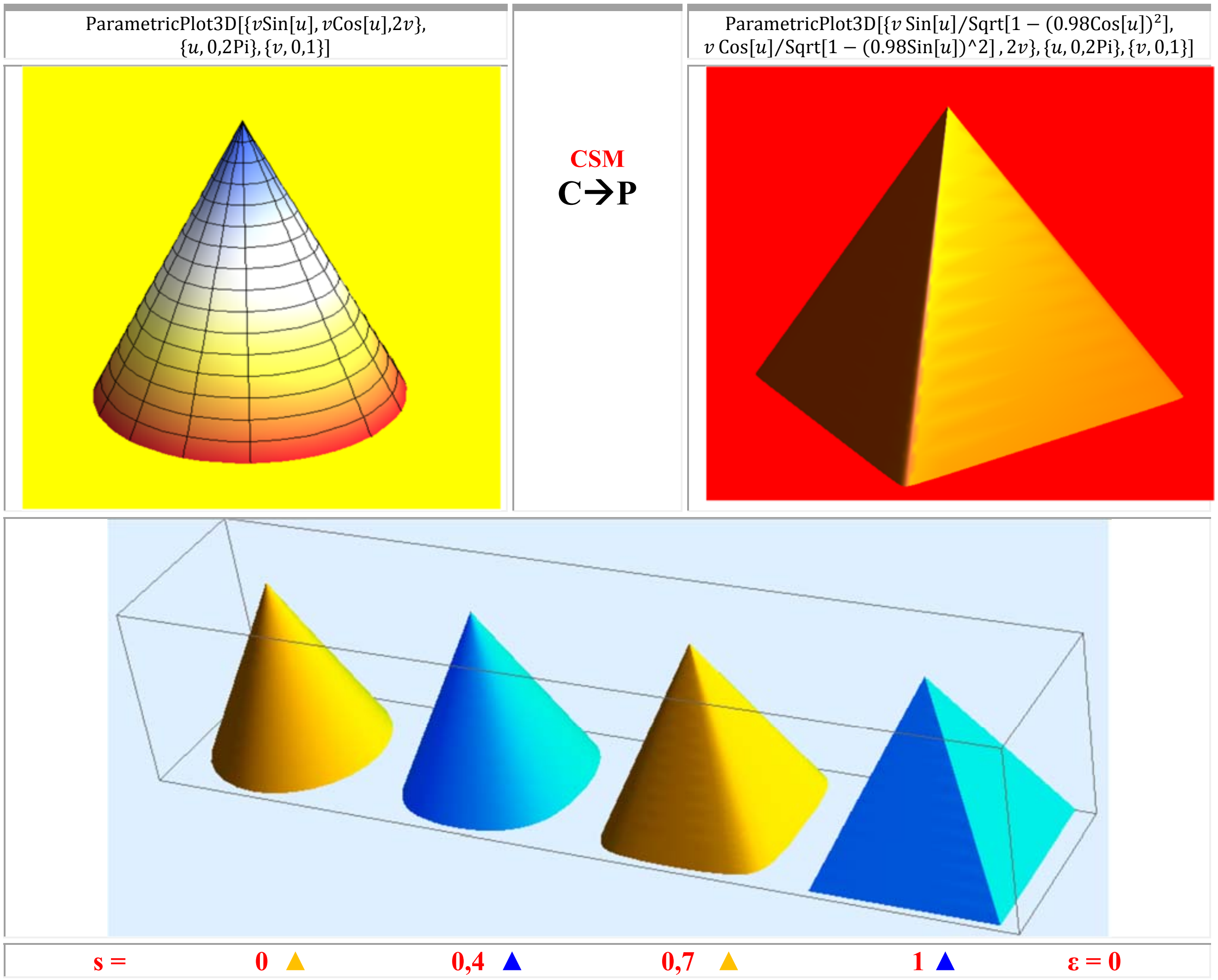

Fig.2,b The Conversion of a cone into a pyramid

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Look what the famous Romanian physicist **Prof. Dr. Fiz. Liviu Sofonea** in "**REPRESENTATIVE GEOMETRIES AND PHYSICAL THEORIES"**, Ed. Dacia, Cluj-Napoca, p. 24, in 1984, in the chapter named "**MATHEMATICAL GEOMETRY AND PHYSICAL GEOMETRY"** wrote:

"Trough ***geometrization*** we look for (deliberately and by sui generis) exactly the ordering directions (detailed, fundamentals, even the supreme, the *unique-unifier*) thinking about the pre-established (relating to physical theory undertaking) from the "geometrical worlds" built and moved after disciplined canons in *more geometrical* style (logical derivability and structure, geometrically proved, where it's done), an extension with the purpose if "it works" also "*physically*", and as we see that we have reasons to say "it really works", we bargain on a methodological-operant gain, heuristically, but even gnoseological. But never ***geometrical*** pre-norming cannot be fully functional; it can be only (inherent) partial, limited, often a simple boundary marking, a suggestion, an incitement, a scheme, sometimes too dummy, but we use it like a scaffold, to rise up, as we can, to a more adequate description or even more understanding"

In the **centric mathematical geometry** one is doing what can be done, how can be done, with what can be done, and in **supermathematical geometry** we can do what must be done, with what must be done, as we will proceed.

In the **supermathematical geometry**, between the elements of the "**CM** scaffold", one can introduce as many other constructive elements we want, which will give an infinitely denser scaffold structure, much more durable and, consequently, higher, able to offer an unseen high level and an extremely deep description and gravity.

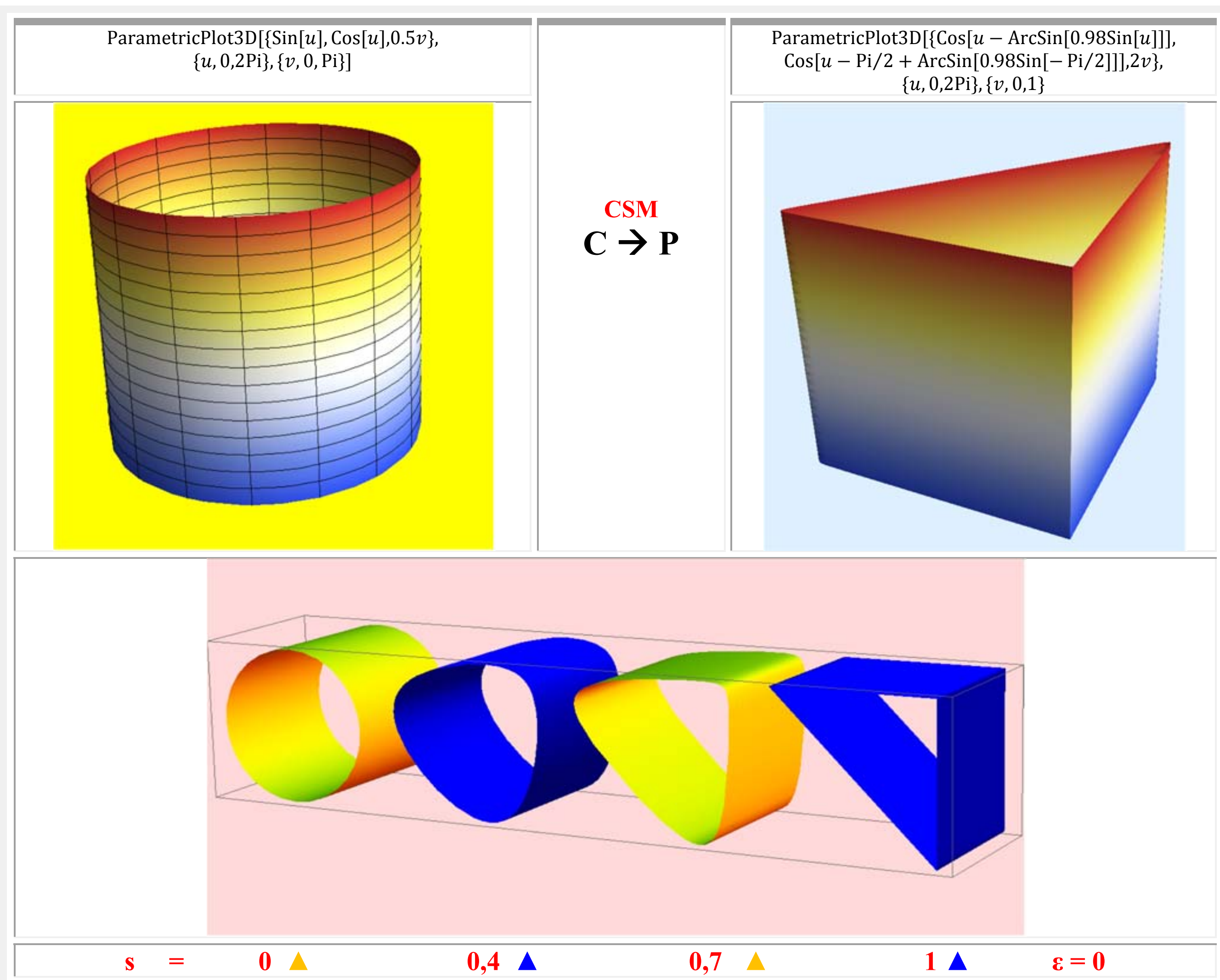

Fig.2,c The Conversion or transfiguration of a **cylinder** into a **prism**

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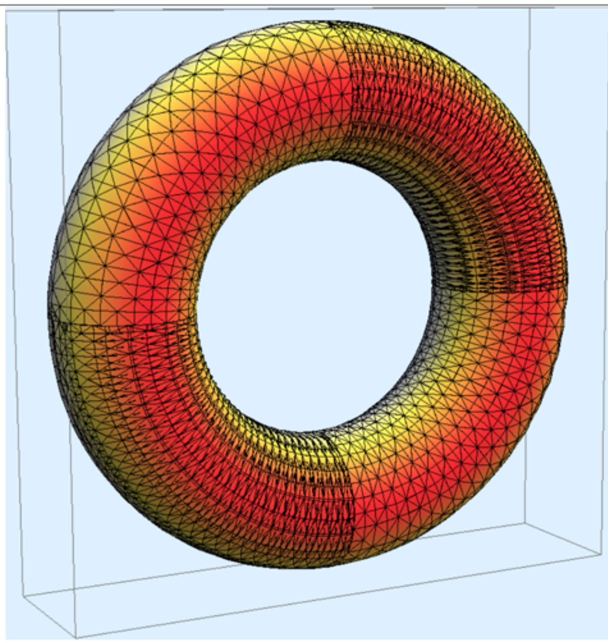
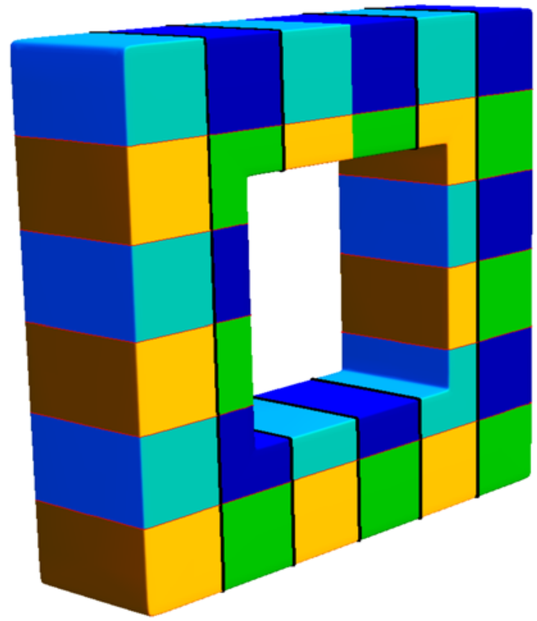
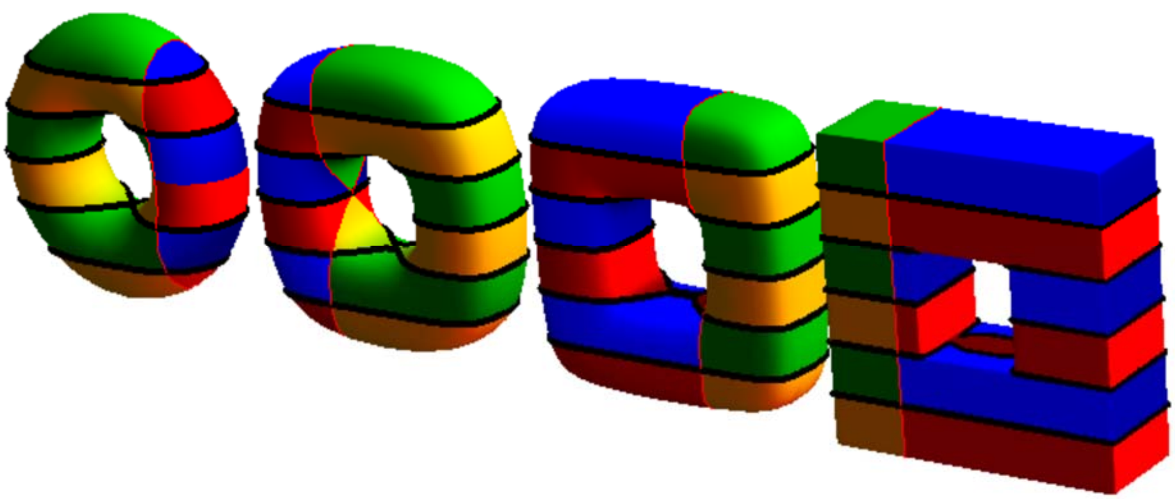
ParametricPlot3D[{(3 + Cos[v])Cos[u], (3 + Cos[v])Sin[u], Sin[v]}, {u, 0,2Pi}, {v, 0,2Pi}	ParametricPlot3D[{ (3 + Cos[v]/Sqrt[1 − (Sin[v])^2]) Cos[u]/Sqrt[1 − (Sin[u])^2], , (3 + Cos[v]/Sqrt[1 − (Sin[v])^2]) Sin[u]/Sqrt[1 − (Cos[u])^2], Sin[v]/Sqrt[1 − (Cos[v])^2]}, {u, 0,2Pi}, {v, 0,2Pi}]
	



s = 0 ▲ **0,4** ▲ **0,7** ▲ **1** ▲ **ε = 0**

Fig.**2,d The conversion** or transfiguration of the **circular thorus** into a **square thorus**, both in form and in section

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The fundamental principles of the geometry are, according their topological dimensions: the **corps** (3) the **line** (2) and the **point** (0)

The elementary principles of geometry are the point, the line, the space, the curve, the plane, geometrical figures (segment, triangle, square, rectangle, rhombus, the polygons, the polyhedrons, etc, the arcs, circle, ellipse, hyperbola, the scroll, the helix, etc.) both in 2D and in 3D spaces.

With the fundamental geometrical elements are defined and built all the forms and geometrical structures of the objects:

- Discrete forms, or discontinuous, statically, directly, starting from a finite set (discrete) of points, statically bonded with lines and planes.
- Continuous forms, or dynamical, mechanical, starting from a single point and considering its motion, therefore the **time,** and obtaining in this way continuous forms of curves, as trajectories of points or curves traces, in the plane (2D) or in the space (3D)

Consequently, one has considered, and still is considering, the existence of two geometries: the geometry of discontinuous, or discrete geometry, and the geometry of the continuum.

As, both the objects limited by plane surfaces (cube, pyramid, prism), apparently discontinuous, as those limited by different kinds of of continuous surfaces (sphere, cone, cylinder) can be described with the same parametric equations, the first ones for numerical eccentricity **s = ± 1** and the last ones for s=0 , it results that in **SM** exists only one geometry, the geometry of the continuum.

In other words, the **SM** erases the boundaries between continueous and discontinuous, as **SM** erased the boundaries between **linear** and **nonlinear**, between **centric** and **eccentric**, between ideal/perfection and real, between circular and hyperbolic, between circular and elliptic, etc.

Between the values of numerical eccentricity of **s=0** and **s = ±1,** exists an infinity of values, and for each value, an infinity of geometrical objects, which, all of them, has the right to a geometrical existence.

If the geometrical mathematical objects for s ∈ [**0** ∨ ±1] belongs to **the centric ordinary mathematics (CM)** (circle→ square, sphere→ cube, cylinder→ prism, etc.), those for s ∈ (**0** , ±1) has forms, equations and denominations unknown in this **centric mathematics (CM)**

They belongs to the new mathematics, the **eccentric mathematics (EM)**, and, implicit, to the **supermathematics (SM)** which is a reunion of the two mathematics: **centric** and **eccentric**, that means **SM** = **MC** ∪ **ME**

By erasing the boundaries between centric and eccentric, the **SM** implicitly dissolved the boundaries between **linear** and **nonlinear**, the linear being the appanage of **CM** and the nonlinear of the **EM** one, and introduced a disjunction between the centric geometrical entities and the eccentric ones. By this way, all the entities of **centric mathematics** in 2 D was named **centrics** (circular centrics, square centrics, triangular centrics, elliptical centrics, hyperbolic centrics, etc.) and those of **eccentyric mathematics** was named as **eccentrics** (circular eccentrics, elliptic eccentrics, hyperbolic eccentrics, parabolic eccentrics, spiral eccentrics, cycloid eccentrics, etc.).

If the 2D **centric** entities can remain to the actual denominations (circle, square, ellipse, spiral, etc.) at the **eccentric** ones one have to specify also the teh denomination of **eccentrics**. The same thing is available for 3D entities: **the centric** ones (sphere, ellipsoid, cube, paraboloid, etc) can carry, further, the old denominations, and for the new ones, the **eccentric** ones, it is necessary to specify that they are **eccentric**. That means: eccentric sphere, eccentric ellypsoid, eccentric cube, eccentric paraboloid, etc.

With the new SM functions, like eccentric amplitude axe **θ** and Axe α, of eccentric variable **θ** and, respectively, centric α, beta eccentric bex **θ** şi Bex α , radial eccentric rex and REX, eccentric derived dex **θ** and Dex α, etc., which having no equivalents in **centric** / (**CM**), doesn't need other denominations for determining the mathematical domain where they belongs.

By way of exception are the last two **FSM-CE,** rex**α** şi dex**α**, (**θ = α**), to which ones are discovered, later, equivalents in **centrics**: the **centric radial** function **radα,** which is the direction fazor α and the **centric derived derα,** which is the direction fazor $\alpha + \frac{\pi}{2}$, fazors reciprocal perpendiculars.

SUPERMATHEMATICAL HYBRIDIZATION AND METAMORPHOSIS THE CONSEQUENCES OF THE NEW SPACE DIMMENSIONS

The space is an abstract entity which reflects an objective form of matter's existence. It shows like a generalization and abstactization of the parameters assembly through which is achieved the **distinction between different systems** that forms a condition of the Universe.

It is an objective and universal form of matter's existency, inseparable from the matter, which has the aspect of a tri-dimensional continuum and expresses the order of the real world's objects coexistence, their position, distance, size, form and extension.

In conclusion, one can say that the space appears like a synthesis, like a generalization and abstractization of the observations about a condition, in a certain moment, of the Universe.

Within the classical mechanics, the notion of space is that of the tridimensional Euclidian space (E3), homogenous, isotropic, infinite.

When one discuss about the space, the first thought is directed to the position, that means the notion of position is directly associated with that of the notion of space. The **position** is expressed in terms of a reference system, or shortly, by a coordinate system.

A tridimensional object has in the E^3 6 variances, made of the 3 translations, on **X**, Y and Z directions and of the **3 rotations,** around the axis **X**, Y and Z, noted, respectively, by **θ, φ, ψ** in Mathematics and in Mechanics and with **A, B** and **C** in technology and in robotics.

An object can be "created", or more specifically, its image can be reproduced in the virtual space, when appears in the 3D space, on the display of a computer, by using some technical programs (CAD) or commercial mathematical programs (MATHEMATICA, MATLAB, MATHCAD, MAPLE, DERIVE, etc.), or special ones, which use **Eccentric-FSM, Elevated** and/or **Exotic -** for objects describing, as at **SM-CAD-CAM**.

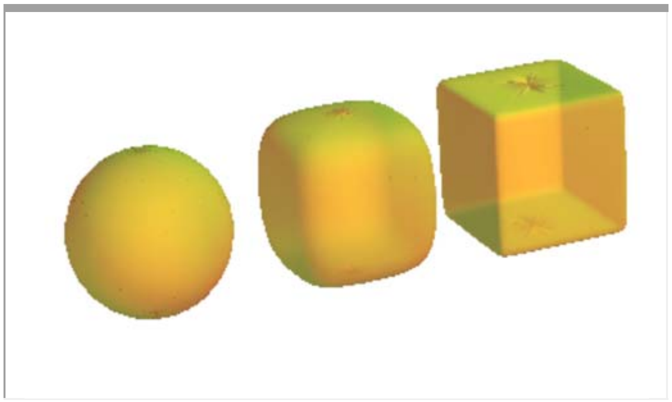
By modifying the eccentricity, the known and formed objects in the centric domain of the supermathematics (**SM**), that means, in centric mathematics (**MC**), can be deformed in the eccentric domain of the **SM,** therefore, in the eccentric mathematics (**ME**) and transformed, initially, in hybrid objects, proper to **ME**, and after that, to be re-transformed in other kind of objects, known in **MC.** As an example, by deforming a perfect **cone** (s = 0) into a **cono-pyramid** [**s** ∈ (0, 1)] with the base a perfect square and conical tip, which constitutes hybrid objects, placed between a cone and a pyramid, up to transforming it into a perfect **pyramid** (**s** = ± 1) with a perfect square base (Fig 3). In the fact, the object can be achieved by different machine works (see **Mircea Şelariu**, Chap.17, **Dispozitive de prelucrare**, PROIECTAREA DISPOZITIVELOR, EDP, Bucureşti, 1982, coordinator **Sanda-Vasii Roşculeţ**], by forming, (casting, sintering), deforming (at worm and cold), dislocation (cutting, chipping, erosion, grinding) and by aggregation (welding and binding).

In both cases, **movements** of the tool and/or of the piece are needed, respectively, of the bright spot which delimitates a pixel on the screen and passes from a pixel to another.

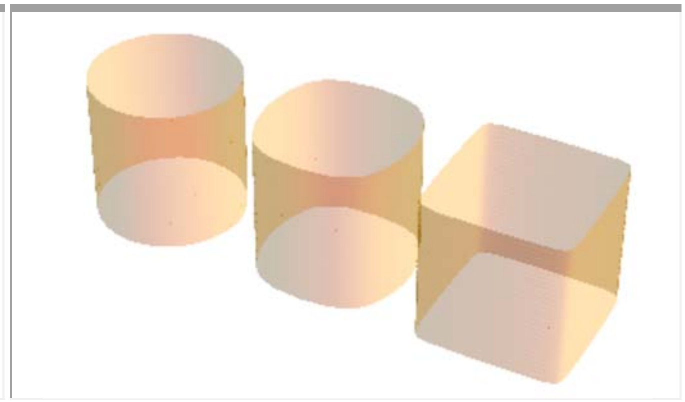
The movement is strongly linked to space and time.

The mechanical movement can be **of the:**

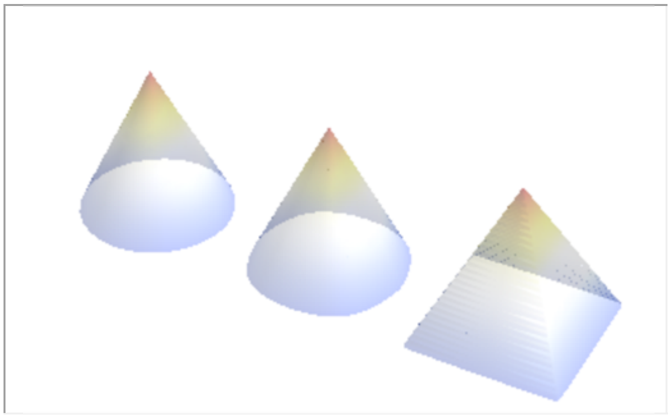
- corps, and implicit, objects **forming** in time ;
- objects **position changing** in time, or of its parts, named corps, in relation to other corps, chosen as referentials.
- corps **form changing** in time, and implicit, of the objects form, by **deforming** them.



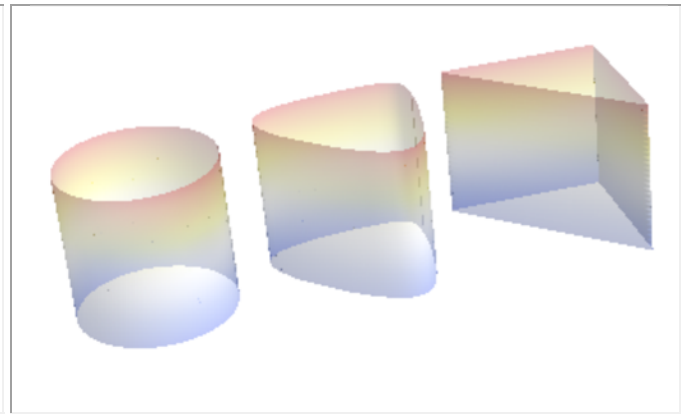
Transforming a sphere into a cube



Transforming a circular cylinder into a square cylinder



Transforming a cone into a pyramid



Transforming a a cylinder into a prism

Fig. 3 Metamorphosis of centric mathematical objects **or mathematical hybridation**

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The Space reflects the coexistence relationship between objects and events, or parts of them, by indicating:

- their **expansion**/bigness, named **gage dimmension**;
- the objects **position**, through **linear coordinates X, Y, Z,** in 3D space, named **localization dimensions;**
- the objects **orientation,** in 3D space, through the **angular coordinates ψ, φ, θ**, or A, B, C, named **orientation dimensions**.
- the relative positions or distances between the objects, named positioning dimensions, if refers to the absolute and/or relative orientation and localization of the objects, and if it refers to parts of them, named corps, then they are named **coordination dimensions**;
- the form of the objects and, respectively, the phenomena evolution, named **forming dimensions**, which defines, at the same time, the objects defining equations;
- the deformation of the objects and phenomena evolution changing, named **dimensions deformation** or **eccentricities.**

- The last space dimension, **eccentricity**, by making possible the apparition of **eccentric mathematics** (**EM**) and by making the pass through from centric mathematics domain to the eccentric mathematics one, as well as the leap from a single mathematical entity, existent in Mathematics and in the **centric** domain, to an infinity of entities, of same kind, but more and more deformed, once the numerical eccentricity value s is growing, up to their transformation in other kind of objects, also existent in the centric domain. An example, became already classical, is the continuous deforming of a sphere until it is transformed into a cube (**Fig. 3**), by using the same **formation dimensions** (parametric equations), both for the sphere and for the cube, by changing only the eccentricity: being **s** = **e** = 0 for the sphere of radius R and **s**= ± 1, or e = R, for the cube of leg L = 2R.
- For **s** ∈ [(-1, 1) \ 0] one obtain **hybrid objects** , proper for eccentric mathematics (**EM**), previously non-existent in mathematics, or, more specific, in Centric Mathematics (**CM**)
- As shown before, the **straight line** is an unidimensional space, and, concurrently, in **Supermathematics (SM), a bent** of zero eccentricity [8].

By increasing the eccentricity, from zero to one, it transforms the straight line into o broken line, both existing and known in **Centric Mathematics**, but not the rest of the bents, which are proper to **Eccentric** Mathematics, being generated by **FSM-CE** eccentric amplitude. In this way, the straight line with angular coefficient $m = \tan\alpha = \tan\frac{\pi}{4} = 1$ which pass through the point P(2, 3) has the equation

(1) $y - 3 = x - 2$,

and the bents family, from the same family with the straight line, has the equation

(2) $y\,[x, S(s, \varepsilon)] - y_0 = m\,\{aex\,[\theta, S(s, \varepsilon)] - x_0\}$,

(3) $y - y_0 = m\{\theta - \arcsin[s.\sin(\theta - \varepsilon)]\} - x_0$, $m = \tan\alpha$,

in eccentric coordinates θ and, in centric coordinates α, the equation is

(4) $y[x, S(s, \varepsilon)] - y_0 = m\,(Aex\,[\theta, S(s, \varepsilon)] - x_0)$,

(5) $y - y_0 = m\,\{\alpha + \arcsin\frac{s.\sin(\alpha - \varepsilon)}{Rex\alpha} - x_0\}$, $m = \tan\alpha$,

(6) $y - y_0 = m\,\{\alpha + \arcsin\frac{s.\sin(\alpha - \varepsilon)}{\sqrt{1 + s^2 - 2s.\cos(\alpha - \varepsilon)}} - x_0\}$.

- The difference, for the two types of bents, of θ and of α, is that the θ ones are continuous only for the numerical eccentricity from the domain s ∈ [-1, 1], while the α ones are continuous for all the values possible for s, it means s ∈ [- ∞ , +∞].
- The broken line in known in Centric Mathematics (**CM**), but without knowing their equations! That in not the case anymore in **SM** and, obviously, in **EM** where it is obtained for the value **s** = 1 of the **numerical eccentricity s**.
- A similar phenomenon of mathematical metamorphosis, through which from **CM** a known object pass through the eccentric mathematics **(EM)** taking hybrid forms and returns in the centric mathematics **(CM) ,** as another type of object (**Fig.3**), is considered to take place also in physics: from vacuum continuously appears particles and they return back into to vacuum. Are they the same or are they other ones?
- The cosmology has a theory which applies to the whole universe, enounced by Einstein in 1916: the General Relativity. It says that the gravitational force, which acts on the objects, acts also on the structure of space, which loses its rigid and immutable frame, becoming flexible and curved, depending of the contained matter or energy. In other words, **the space is deforming**.

  The space-time continuum, of general relativity, is not conceived without a content, so it not admits the vacuum! As Einstein said to the journalists that beg him to resume his theory: "Before, **one believed** that, if all the things would disappear from the Universe, the space and time will still be here, whatever. In the theory of general relativity, the time and space disappears, together with the disappearance of the other things from the Universe."

- As one said before, **s** = **e** = 0 is the world of CM, of the linearity, of perfect, ideal entities, as long as the infinite possible values referable to the eccentrities **s** and **e**, give birth to **EM** and, at the same time, to worlds that belongs to to the reality, to the imperfect world, which are farther of the ideal world as s and e are farther from zero.
- What happens if **e** = s → 0 ? The real world, as **EM** too, disappears, and because an ideal world cannot exist, everything disappears!
- As shown in the author's theory from SUPERMATEMATICA. Fundamente, Vol. I, Editura POLITEHNICA, Timişoara, Cap. 1 INTRODUCERE [23], [24], the expansion of the Universe is a process of developing the order into absolute chaos , a progressive passing-through of the chaotic space in a more and more pronounced order.
- As a conclusion, the space, and also the time, is **forming and deforming**, it means that the space eccentricity, of a certain value, takes to a space **forming**, and then, by modifying its value, the space **deforms**/modifies itself.
- The modified form of the the space is depending on the value of the eccentricity, which becomes o new space dimension: the deformation dimension.

Installing an object for machining in the working space of a modern machine tool, with computer numerical control (CNC) is very similar with "installing" a mathematical object in the R^3 tridimensional Euclidian space. Therefore, we will further use some notions from technological domain.

In technology, **installing** is the operation that precedes machining; only an installed object / piece can be machined. This involves the next phases or technological operations, in this sequence / order; only achieving one phase makes possible to pass to the next phase:

1. **ORIENTATION,** is the action or the operation where the object's geometrical elements, which are orientation technological referential bases, shortly, orientation bases **(OB),** accept a well determined direction, regarding to the directions of a referential. In technology, this is regarding to the main and/or secondary working movements, and/or regarding the directions of dimensional arrangement movements of the technological system.

As **orientation bases (OB)** one can use:

a) A plane of the object, respectively a flat surface of the piece, if it exists; in that case, this surface, determined by three contact points between the object and the device, is named emplacement of orientation technological referential base (**EOB**), or shortly, emplacement base (**EB**), being theoretically determined by the three mutual contact points of the piece with the device, which has the task to achieve the piece installing on the working machine. As **EB**, virtually, the most extended surface of the piece is chosen, if other positioning restrictions are not imposed, or that one from where the resulting surface after machining has the highest imposed precision, or parallelism constraints with **EB**.

By imposing the condition of mutual piece/device contact on **EB**, the object/piece loses 3 degrees of freedom, among them, a translation on the direction, let's name it **Z**, perpendicular on **EB** (a plane) and two rotations: around the **X** axis, noted in technology with **A**, and around the **Y** axis, noted in technology with **B**.

The object/piece can also be rotated around the **Z** axis, rotation noted with C and can be translated on **EB** on **X** and **Y** directions, by permanently keeping contact with **EB**.

From this surface is established, in technology, the **z** coordinate, by example, as a distance between **EOB** and the machining technological base **(MTB)**, or shortly, machining base (**MB**), that means the plane generated on the piece by the machining tool. In a surface is totally machined (by milling, as example, with large milling machines, for a single passage), then the other coordinates y and x can be established with a very large approximation, because they did not influence the plane surface precision achievement, at **z** distance of **EB**, resulted after piece machining and named **MTP** or shortly, MP, whose technological demand is to be parallel to **EOB** and to be located at **z** distance from it.

The **z** dimension, being, in this case, a **forming dimension** of the piece, on the one hand and on the other hand also a **coordinating dimension** for tool/piece relative position, and from technological point of view, one of the **dimensional alignment dimensions** of the technological system **MDPT** (**M**achine-**D**evice-**P**iece-**T**ool). Mathematically speaking, it's about two surfaces situated at **z** distance, it means parallel planes.

b) A straight line belonging to the object, if it exists, as axes on/or edges, as intersection of plane surfaces in Mathematics.

In Technology, the edges are avoided, because their irregularities, in other words because the deviations from semifabricates linear geometrical shape, ond of the pieces too, after machining their semifabricates.

In Technology, this straight line is determined by the two points from a piece surface, other than **EB,** common to the piece and the device, which achieve the piece and device orientation base, as heteronymous elements, a straight line named conducting orientation base (**COB**) or shortly, conducting base (**CB**), name derived from the fact that these two conducting elements, conducts/guides the movement of the object/piece for its localization, if the contact piece/device is permanently maintained during the movement. In this way, the **CB** takes over two degrees of freedom of the object: the translation on a direction perpendicular on the straight line determined by the two contact points between piece/device that materializes **CB**, translation on Y axis, as example, if **CB** is always parallel, with the **EB** from **XOY** pane, and the rotation around **Z** axis, noted in technology with C.

As **COB** is chosen, on principle, it's easy to understand why, by aiming the guiding precision, the longest surface of the piece, if other reasons are not imposed by the execution drawing.

From **COB** can be established/measured the level/dimension y, parallel to **EOB** and perpendicular on **COB**, as example, perpendicular on **z**, because **COB** is parallel with **EOB**.

Therefore, if the two points belongs to a parallelipipedical object, so bounded by plane surfaces, and **COB** is parallel with **EOB**, by maintaining the contact between piece/device on the two bases, by a translation movement, the piece can only be translated, in the device, on **X** direction, until it comes into collision with a **localization element.**

1) from this one, named localization element, namely **localization technological base** (**LTB**), or shortly, **localization base (LB)** can be established the **x** coordinate/dimension perpendicular simultaneously on **y** and **z**. But without being coordinates/dimensions/concurrent segments in a common point **O(x,y,z)** as in mathematics, only if **COB** and **LTB** drops to the level **EOB**, and, in addition, **LTB** moves toward **COB** and will be contained in it, both going to be contained in **EOB**, so the point **O(x, y,z),** as **LTB** will be a tip of the parallelipipedical piece, contained simultaneously in the **EOB** plane, the **CB** straight line in **LB** point, resulting, in this case, that **O(x,y,z) ≡ BL**

If the localization is achieved by a translation movement, as previously assumed, it is also named **translation localization (TL).**

If the localization is achieved through a rotational movement of the object, it is named **rotational localization (RL).** In this case, **CB** can be, or is, usually, a symmetry plane of the piece, by example a cylindrical one, a plane named **semicentering orientation base (SCOB**), in the case of a semicentering, or an axis of a rotational surface (cylindrical or spherical) of the object, named **Centering orientation base (COB)**, around whom the object rotates until another corps of the piece come into collision with the rotation localization element. Or, until a locator gets into a muzzle perpendicular on **COB** or into a channel parallel with **COB**.

The objects which did not bring out **elements/orientation bases**, like the sphere in mathematics or the balls for ball bearings in technology, as example, are non-orientational objects.

1. **LOCALIZATION,** is the operation or the action to establish the place, in E^3 tridimensional Euclidian space, of an O(x,y,z) point, characteristic for the object, which belongs to a orientating referential element

of this one, from which one are established the coordinates/linear dimensions x,y,z regarding a given referential system, or in technology, regarding the machining tool.

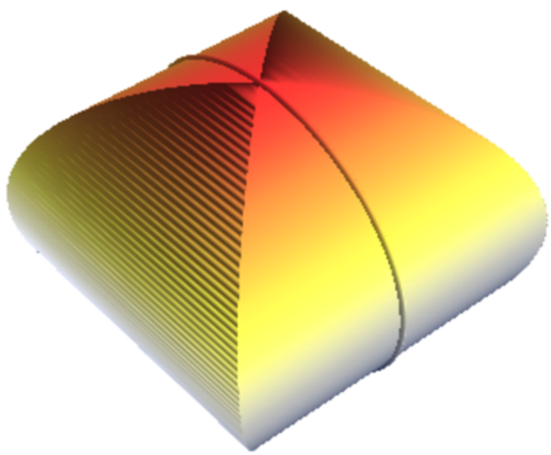
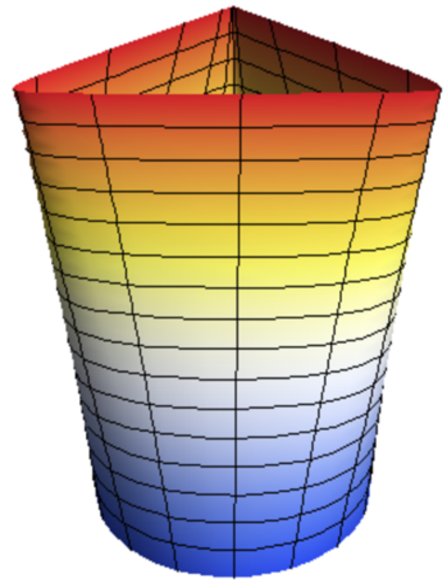
Conopyramid	Cylinder C/S
	
Spherocube	Cylinder C/T

Fig.4 Hybrid mathematical objects

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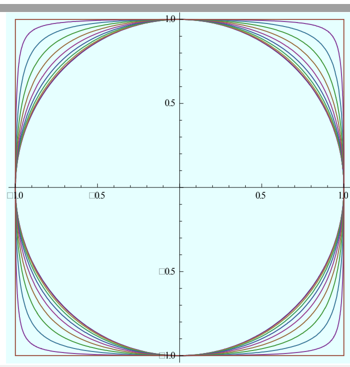
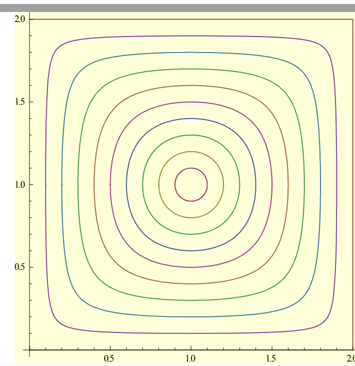
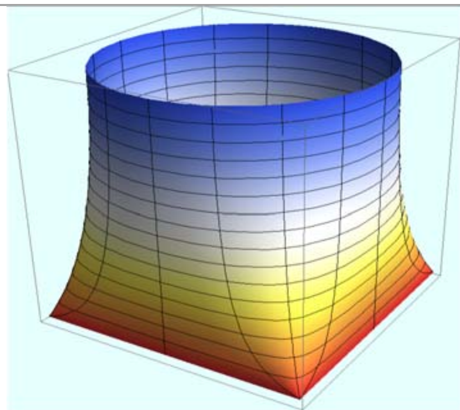
The **O(x,y,z)** point of the **non-orientational** objects is the symmetry center of them, and of the **orientational** objects, like the parallelipipedical ones, in Technology, as example, the **O(x,y,z)** point is disseminated in three distinctive points, for each coordinate apart, **Ox ⊂ LB** for **x** , **Oy ⊂ CB** for **y** şi **Oz ⊂ EB** for **z**, as explained before.
In the Technology, the succession orientation → localization is compulsory; only an oriented object can be then located. Beside this, as in mathematics. First, one chose a reference system unitive with the **O(x,y,z)** object, and after that, an invariant one **(O, X, Y, Z)** which one, initially, coincide with the other one, in 3D space or in the E^3 tridimensional one, and then are operated various translation and/or rotation transformations.
The union between orientation and localization represents the most important technological action/operation, named **positioning,** namely **orientation ∪ localization = positioning**

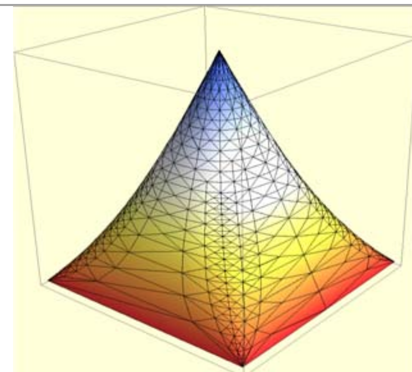
If the object **positioning** is achieved/ finished/ fulfilled, then the relative position piece/device can be maintained by the operation of **anchorage** of the piece in the device.

Further, one can establish the distances/dimensions between the tool and the piece, so one can obtain the piece of dimensions and precisions imposed by the piece work drawing. This technological operation is named **dimensional adjustment**. With this, the installing process is finished, and the machining of the piece can be started





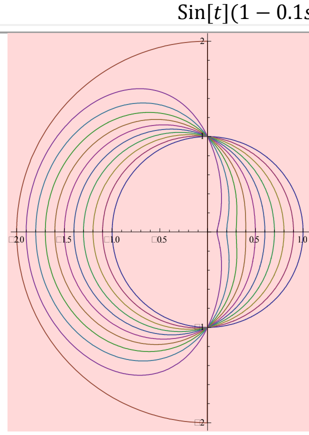


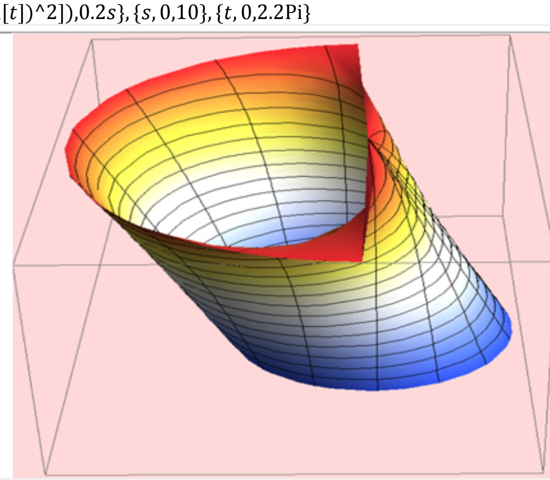


a) $\begin{cases} x = R.coq\theta \\ y = R.siq\theta \\ z = s \end{cases}$, R = u = 1

b) $\begin{cases} x = R.dex\theta \\ y = R.dex(\theta - \frac{\pi}{2}) \\ z = s \end{cases}$

ParametricPlot3D[{Cos[t](1 − 0.1s Cos[t]/Sqrt[1 − (0.1sSin[t])^2]), Sin[t](1 − 0.1s Cos[t]/Sqrt[1 − (0.1sSin[t])^2]),0.2s},{s, 0,10},{t, 0,2.2Pi}





c) $\begin{cases} x = R.dex\theta.cos\theta \\ y = R.dex\theta.sin\theta \\ z = s \end{cases}$, $R = 1$; s∈[0,1]

▲ TRANSFORMING THE CIRCLE **C**$_1$[O$_C$(0, 0), R = 1]] INTO THE SEMI-CIRCLE **SC [O$_{SC}$(-1, 0), R = 2]**

Fig.5 Connected hybrid mathematical objects

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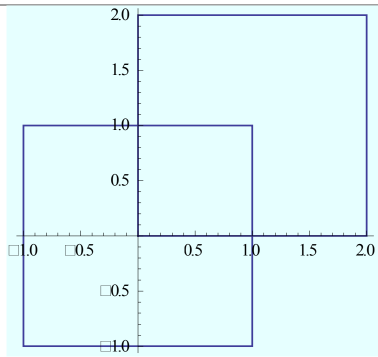
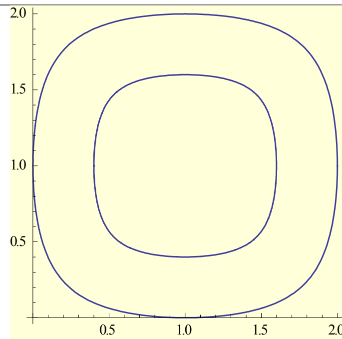
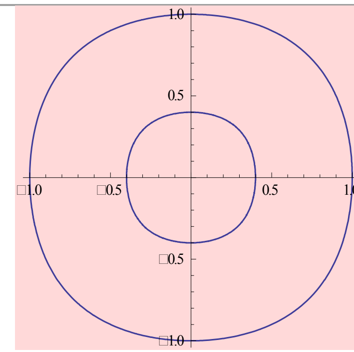
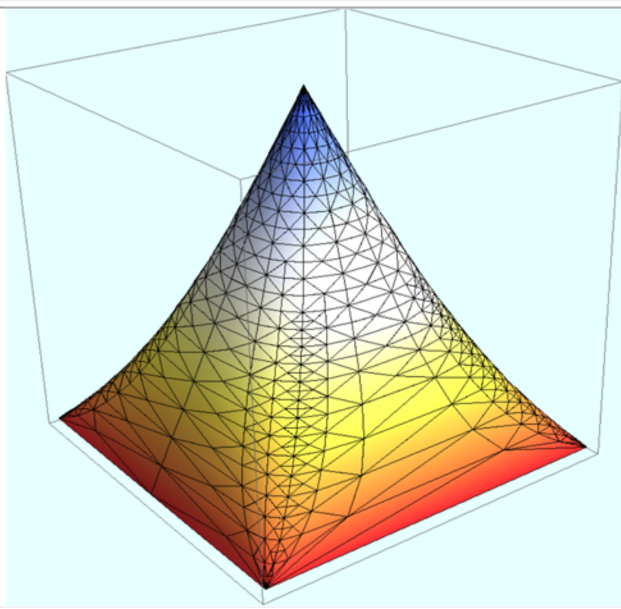
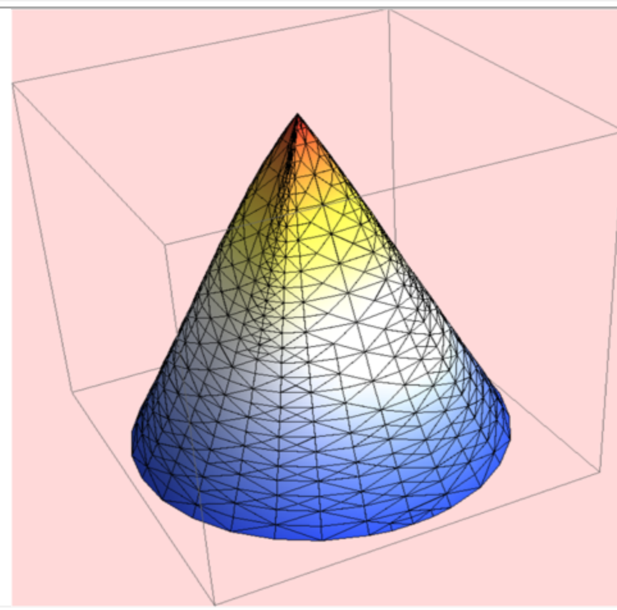
s = 1, $C_1 \neq C_2$	s = 0,8; $C_1 \equiv C_2$ (1,1)	s = 0,6 ; $C_1 \equiv C_2$ (0,0)
		

R = s – 1	R = 1– s
	

PYRAMIDO-CONE ◄ $\begin{cases} x = R.coq\theta \\ y = R.siq\theta, S(s\in[0,1]) \\ z = s \end{cases}$ ► **CONO-PYRAMID**

Fig.**6** The contrasts between **connected hybrid** mathematical objects

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Reductively, installing an object is an union of positioning with anchorage and dimensional adjustment of the technological system, namely:

installing = **pozitioning** ∪ **anchorage** ∪ **adjustment (dimensional)**

In Technology, **the adjustment** can be achieved by (fixing) **force** or by **form** (which blocks the piece displacement during the machining). In Mathematics, the anchorage is "achieved" by **convention.**

By telling that the **(O, x,y,z)** system is linked to the piece, it cannot move anymore relative to the piece, but only together with the object, so they are "bonded" each other. Therefore, in Mathematics, the anchorage of the elements relative to the reference systems, is a matter of course, it doesn't exist anymore, because in mathematics doesn't exist "mathematical forces". These belonging to the Mechanics, namely it's dynamics , also in mathematics doesn't exist machining tools, neither various coordinating dimensions, dimensional adjustments, dimensional machining, etc.

Therefore, in Centric mathematics **(CM),** only 3 **x, y and z** linear dimensions exists, which are, at the same time, forming dimensions of the 3D objects, by their parametric equations, by example.

Reductively, in this Centric mathematics **(CM),** entities as straight line, the square, the circle, the sphere, the cube e.a., are unique, while in the Eccentric Mathematics (**EM**), and implicit, in Supermathematics (**SM**), they are infinitely multiplied through **hybridation**, a hybridation possible by introducing of a new space dimension, the **eccentricity**.

The supermathematical Hybridation can be defined as the mathematical process of **"cross-breeding"** of two mathematical entities from **CM** (the circle, and the square, the sphere and the cube, the cone and the pyramid) and obtaining of a supermathematical new entity in **EM**, which is unknown/non-existent in **CM** (by example: cono-pyramid).

Through **metamorphosis** one understand a continuous passing from a certain entity, existing in **CM**, to another entity, also existing in CM, through an infinity of hybrid entities, appropriates only to **EM**. In other words, transforming a centric mathematical entity into another centric mathematical entity, an action that became possible inside the **Eccentric mathematics (EM)** , by using **supermathematical** functions.

By **metamorphosis** one obtain new entities, previously non-existent in **CM**, named **hybrid entities,** and also **eccentric** entities, or **supermathematical (SM)**, to differ the centric ones, also by name, because **by form**, they are essentially different.

The first object obtained through **mathematical hybridation** was the **cono-pyramid**: a supermathematical corps with the square base of a pyramid and the tip of a circular cone, resulting from the transformation of the unity square of L=2 into the unity circle of R=1 and/or viceversa (Fig. 4). The parametric equations of the cono-pyramid are obtained from the parametric equations of right circular cone, where the FCC are changed/converted with the corresponding quadrilobe supermathematical functions **(FSM-Q).**

$$\begin{cases} x = u.coq\theta = u.\dfrac{cos\theta}{\sqrt{1-s^2.sin^2\theta}} \\ y = u.siq\theta = u.\dfrac{sin\theta}{\sqrt{1-s^2.cos^2\theta}}, \\ z = u \end{cases} \quad for \quad \begin{cases} u = 1-s, \quad s \in [0, \ 1] \blacktriangleright CONO-PIRAMIDĂ \\ u = s-1, \quad s \in [0, \ 1] \blacktriangleright PIRAMIDO-CON \\ u = 1; \quad s = 1 \blacktriangleright \text{PĂTRAT}; \ \mathbf{L = 2} \\ u = 1; \quad s = 0 \ \blacktriangleright CERC; \quad \boldsymbol{R = 1} \\ u = 1; \quad s \in [0, \ 1] \blacktriangleright \textbf{CILINDRU C/P} \end{cases}$$

(**Fig. 1, Fig. 3** şi **Fig. 5,a**), because **FSM-Q** can achieve the contiuous transformation of the circle into a square and viceversa, also as **FSM-CE** eccentric derivate $\mathbf{dex_{1,2}\theta}$

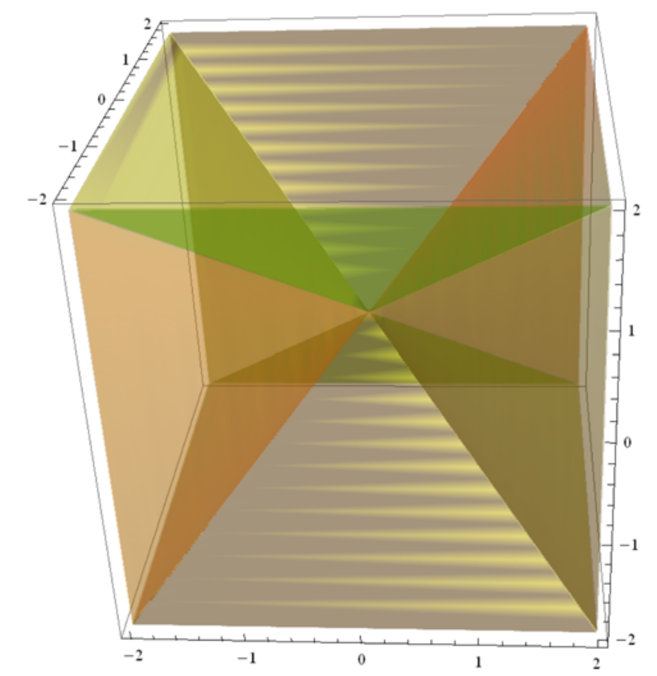
$$\begin{cases} x = u.dex\theta = u[1 - \frac{s.\cos(\theta-\varepsilon)}{\sqrt{1-s^2sin^2(\theta-\varepsilon)}}] \\ y = u.dex\left(\theta - \frac{\pi}{2}\right) = u[1 - \frac{s.\cos\left(\theta-\varepsilon-\frac{\pi}{2}\right)}{\sqrt{1-s^2sin^2\left(\theta-\varepsilon-\frac{\pi}{2}\right)}}], pentru \\ z = u \end{cases} \begin{cases} u = 1; \ s = 0 \blacktriangleright CON \\ u = 1, \ s = 1 \blacktriangleright PIRAMIDĂ \\ u = \ s \in \ [0, \ 1] \blacktriangleright CONOPIRAMIDĂ \\ u = 1; \ s \in \ [0, \ 1] \blacktriangleright \text{Fig } \mathbf{5, c} \end{cases} \quad (7)$$

(**Fig. 4** şi **Fig. 5,b şi Fig. 5,c**).

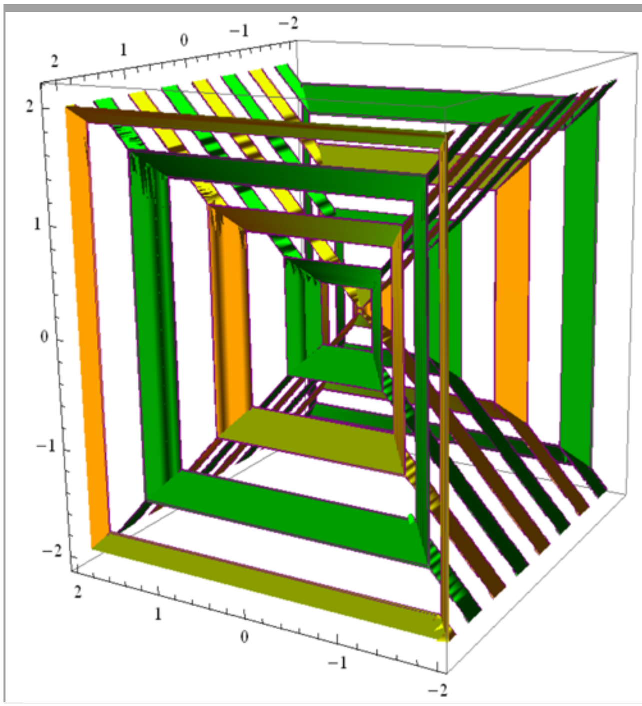
The relations (7) are expressed with the help of quadrilobes **FSM-Q,** introduced in Mathematics since 2005, in the work [19], quadrilobe cosine **coqθ** and quadrilobe sine **siqθ**.

The (7) and (8) equations express the same forms, but with following remarks:

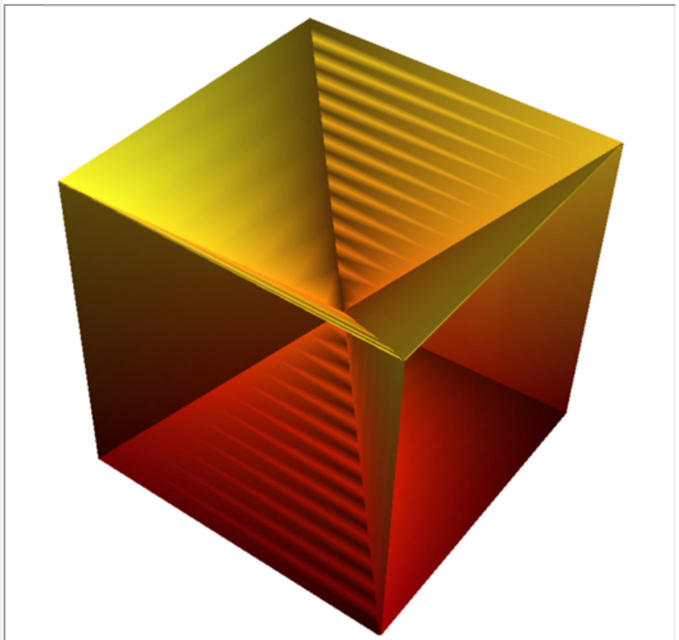
- Of a **circle** only for an eccenter S(s = 0, ε = 0), with the difference that the first one (7) has the radius R = 1, and the other one (8) has the radius R = 0, **Fig. 6**, up ▲;
- Of a **square** for an eccenter S (s = 1, ε = 0), of the same dimensions L = 2R, as one can see in the figure **6**., but centered in different points; one is centered in the origin O(0, 0), the one expressed by the



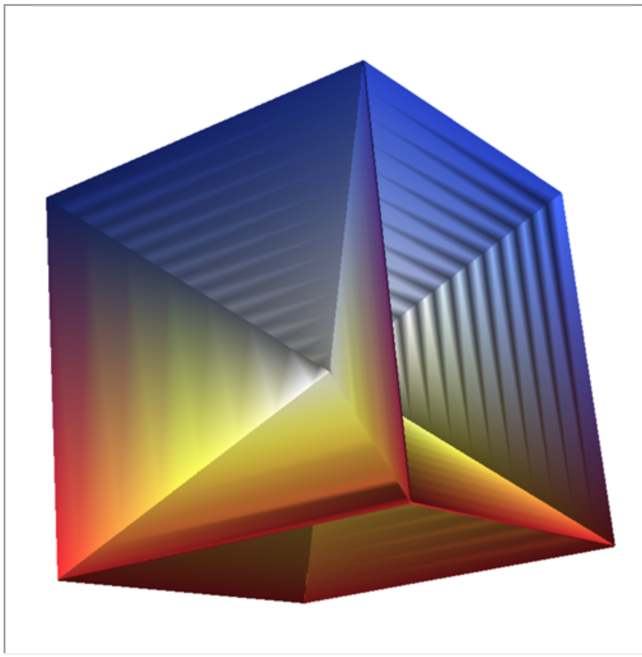
Semitransparent RC



Transparent RC



Opaque RC



Tricolor RC

Fig. 7 The ROMANIAN Cube (RC) , the lightest cube in the world, of V = 0 volume

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- relations (7), and the other one is ex-centered, centered eccentrical relative to the origin O(0, 0)- in the point C(1,1);
- Of a **quadrilobe** (neither circle and neither square, namely an infinity of hybrid forms, between circle and square). For the same numerical eccentricity **s ∈ (0, 1)**, which characterizes the **mathematical excenter** (**ME**) domain, they has the same forms, but are of different dimensions; the first one, having higher dimensions then those expressed with dexθ function, what can be concluded also from the **figure 5,b** from 2D.

  One can see that the dimension of the quadrilobes expressed by the relation (8) by dexθ decrease as eccentricity increase.

The Romanian cube from the **Fig 7**, "**the lightest cube of the world**", is the cube with zero volume, obtained from 6 pyramids, without their square base surfaces, with the common tip in the cube's symmetry center.

In this case, the pyramid was expressed through the relations (7), by quadrilobe functions of s=1.

As a conclusion, **supermatematics** offer multiple possibilities to express different mathematical entities from **center mathematics (CM),** and, at the same time, an infinity of hybrid entities from the **eccentric mathematics (EM).**

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62	Gheorghiu Em. Octav Şelariu Mircea Bozântan Emil	**FUNCŢII CIRCULARE EXCENTRICE DE SUMĂ DE ARCE**	Ses.de com.şt.stud.,Secţia Matematică,Timişoara, Premiul II la Secţia Matematică, 1983
64	Gheorghiu Emilian Octav Şelariu Mircea Cojerean Ovidiu	**FUNCŢII CIRCULARE EXCENTRICE. DEFINIŢII, PROPRIETẮŢI, APLICAŢII TEHNICE**	Ses. de com. şt.stud. Secţia Matematică, premiul II la Secţia Matematică, pe anul 1985.
65	Şelariu Mircea Eugen, Bălă Dumitru	**WAYS OF PRESENTING THE DELTA FUNCTION AND AMPLITUDE FUNCTION JACOBI**	Proceedings of the2nd World Congress on Science, Economics and Culture, 25-29 August 2008 New York, paper published in Denbridge Journals, p.42 … 55
66	Dumitru Bălă	**SUPERMATHEMATICAL – ŞELARIU FUNCTIONS BETA ECCENTRIC bexθ SOLUTIONS OF SOME OSCILATORY NON-LINIAR SYSTEMS (SOβ)**	Proceedings of the2nd World Congress on Science, Economics and Culture, 25-29 August 2008 New York, paper published in Denbridge Journals, p.27 … 41
67	Şelariu Mircea Eugen Smarandache Florentin Niţu Marian	**CARDINAL FUNCTIONS AND INTEGRAL FUNCTIONS**	International Journal of Geometry Vol.1 (2012), N0. 1, 5-14

Parameterized Special Theory of Relativity (PSTR)

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We have parameterized Einstein's thought experiment with atomic clocks, supposing that we knew neither if the space and time are relative or absolute, nor if the speed of light was ultimate speed or not. We have obtained a Parameterized Special Theory of Relativity (PSTR), first introduced in 1982. Our PSTR generalized not only Einstein's Special Theory of Relativity, but also our Absolute Theory of Relativity, and introduced three more possible Relativities to be studied in the future. After the 2011 CERN's superluminal neutrino experiments, we recall our ideas and invite researchers to deepen the study of PSTR, ATR, and check the three new mathematically emerged Relativities 4.3, 4.4, and 4.5.

1 Einstein's thought experiment with the light clocks

There are two identical clocks, one is placed aboard of a rocket, which travels at a constant speed v with respect to the Earth, and the second one is on the Earth. In the rocket, a light pulse is emitted by a source from A to a mirror B that reflects it back to A where it is detected. The rocket's movement and the light pulse's movement are orthogonal. There is an observer in the rocket (the astronaut) and an observer on the Earth. The trajectory of light pulse (and implicitly the distance traveled by the light pulse), the elapsed time it needs to travel this distance, and the speed of the light pulse at which is travels are perceived differently by the two observers (depending on the theories used — see below in this paper).

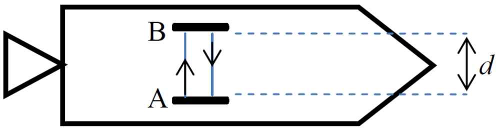

Figure 1

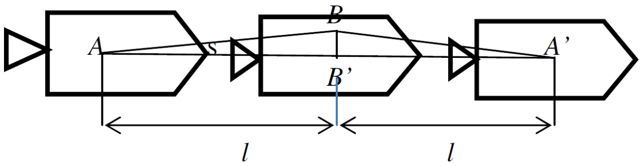

Figure 2

According to the astronaut (see Fig. 1):

$$\Delta t' = \frac{2\,d}{c}\,, \tag{1}$$

where $\Delta t'$ time interval, as measured by the astronaut, for the light to follow the path of double distance $2d$, while c is the speed of light.

According to the observer on the Earth (see Fig. 2):

$$\left.\begin{array}{ll} 2\,l = v\,\Delta t\,, & s = |AB| = |BA'| \\ d = |BB'|\,, & l = |AB'| = |b'A'| \end{array}\right\}, \tag{2}$$

where Δt is the time interval as measured by the observer on the Earth. And using the Pythagoras' Theorem in the right triangle $\Delta ABB'$, one has

$$2s = 2\,\sqrt{d^2 + l^2} = 2\,\sqrt{d^2 + \left(\frac{v\,\Delta t}{2}\right)^2}\,, \tag{3}$$

but $2s = c\,\Delta t$, whence

$$c\,\Delta t = 2\,\sqrt{d^2 + \left(\frac{v\,\Delta t}{2}\right)^2}\,. \tag{4}$$

Squaring and computing for Δt one gets:

$$\Delta t = \frac{2\,d}{c}\,\frac{1}{\sqrt{1-\frac{v^2}{c^2}}}\,. \tag{5}$$

Whence Einstein gets the following time dilation:

$$\Delta t = \frac{\Delta t'}{\sqrt{1-\frac{v^2}{c^2}}}\,. \tag{6}$$

where $\Delta t > \Delta t'$

2 Parameterized Special Theory of Relativity (PSTR)

In a more general case when we don't know the speed x of the light as seen by the observer on Earth, nor the relationship between $\Delta t'$ and Δt, we get:

$$x\,\Delta t = 2\,\sqrt{d^2 + \left(\frac{v\,\Delta t}{2}\right)^2}\,. \tag{7}$$

But $d = \frac{c\,\Delta t'}{2}$, therefore:

$$x\,\Delta t = 2\,\sqrt{\left(\frac{c\,\Delta t}{2}\right)^2 + \left(\frac{v\,\Delta t}{2}\right)^2}\,, \tag{8}$$

or

$$x\,\Delta t = \sqrt{c^2(\Delta t')^2 + v^2(\Delta t')^2}\,. \tag{9}$$

Dividing the whole equality by Δt we obtain:

$$x = \sqrt{v^2 + c^2 \left(\frac{\Delta t'}{\Delta t}\right)^2}\,. \tag{10}$$

which is the *PSTR Equation*.

3 PSTR elapsed time ratio τ (parameter)

We now substitute in a general case

$$\frac{\Delta t'}{\Delta t} = \tau \in (0, +\infty)\,, \tag{11}$$

where τ is the PSTR elapsed time ratio. Therefore we split the Special Theory of Relativity (STR) in the below ways.

4 PSTR extends STR, ATR, and introduces three more Relativities

4.1 If $\tau = \sqrt{1 - \frac{v^2}{c^2}}$ we get the STR (see [1]), since replacing x by c, one has

$$c^2 = v^2 + c^2 \left(\frac{\Delta t'}{\Delta t}\right)^2, \tag{12}$$

$$\frac{c^2}{c^2} - \frac{v^2}{c^2} = \left(\frac{\Delta t'}{\Delta t}\right)^2, \tag{13}$$

or $\frac{\Delta t'}{\Delta t} = \sqrt{1 - \frac{v^2}{c^2}} \in [0, 1]$ as in the STR.

4.2 If $\tau = 1$, we get our *Absolute Theory of Relativity* (see [2]) in the particular case when the two trajectory vectors are perpendicular, i.e.

$$X = \sqrt{v^2 + c^2} = |\vec{v} + \vec{c}|\,. \tag{14}$$

4.3 If $0 < \tau < \sqrt{1 - \frac{v^2}{c^2}}$, the time dilation is increased with respect to that of the STR, therefore the speed x as seen by the observer on the Earth is decreased (becomes subluminal) while in STR it is c.

4.4 If $\sqrt{1 - \frac{v^2}{c^2}} < \tau < 0$, there is still time dilation, but less than STR's time dilation, yet the speed x as seen by the observer on the Earth becomes superluminal (yet less than in our Absolute Theory of Relativity). About superluminal velocities see [3] and [4].

4.5 If $\tau > 1$, we get an *opposite time dilation* (i.e. $\Delta t' > \Delta t$) with respect to the STR (instead of $\Delta t' < \Delta t$), and the speed x as seen by the observer on earth increases even more than in our ATR.

5 Further research

The reader might be interested in studying these new Relativities mathematically resulted from the above 4.3, 4.4, and 4.5 cases.

Submitted on February 6, 2012 / Accepted on February 12, 2012

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Oblique-Length Contraction Factor in the Special Theory of Relativity

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In this paper one generalizes the Lorentz Contraction Factor for the case when the lengths are moving at an oblique angle with respect to the motion direction. One shows that the angles of the moving relativistic objects are distorted.

1 Introduction

According to the Special Theory of Relativity, the Lorentz Contraction Factor is referred to the lengths moving along the motion direction. The lengths which are perpendicular on the direction motion do not contract at all [1].

In this paper one investigates the lengths that are oblique to the motion direction and one finds their Oblique-Length Contraction Factor [3], which is a generalization of the Lorentz Contraction Factor (for $\theta = 0$) and of the perpendicular lengths (for $\theta = \pi/2$). We also calculate the distorted angles of lengths of the moving object.

2 Length-Contraction Factor

Length-Contraction Factor $C(v)$ is just Lorentz Factor:

$$C(v) = \sqrt{1 - \frac{v^2}{c^2}} \in [0, 1] \;\; for\; v \in [0, 1] \qquad (1)$$

$$L = L' \cdot C(v) \qquad (2)$$

where L = non-proper length (length contracted), L' = proper length. $C(0) = 1$, meaning no space contraction [as in Absolute Theory of Relativity (ATR)].

$C(c) = 0$, which means according to the Special Theory of Relativity (STR) that if the rocket moves at speed ‘c’ then the rocket length and laying down astronaut shrink to zero! This is unrealistic.

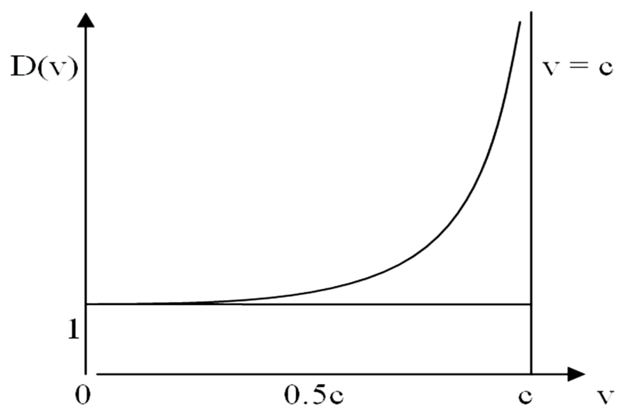

Fig. 1: The graph of the Time-Dilation Factor

3 Time-Dilation Factor

Time-Dilation Factor D(v) is the inverse of Lorentz Factor:

$$D(v) = \frac{1}{\sqrt{1 - \frac{v^2}{c^2}}} \in [1, +\infty] \;\; for\; v \in [0, c] \qquad (3)$$

$$\Delta t = \Delta t' \cdot D(v) \qquad (4)$$

where Δt = non-proper time and, $\Delta t'$ = proper time. $D(0) = 1$, meaning no time dilation [as in Absolute Theory of Relativity (ATR)]; $D(c) = \lim_{v \to c} D(v) = +\infty$, which means according to the Special Theory of Relativity (STR) that if the rocket moves at speed ‘c’ then the observer on earth measures the elapsed non-proper time as infinite, which is unrealistic. $v = c$ is the equation of the vertical asymptote to the curve of $D(v)$.

4 Oblique-Length Contraction Factor

The Special Theory of Relativity asserts that all lengths in the direction of motion are contracted, while the lengths at right angles to the motion are unaffected. But it didn’t say anything about lengths at oblique angle to the motion (i.e. neither perpendicular to, nor along the motion direction), how would they behave? This is a generalization of Galilean Relativity, i.e. we consider the oblique lengths. The length contraction factor in the motion direction is:

$$C(v) = \sqrt{1 - \frac{v^2}{c^2}}. \qquad (5)$$

Suppose we have a rectangular object with width W and length L that travels at a constant speed v with respect to an observer on Earth.

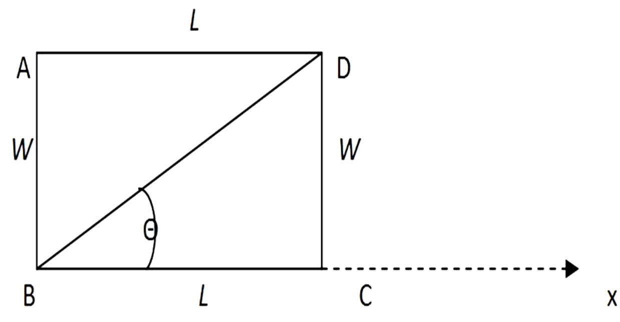

Fig. 2: A rectangular object moving along the x-axis

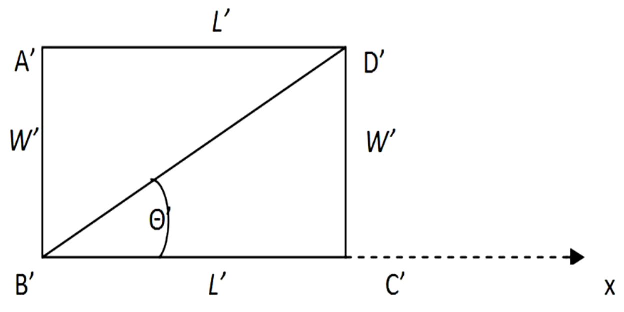

Fig. 3: Contracted lengths of the rectangular object moving along the x-axis

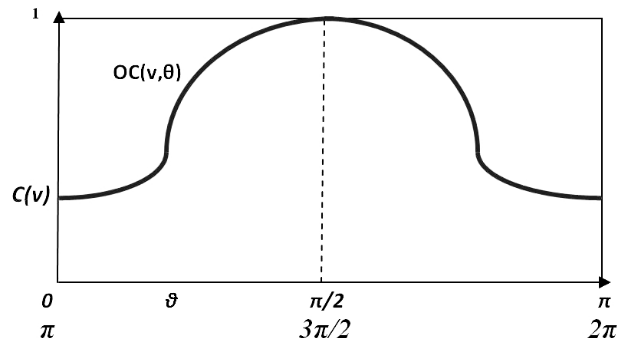

Fig. 4: The graph of the Oblique-Length Contraction Factor $OC(v, \theta)$

Then its lengths contract and its new dimensions will be L' and W': where $L' = L \cdot C(v)$ and $W' = W$. The initial diagonal of the rectangle ABCD is:

$$\begin{aligned} \delta &= |AC| = |BD| = \sqrt{L^2 + W^2} \\ &= \sqrt{L^2 + L^2 \tan^2 \theta} = L\sqrt{1 + \tan^2 \theta} \end{aligned} \tag{6}$$

while the contracted diagonal of the rectangle $A'B'C'D'$ is:

$$\begin{aligned} \delta' &= |A'C'| = |B'D'| \\ &= \sqrt{(L')^2 + (W')^2} = \sqrt{L^2 \cdot C(v)^2 + W^2} \\ &= \sqrt{L^2 C(v)^2 + L^2 \tan^2 \theta} = L\sqrt{C(v)^2 + \tan^2 \theta}. \end{aligned} \tag{7}$$

Therefore the lengths at oblique angle to the motion are contracted with the oblique factor

$$\begin{aligned} OC(v, \theta) &= \frac{\delta'}{\delta} = \frac{L\sqrt{C(v)^2 + \tan^2 \theta}}{L\sqrt{1 + \tan^2 \theta}} \\ &= \sqrt{\frac{C(v)^2 + \tan^2 \theta}{1 + \tan^2 \theta}} = \sqrt{C(v)^2 \cos^2 \theta + \sin^2 \theta} \end{aligned} \tag{8}$$

which is different from C(v).

$$\delta' = \delta \cdot OC(v, \theta) \tag{9}$$

where $0 \leq OC(v, \theta) \leq 1$.

For unchanged constant speed v, the greater is θ in $\left(0, \frac{\pi}{2}\right)$ the larger gets the oblique-length contradiction factor, and reciprocally. By oblique length contraction, the angle

$$\theta \in \left(0, \frac{\pi}{2}\right) \cup \left(\frac{\pi}{2}, \pi\right) \tag{10}$$

is not conserved.

In Fig. 4 the horizontal axis represents the angle θ, while the vertical axis represents the values of the Oblique-Length Contraction Factor $OC(v, \theta)$ for a fixed speed v. Hence $C(v)$ is thus a constant in this graph. The graph, for v fixed, is periodic of period π, since:

$$\begin{aligned} OC(v, \pi + \theta) &= \sqrt{C(v)^2 \cos^2(\pi + \theta) + \sin^2(\pi + \theta)} \\ &= \sqrt{C(v)^2[-\cos\theta]^2 + [-\sin\theta]^2} \\ &= \sqrt{C(v)^2 \cos^2 \theta + \sin^2 \theta} \\ &= OC(v, \theta). \end{aligned} \tag{11}$$

More exactly about the $OC(v, \theta)$ range:

$$OC(v, \theta) \in [C(v), 1] \tag{12}$$

but since $C(v) \in [0, 1]$, one has:

$$OC(v, \theta) \in [0, 1]. \tag{13}$$

The Oblique-Length Contractor

$$OC(v, \theta) = \sqrt{C(v)^2 \cos^2 \theta + \sin^2 \theta} \tag{14}$$

is a generalization of Lorentz Contractor $C(v)$, because: when $\theta = 0$ or the length is moving along the motion direction, then $OC(v, 0) = C(v)$. Similarly

$$OC(v, \pi) = OC(v, 2\pi) = C(v). \tag{15}$$

Also, if $\theta = \frac{\pi}{2}$, or the length is perpendicular on the motion direction, then $OC(v, \pi/2) = 1$, i.e. no contraction occurs. Similarly $OC(v, \frac{3\pi}{2}) = 1$.

5 Angle Distortion

Except for the right angles $(\pi/2, 3\pi/2)$ and for the 0, π, and 2π, all other angles are distorted by the Lorentz transform.

Let's consider an object of triangular form moving in the direction of its bottom base (on the x-axis), with speed v, as in Fig. 5:

$$\theta \in \left(0, \frac{\pi}{2}\right) \cup \left(\frac{\pi}{2}, \pi\right) \tag{16}$$

is not conserved.

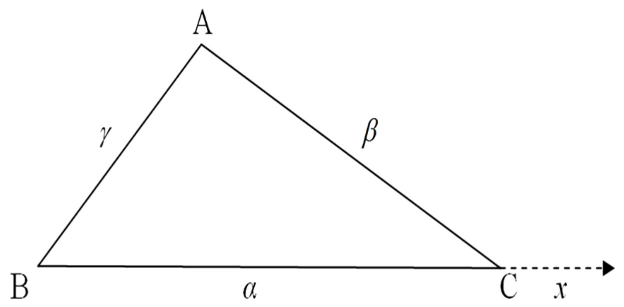

Fig. 5:

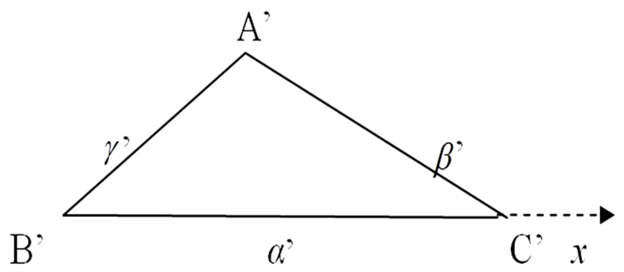

Fig. 6:

The side $|BC| = \alpha$ is contracted with the contraction factor $C(v)$ since BC is moving along the motion direction, therefore $|B'C'| = \alpha \cdot C(v)$. But the oblique sides AB and CA are contracted respectively with the oblique-contraction factors $OC(v, \measuredangle B)$ and $OC(v, \measuredangle \pi - C)$, where $\measuredangle B$ means angle B:

$$\left|A'B'\right| = \gamma \cdot OC(v, \measuredangle B) \tag{17}$$

and

$$\left|C'A'\right| = \beta \cdot OC(v, \measuredangle \pi - C) = \beta \cdot OC(v, \measuredangle A + B) \tag{18}$$

since

$$\measuredangle A + \measuredangle B + \measuredangle C = \pi. \tag{19}$$

Triangle ABC is shrunk and distorted to $A'B'C'$ as in Fig. 6.

Hence one gets:

$$\begin{aligned} \alpha' &= \alpha \cdot C(v) \\ \beta' &= \beta \cdot OC(v, \measuredangle A + B) \\ \gamma' &= \gamma \cdot OC(v, \measuredangle B) \end{aligned} \tag{20}$$

In the resulting triangle $A'B'C'$, since one knows all its side lengths, one applies the Law of Cosine in order to find each angle $\measuredangle A'$, $\measuredangle B'$, and $\measuredangle C'$. Therefore:

$$\measuredangle A' = \arccos \frac{-\alpha^2 \cdot C(v)^2 + \beta^2 \cdot OC(v, \measuredangle A + B)^2 + \gamma^2 \cdot OC(v, \measuredangle B)^2}{2\beta \cdot \gamma \cdot OC(v, \measuredangle B) \cdot OC(v, \measuredangle A + B)}$$

$$\measuredangle B' = \arccos \frac{\alpha^2 \cdot C(v)^2 - \beta^2 \cdot OC(v, \measuredangle A + B)^2 + \gamma^2 \cdot OC(v, \measuredangle B)^2}{2\alpha \cdot \gamma \cdot OC(v) \cdot OC(v, \measuredangle B)}$$

$$\measuredangle C' = \arccos \frac{\alpha^2 \cdot C(v)^2 + \beta^2 \cdot OC(v, \measuredangle A + B)^2 - \gamma^2 \cdot OC(v, \measuredangle B)^2}{2\alpha \cdot \beta \cdot OC(v) \cdot OC(v, \measuredangle A + B)}.$$

As we can see, the angles $\measuredangle A'$, $\measuredangle B'$, and $\measuredangle C'$ are, in general, different from the original angles A, B, and C respectively.

The distortion of an angle is, in general, different from the distortion of another angle.

Submitted on November 12, 2012 / Accepted on November 15, 2012

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Relations between Distorted and Original Angles in STR

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Using the Oblique-Length Contraction Factor, which is a generalization of Lorentz Contraction Factor, one shows several trigonometric relations between distorted and original angles of a moving object lengths in the Special Theory of Relativity.

1 Introduction

The lengths at oblique angle to the motion are contracted with the Oblique-Length Contraction Factor $OC(v, \theta)$, defined as [1-2]:

$$OC(v, \theta) = \sqrt{C(v)^2 \cos^2\theta + \sin^2\theta} \tag{1}$$

where $C(v)$ is just Lorentz Factor:

$$C(v) = \sqrt{1 - \frac{v^2}{c^2}} \in [0, 1] \text{ for } v \in [0, \mathrm{c}]. \tag{2}$$

Of course

$$0 \leq OC(v, \theta) \leq 1. \tag{3}$$

The Oblique-Length Contraction Factor is a generalization of Lorentz Contractor $C(v)$, because: when $\theta = 0$, or the length is moving along the motion direction, then $OC(v, 0) = C(v)$. Similarly

$$OC(v, \pi) = OC(v, 2\pi) = C(v). \tag{4}$$

Also, if $\theta = \pi/2$, or the length is perpendicular on the motion direction, then $OC(v, \pi/2) = 1$, i.e. no contraction occurs. Similarly $OC(v, \frac{3\pi}{2}) = 1$.

2 Tangential relations between distorted acute angles vs. original acute angles of a right triangle

Let's consider a right triangle with one of its legs along the motion direction (Fig. 1).

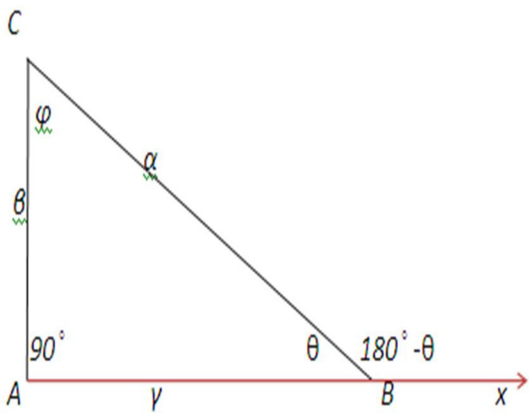

Fig. 1:

$$\tan\theta = \frac{\beta}{\gamma} \tag{5}$$

$$\tan(180^\circ - \theta) = -\tan\theta = \frac{\beta}{\gamma} \tag{6}$$

After contraction of the side AB (and consequently contraction of the oblique side BC) one gets (Fig. 2):

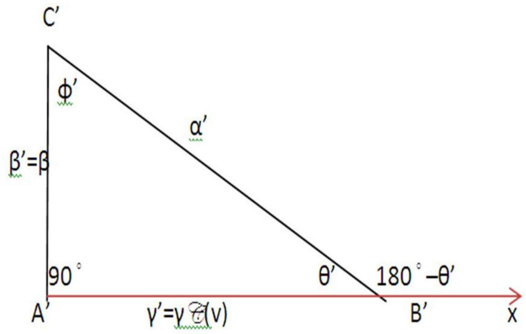

Fig. 2:

$$\tan(180^\circ - \theta') = -\tan\theta' = -\frac{\beta'}{\gamma'} = -\frac{\beta}{\gamma C(v)}. \tag{7}$$

Then:

$$\frac{\tan(180^\circ - \theta')}{\tan(180^\circ - \theta)} = \frac{-\dfrac{\beta}{\gamma C(v)}}{-\dfrac{\beta}{\gamma}} = \frac{1}{C(v)}. \tag{8}$$

Therefore

$$\tan(\pi - \theta') = -\frac{\tan(\pi - \theta)}{C(v)} \tag{9}$$

and consequently

$$\tan(\theta') = \frac{\tan(\theta)}{C(v)} \tag{10}$$

or

$$\tan(B') = \frac{\tan(B)}{C(v)} \tag{11}$$

which is the Angle Distortion Equation, where θ is the angle formed by a side travelling along the motion direction and another side which is oblique on the motion direction.

The angle θ is increased (i.e. $\theta' > \theta$).

$$\tan\varphi = \frac{\gamma}{\beta} \quad \text{and} \quad \tan\varphi' = \frac{\gamma'}{\beta'} = \frac{\gamma C(v)}{\beta} \tag{12}$$

whence:

$$\frac{\tan\varphi'}{\tan\varphi} = \frac{\frac{\gamma C(v)}{\beta}}{\frac{\gamma}{\beta}} = C(v). \tag{13}$$

So we get the following Angle Distortion Equation:

$$\tan\varphi' = \tan\varphi \cdot C(v) \tag{14}$$

or

$$\tan C' = \tan C \cdot C(v) \tag{15}$$

where φ is the angle formed by one side which is perpendicular on the motion direction and the other one is oblique to the motion direction.

The angle φ is decreased (i.e. $\varphi' < \varphi$). If the traveling right triangle is oriented the opposite way (Fig. 3)

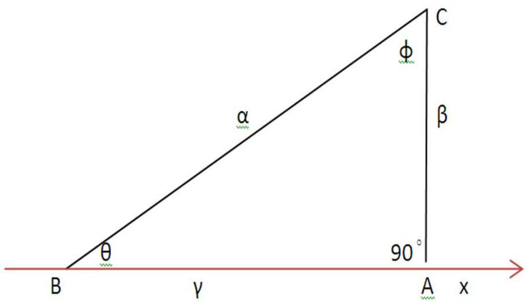

Fig. 3:

$$\tan\theta = \frac{\beta}{\gamma} \quad \text{and} \quad \tan\varphi = \frac{\gamma}{\beta}. \tag{16}$$

Similarly, after contraction of side AB (and consequently contraction of the oblique side BC) one gets (Fig. 4)

$$\tan\theta' = \frac{\beta'}{\gamma'} = \frac{\beta}{\gamma C(v)} \tag{17}$$

and

$$\tan\varphi' = \frac{\gamma'}{\beta'} = \frac{\gamma C(v)}{\beta} \tag{18}$$

$$\frac{\tan\theta'}{\tan\theta} = \frac{\frac{\beta}{\gamma C(v)}}{\frac{\beta}{\gamma}} = \frac{1}{C(v)} \tag{19}$$

or

$$\tan\theta' = \frac{\tan\theta}{C(v)} \tag{20}$$

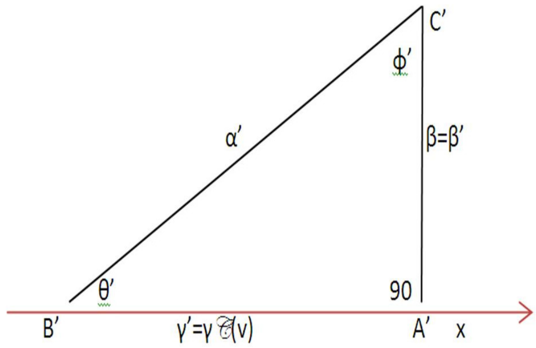

Fig. 4:

and similarly

$$\frac{\tan\varphi'}{\tan\varphi} = \frac{\frac{\gamma C(v)}{\beta}}{\frac{\gamma}{\beta}} = C(v) \tag{21}$$

or

$$\tan\varphi' = \tan\varphi \cdot C(v). \tag{22}$$

Therefore one got the same Angle Distortion Equations for a right triangle traveling with one of its legs along the motion direction.

3 Tangential relations between distorted angles vs. original angles of a general triangle

Let's suppose a general triangle ΔABC is travelling at speed v along the side BC as in Fig. 5.

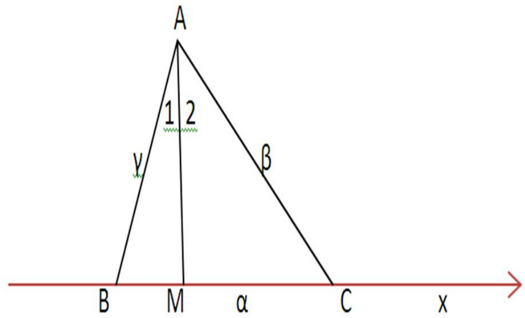

Fig. 5:

The height remains not contracted: $AM \equiv A'M'$. We can split this figure into two traveling right sub-triangles as in Fig. 6.

In the right triangles $\Delta A'M'B'$ and respectively $\Delta A'M'C'$ one has

$$\tan B' = \frac{\tan B}{C(v)} \quad \text{and} \quad \tan \mathrm{C}' = \frac{\tan \mathrm{C}}{\mathrm{C}(v)}. \tag{23}$$

Also

$$\tan A'_1 = \tan A_1 C(v) \quad \text{and} \quad \tan A'_2 = \tan A_2 C(v). \tag{24}$$

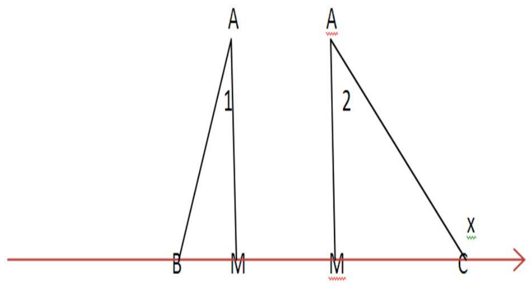

Fig. 6:

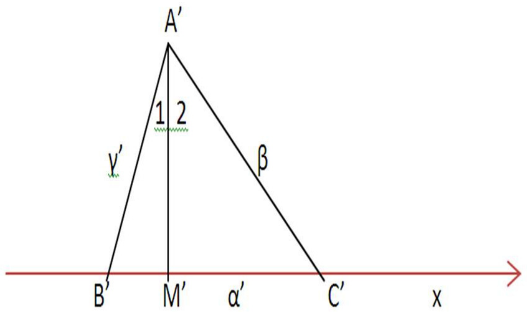

Fig. 7:

But

$$\begin{aligned}\tan A' &= \tan(A'_1 + A'_2) = \frac{\tan A'_1 + \tan A'_2}{1 - \tan A'_1 \tan A'_2} \\ &= \frac{\tan A_1 C(v) + \tan A_2 C(v)}{1 - \tan A_1 C(v) \tan A_2 C(v)} \\ &= C(v) \cdot \frac{\tan A_1 + \tan A_2}{1 - \tan A_1 \tan A_2 C(v)^2} \\ &= C(v) \cdot \frac{\frac{\tan A_1 + \tan A_2}{1 - \tan A_1 \tan A_2} \cdot (1 - \tan A_1 \tan A_2)}{1 - \tan A_1 \tan A_2 C(v)^2} \\ &= C(v) \cdot \frac{\tan(A_1 + A_2)}{1} \cdot \frac{1 - \tan A_1 \tan A_2}{1 - \tan A_1 \tan A_2 C(v)^2}.\end{aligned}$$

$$\tan A' = C(v) \cdot \tan(A) \cdot \frac{1 - \tan A_1 \tan A_2}{1 - \tan A_1 \tan A_2 C(v)^2}. \tag{25}$$

We got

$$\tan A' = \tan(A) \cdot C(v) \cdot \frac{1 - \tan A_1 \tan A_2}{1 - \tan A_1 \tan A_2 C(v)^2} \tag{26}$$

Similarly we can split this Fig. 7 into two traveling right sub-triangles as in Fig. 8.

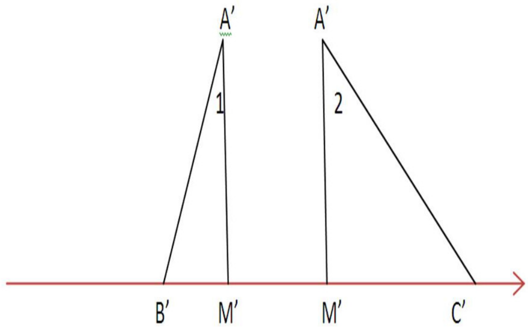

Fig. 8:

4 Other relations between the distorted angles and the original angles

1. Another relation uses the Law of Sine in the triangles ΔABC and respectively $\Delta A'B'C'$:

$$\frac{\alpha}{\sin A} = \frac{\beta}{\sin B} = \frac{\gamma}{\sin C} \tag{27}$$

$$\frac{\alpha'}{\sin A'} = \frac{\beta'}{\sin B'} = \frac{\gamma'}{\sin C'}. \tag{28}$$

After substituting

$$\alpha' = \alpha C(v) \tag{29}$$

$$\beta' = \beta \mathcal{O}C(v, C) \tag{30}$$

$$\gamma' = \gamma \mathcal{O}C(v, B) \tag{31}$$

into the second relation one gets:

$$\frac{\alpha C(v)}{\sin A'} = \frac{\beta \mathcal{O}C(v, C)}{\sin B'} = \frac{\gamma \mathcal{O}C(v, B)}{\sin C'}. \tag{32}$$

Then we divide term by term the previous equalities:

$$\frac{\frac{\alpha}{\sin A}}{\frac{\alpha C(v)}{\sin A'}} = \frac{\frac{\beta}{\sin B}}{\frac{\beta \mathcal{O}C(v, C)}{\sin B'}} = \frac{\frac{\gamma}{\sin C}}{\frac{\gamma \mathcal{O}C(v, B)}{\sin C'}} \tag{33}$$

whence one has:

$$\begin{aligned}\frac{\sin A'}{\sin A \cdot C(v)} &= \frac{\sin B'}{\sin B \cdot \mathcal{O}C(v, C)} \\ &= \frac{\sin C'}{\sin C \cdot \mathcal{O}C(v, B)}.\end{aligned} \tag{34}$$

2. Another way:

$$A' = 180^\circ - (B' + C') \quad \text{and} \quad \text{A} = 180^\circ - (\text{B} + \text{C}) \tag{35}$$

$$\begin{aligned}\tan A' &= \tan[180^\circ - (B' + C')] = -\tan(B' + C') \\ &= -\frac{\tan B' + \tan C'}{1 - \tan B' \cdot \tan C'}\end{aligned}$$

$$= -\frac{\frac{\tan B}{C(v)} + \frac{\tan C}{C(v)}}{1 - \tan B \cdot \tan C / C(v)^2}$$

$$= -\frac{1}{C(v)} \cdot \frac{\tan B + \tan C}{1 - \tan B \cdot \tan C / C(v)^2}$$

$$= -\frac{\tan(B + C)}{C(v)} \cdot \frac{1 - \tan B \tan C}{1 - \tan B \cdot \tan C / C(v)^2}$$

$$= -\frac{-\tan[180° - (B + C)]}{C(v)} \cdot \frac{1 - \tan B \cdot \tan C}{1 - \tan B \cdot \tan C / C(v)^2}$$

$$= \frac{\tan A}{C(v)} \cdot \frac{1 - \tan B \cdot \tan C}{1 - \tan B \cdot \tan C / C(v)^2}.$$

We got

$$\tan A' = \frac{\tan A}{C(v)} \cdot \frac{1 - \tan B \cdot \tan C}{1 - \tan B \cdot \tan C / C(v)^2}. \quad (36)$$

Submitted on March 30, 2013 /Accepted on April 2, 2013

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On Gödel's incompleteness theorem(s), Artificial Intelligence/Life, and Human Mind

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Abstract

In the present paper we have discussed concerning Gödel's incompleteness theorem(s) and plausible implications to artificial intelligence/life and human mind. Perhaps we should agree with Sullins III, that the value of this finding is not to discourage certain types of research in AL, but rather to help move us in a direction where we can more clearly define the results of that research. Gödel's incompleteness theorems have their own limitations, but so do Artificial Life (AL)/AI systems. Based on our experiences so far, human mind has incredible abilities to interact with other part of human body including heart, which makes it so difficult to simulate in AI/AL. However, it remains an open question to predict whether the future of AI including robotics science can bring this gap closer or not. In this regard, fuzzy logic and its generalization –neutrosophic logic- offer a way to improve significantly AI/AL research.[15]

Introduction

In 1931 a German mathematician named Gödel published a paper which included a theorem which was to become known as his Incompleteness Theorem. This theorem stated that:

> "To every w-consistent recursive class k of formulae there
>
> correspond recursive class-signs r, such that neither v Gen r
>
> nor Neg (v Gen r) belongs to Flg(k) (where v is the free variable of r)" [9].

In more common mathematical terms, this means that "all consistent axiomatic formulations of number theory include undecidable propositions."[9]

Another perspective on Gödel's incompleteness theorem can be found using polynomial equations [10]. It can be shown that Gödel's analysis does not reveal any essential incompleteness in formal reasoning systems, nor any barrier to proving the consistency of such systems by ordinary mathematical means.[10] In the mean time, Beklemishev discusses the limits of applicability of Gödel's incompleteness theorems.[11]

Does Gödel's incompleteness theorem limit Artificial Intelligence?

In the 1950s and 1960s, researchers predicted that when human knowledge could be expressed using logic with mathematical notation, it would be possible to create a machine that reasons, or artificial intelligence. This turned out to be more difficult than expected because of the complexity of human reasoning.[12]

Nowadays, it is widely accepted that general purpose of artificial intelligence (AI) is to develop (1) conceptual models (2) formal rewriting processes of these models and (3) programming strategies and physical machines to reproduce as efficiently and thoroughly as possible the most authentic, cognitive, scientific and technical tasks of biological systems that we have labeled Intelligent [5, p.66].

According to Gelgi, Penrose claims that results of Gödel's theorem established that human understanding and insight cannot be reduced to any set of computational rules [1]. Gelgi goes on to say that:

> "Gödel's theorem states that in any sufficiently complex formal
>
> system there exists at least one statement that cannot be proven to
>
> be true or false. Penrose believes that this would limit
>
> the ability of any AI system in its reasoning. He argues that there
>
> will always be a statement that can be constructed which is unprovable
>
> by the AI system."[1]

The above question is very interesting to ponder, considering recent achievements in modern AI research. There are ongoing debates on this subject in many online forums, see for instance [5][6][7][8][9]. Here we give a summary of those articles and papers in simple words. Hopefully this effort will shed some light on this debatable subject. Those arguments basically stand either on the optimistic side (that Gödel's theorems do not limit AI), or on the pessimistic side (that Gödel's theorems limit AI).

Mechanism and reductionism in biology and implications to AI/AL

It is known that mechanistic or closely related reductionistic theories have been part of theoretical biology in one form or another at least since Descartes.[8] The various mechanistic and reductionistic theories are historically opposed to the much older and mostly debunked theories of vitalism (see Emmeche, 1991). These theories (the former more than the latter), along with formism, contextualism, organicism, and a number of other "isms" mark the major centers of thought in the modern theoretical biology debate (see Sattler, 1986).[8]

Such mechanistic and reductionistic view of the world were discussed by F. Capra in his book: The Turning Point [13].

According to Sullins III [8], AL (Artificial Life) falls curiously on many sides of these debates in the philosophy of biology. For instance AL uses the tools of complete mechanization, namely the computer, while at the same time it acknowledges the existence of emergent phenomena (Langton, 1987, p. 81). Neither mechanism nor reductionism is usually thought to be persuaded by arguments appealing to emergence. Facts like this should make our discussion interesting. It may turn out that AL is hopelessly contradictory on this point, or it may provide an escape route for AL if we find that Gödel's incompleteness theorems do pose a theoretical road block to the mechanistic-reductionistic theories in biology.

Sullins III also writes that most theorists have outgrown the idea that life can be explained wholly in terms of classical mechanics.[8] Instead, what is usually meant is the following (paraphrased from Sattler, 1986):

1) Living systems can and/or should be viewed as physico- chemical systems.

2) Living systems can and/or should be viewed as machines. (This kind of mechanism is

also known as the machine theory of life.)

3) Living systems can be formally described. There are natural laws which fully describe

living systems.

According to Sullins III[8], reductionism is related to mechanism in biology in that mechanists wish to reduce living systems to a mechanical description. Reductionism is also the name of a more general world view or scientific strategy. In this world view we explain phenomena around us by reducing them to their most basic and simple parts. Once we have an understanding of the components, it is then thought that we have an understanding of the whole. There are many types of reductionist strategies.[8]

According to Sullins III [8], reductionism is a tool or strategy for solving complex problems. There does not seem to be any reason that one has to be a mechanist to use these tools. For instance one could imagine a causal reductionistic vitalist who would believe that life is reducible to the elan vital or some other vital essence. And, conversely, one could imagine a mechanist who might believe that living systems can be described metaphorically as machines but that life was not reducible to being only a property of mechanics.

Sullins III [8] also asserts that the strong variety of AL does not believe that living systems should only be viewed as physico-chemical systems. AL is life-as-it-could-be, not life-as-we-know-it (Langton, 1989, p. 1), and this statement suggests that AL is not overly concerned with modeling only physico-chemical systems. Postulates 2 and 3 seem to hold, though, as strong AL theories clearly state that the machine, or formal, theory of life is valid and that simple laws underlie the complex, nonlinear behavior of living systems (Langton, 1989, p. 2).

Sullins III [8] goes on with his argument, saying that at least one of the basic qualities of our reality will always be missing from any conceivable artificial reality, namely, a complete formal system of mathematics. This argument tends to make more sense when applied to strong AI claims about intelligent systems understanding concepts (see Tieszen, 1994, for a more complete argument as it concerns AI). He also concludes that it is impossible to completely formalize an artificial reality that is equal to the one we experience, so AL systems entirely resident in a computer must remain, for anyone persuaded by the mathematical realism posited by Gödel, a science which can only be capable of potentially creating extremely robust simulations of living systems but never one that can become a complete instantiation of a living system.[8]

However, Sullins III [8] also writes that the value of this finding is not to discourage certain types of research in AL, but rather to help move us in a direction where we can more clearly define the results of that research. In fact, since one of the above arguments rests on the assumption that the universe is infinite and that some form of mathematical realism is true, if we are someday able to complete the goal advanced in strong AL it would seem to cast doubt on the validity of the assumptions made above.

For a recent debate on this issue in the context of fuzzy logic, see for instance Yalciner et al. [5]. The debates on the possibility of thinking machines, or the limitations of AI research, have never stopped. According to Yalciner et al. (2010), these debates on AI have been focused on three claims:

- An AI system is in principle an axiomatic system.

- The problem solving process of an AI system is equivalent to a Turing machine.

- An AI system is formal, and only gets meaning according to model theoretic semantic (Wang 2006).[16]

More than other new sciences, AI and philosophy have things to say to one to another: any attempt to create and understand minds must be of philosophical interest.[5]

May be we will never manage to build real artificial intelligence. The problem could be too difficult for human brain over to solve (Bostrom, 2003).

Yalciner et al. [5] also write that a fundamental problem in artificial intelligence is that nobody really knows what intelligence is. The problem is especially acute when we need to consider artificial systems which are significantly different to humans.

Human mind is beyond machine capabilities

According to Gelgi [1], it follows that no machine can be a complete or adequate model of the mind, that minds are essentially different from machines. This does not mean that a machine cannot simulate any piece of mind; it only says that there is no machine that can simulate every piece of mind. Lucas says that there may be deeper objections. Gödel's theorem applies to deductive systems, and human beings are not confined to making only deductive inferences. Gödel's theorem applies only to consistent systems, and one may have doubts about how far it is permissible to assume that human beings are consistent. [1]

Therefore it appears that there are some characteristics of human mind which go beyond machine capabilities. For example there are human capabilities as follows:

a. to synchronize with heart, i.e. to love and to comprehend love;

b. to fear God and to acknowledge God: "The fear of the LORD is the beginning of knowledge" (Proverbs 1:7)

c. to admit own mistakes and sins

d. to repent and to do repentance

e. to consider things from ethical perspectives.

All of the above capabilities are beyond the scope of present day AI machines, i.e. it seems that there is far distance between human mind capabilities and machine capabilities. However, we can predict that there will be much progress by AI research. For instance, by improving AI-based chess programs, one could see how far the machine can go.

Furthermore there are other philosophical arguments concerning the distinction between human mind and machine intelligence. Dreyfus contends that it is impossible to create intelligent computer programs analogous to the human brain because the workings of human intelligence are entirely different from that of computing machines. For Dreyfus, the human mind functions intuitively and not formally. Dreyfus's critique on AI proceeds from his critique on rationalist epistemological assumptions about human intelligence. Dreyfus's major attack targets the rationalist conception that human understanding or intelligence can be "formalized".[5, p.67]

We agree with the content related to the distinctions between Human and Computer. Yet, we think that the differences (Love, God, Own mistakes, Repentance, Ethical) between Human and Computer will be in the future little by little diminished, since it would be possible to train a computer at least for partial adjustments in each of them.

In addition to the fuzzy logic in AI, neutrosophic logic provides besides truth and falsehood a third component, called indeterminacy that can be used in AI, since many approaches of reality that AI has to model or describe involve a degree of uncertainty, unknown. Neutrosophic logic is a generalization of intuitionistic fuzzy logic.[15] We have a lot of unknown and paradoxist, contradictory information that AI has to deal with in our world.

The above argument can be seen as stronger than Penrose's.

However, one should admit the differences between human intelligence and machine intelligence. There are fundamental differences between the human intelligence and today's machine intelligence. Human intelligence is very good in identifying patterns and subjective matters. However, it is usually not very good in handling large amounts of data and doing massive computations. Nor can it process and solve complex problems with large number of constraints. This is especially true when real time processing of data and information is required. For these types of issues, machine intelligence is an excellent substitute.[5]

Concluding remarks

In the present paper we have discussed concerning Gödel's incompleteness theorem(s) and plausible implications to artificial intelligence/life and human mind.

Perhaps we should agree with Sullins III, that the value of this finding is not to discourage certain types of research in AL, but rather to help move us in a direction where we can more clearly define the results of that research. Gödel's incompleteness theorems have their own limitations, but so do Artificial Life (AL)/AI systems. Based on our experiences so far, human mind has incredible abilities to interact with other part of human body including heart, which makes it so difficult to simulate in AI/AL. However, it remains an open question to predict whether the future of AI including robotics science can bring this gap closer or not. In this regard, fuzzy logic and its generalization –neutrosophic logic- offer a way to improve significantly AI/AL research. [15]

1st version: march 8, 2013. 2nd version: march 18, 2013. 3rd version: march 30, 2013

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On recent discovery of new planetoids in the solar system and quantization of celestial system

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The present note revised the preceding article discussing new discovery of a new planetoid in the solar system. Some recent discoveries have been included, and its implications in the context of quantization of celestial system are discussed, in particular from the viewpoint of superfluid dynamics. In effect, it seems that there are reasons to argue in favor of gravitation-related phenomena from boson condensation.

Keywords: quantization, planetary orbit, quantized superfluid, boson condensation, gravitation

Discovery of new planetoids

Discovery of new objects in the solar system is always interesting for astronomers and astrophysicists alike, not only because such discovery is very rare, but because it also presents new observation data which enables astronomers to verify what has been known concerning how our solar system is functioning.

In recent years a number of new planetoids have been reported, in particular by M. Brown and his team [1][2][3][4]. While new planet discoveries have been reported from time to time, known as *exoplanets* [9][10], nonetheless discovery of new planetoids in the solar system are very interesting, because they are found after a long period of silence after Pluto finding, around seventy years ago. Therefore, it seems interesting to find out implications of this discovery to our knowledge of solar system, in particular in the context of quantization of celestial system.

As we discussed in the preceding article [5], there are some known methods in the literature to predict planetary orbits using quantumwave-like approach, instead of classical dynamics approach. These new approaches have similarity, i.e. they extend the Bohr-Sommerfeld's quantization of angular momentum to large-scale celestial systems. This application of wave mechanics to large-scale structures [6] has led to several impressive results in particular to predict orbits of exoplanets [8][9][10]. However, in the present note we will not discuss again the physical meaning of wave mechanics of such large-scale structures, but instead to focus on discovery of new planetoids in solar system in the context of quantization of celestial system.

As contrary as it may seem to present belief that it is unlikely to find new planets beyond Pluto, Brown *et al*. have reported not less than four new planetoids in the outer side of Pluto orbit, including 2003EL61 (at 52AU), 2005FY9 (at 52AU), 2003VB12 (at 76AU, dubbed as *Sedna*. It is somewhat different to our preceding article suggesting orbit distance = 86AU in accordance with ref. [14]). And recently Brown and his team report new planetoid finding, dubbed as 2003UB31 (97AU). This is not to include *Quaoar* (42AU), which has orbit distance more or less near Pluto (39.5AU), therefore this object is excluded from our discussion. Before discovery of 2003UB31

(Brown himself prefers to call it '*Lila*'), Sedna has been reported as the most distant object found in the solar system, but its mass is less than Pluto, therefore one could argue whether it could be considered as a 'new planet'. But 2003UB31 is reported to have mass definitely greater than Pluto, therefore Brown argues that it is definitely worth to be considered as a 'new planet'. (Table 1)

Table 1. Comparison of prediction and observed orbit distance of planets in the Solar system (in 0.1AU unit)

Object	No.	Titius	Nottale	CSV	Observed	Δ (%)
	1		0.4	0.428		
	2		1.7	1.71		
Mercury	3	4	3.9	3.85	3.87	0.52
Venus	4	7	6.8	6.84	7.32	6.50
Earth	5	10	10.7	10.70	10.00	-6.95
Mars	6	16	15.4	15.4	15.24	-1.05
Hungarias	7		21.0	20.96	20.99	0.14
Asteroid	8		27.4	27.38	27.0	1.40
Camilla	9		34.7	34.6	31.5	-10.00
Jupiter	2	52		45.52	52.03	12.51
Saturn	3	100		102.4	95.39	-7.38
Uranus	4	196		182.1	191.9	5.11
Neptune	5			284.5	301	5.48
Pluto	6	388		409.7	395	-3.72
2003EL61	7			557.7	520	-7.24
Sedna	8	722		728.4	760	4.16
2003UB31	9			921.8	970	4.96
Unobserved	10			1138.1		
Unobserved	11			1377.1		

Moreover, from the viewpoint of quantization of celestial systems, these findings provide us with a set of unique data to be compared with our prediction based on CSV hypothesis [5]. It is therefore interesting to remark here that all of those new 'planetoids' are within 8% bound compared to our prediction (Table 1). While this result does not yield high-precision accuracy, one could argue that this 8% bound limit corresponds to the remaining planets, including inner planets. Therefore this 8% uncertainty could be attributed to macroquantum uncertainty and other local factors.

What's more interesting here is perhaps that some authors have argued using gravitational Schrödinger equation [12], that it is *unlikely to find new planets beyond Pluto* because density distribution becomes near zero according to the solution of Schrödinger equation [7][8][11]. From this viewpoint, one could argue concerning to how extent applicability of gravitational Schrödinger equation to predict quantization of celestial systems, despite its remarkable usefulness to predict exoplanets [9][10].

Therefore in the subsequent section, we argue that using Ginzburg-Landau equation, which is more consistent with superfluid dynamics, one could derive similar result with known gravitational Bohr-Sommerfeld quantization [13][15]:

$$a_n = GMn^2 / v_o^{\ 2} \tag{1}$$

where a_n,G,M,n,v_o each represents orbit radius for given n, Newton gravitation constant, mass of the Sun, quantum number, and specific velocity (v_o=144 km/sec for Solar system and also exoplanet systems), respectively [7][8].

Interpretation

In principle the Cantorian superfluid vortex (CSV) hypothesis [5] suggests that the quantization of celestial systems corresponds to superfluid quantized vortices, where it is known that such vortices are subject to quantization condition of integer multiples of 2π, or $\oint v_s.dl = 2\pi.n\hbar/m_4$ [5]. For a *planar cylindrical case* of solar system, this hypothesis leads to Bohr-Sommerfeld-type quantization of planetary orbits. It is also worthnoting here, while likelihood to find planetoid at around 90AU has been predicted by some astronomers, our prediction of new planets corresponding to n=7 (55.8AU) and n=8 (72.8AU) were purely derived from Bohr-Sommerfeld quantization [5].

The CSV hypothesis starts with observation that in quantum fluid systems like superfluidity, quantized vortices are distributed in equal distance, which phenomenon is known as vorticity. In a large superfluid system, we usually use Landau two-fluid model, with normal and superfluid component. Therefore, in the present note we will not discuss again celestial quantization using Bohr-Sommerfeld quantization, but instead will derive equation (1) from Ginzburg-Landau equation, which is known to be more consistent with superfluid dynamics. To our knowledge, deriving equation (1) from Ginzburg-Landau equation has *never* been made before elsewhere.

According to Gross, Pitaevskii, Ginzburg, wavefunction of N bosons of a reduced mass m* can be described as [17]:

$$-(\hbar^2/2m^*).\nabla^2\psi + \kappa|\psi|^2\psi = i\hbar.\partial\psi/\partial t \qquad (2)$$

For some conditions, it is possible to substitute the potential energy term ($\kappa|\psi|^2$) in (2) by Hulthen potential, which yields:

$$-(\hbar^2/2m^*).\nabla^2\psi + V_{Hulthen}.\psi = i\hbar.\partial\psi/\partial t \qquad (3)$$

where Hulthen potential could be written in the form:

$$V_{Hulthen} = -Ze^2.\boldsymbol{d}.e^{-dr} / (1 - e^{-dr}) \quad (4)$$

It could be shown that for small values of screening parameter $\boldsymbol{d}$, the Hulthen potential (4) approximates the effective Coulomb potential:

$$V^{eff}_{Coulomb} = -e^2 / r + \ell(\ell + 1).\hbar^2 / (2mr^2) \quad (5)$$

Therefore equation (3) could be rewritten as:

$$-\hbar^2\nabla^2\boldsymbol{y} / 2m^* + \left[-e^2 / r + \ell(\ell+1).\hbar^2 / (2mr^2)\right].\boldsymbol{y} = i\hbar.\partial\boldsymbol{y} / \partial t \quad (6)$$

Interestingly, this equation takes the form of time-dependent Schrödinger equation. In the limit of time-independent case, equation (6) becomes similar with Nottale's time-independent gravitational Schrödinger equation from Scale relativistic hypothesis with Kepler potential [7][8][9]:

$$2D^2\Delta\Psi + (E / m + GM / r).\Psi = 0 \quad (7)$$

Solving this equation with Hulthen effect (4) will make difference, but for gravitational case it will yield different result only at the order of 10^{-39} m compared to prediction using equation (7), which is of course negligible. Therefore, we conclude that for most celestial quantization problems the result of TDGL-Hulthen (3) is *essentially* the same with the result derived from equation (7).

Furthermore, the extra potential to Keplerian potential in equation (5) is also negligible, in accordance with Pitkanen's remarks: "centrifugal potential $l(l+1)/r^2$ in the Schrödinger equation is negligible as compared to the potential term at large distances so that one expects that degeneracies of orbits with small values of l do not depend on the radius." [18]

It seems also worth noting here that planetoids 2003EL61 and 2005FY9 correspond to orbit distance of 52AU. This pair of planetoids could also be associated with Pluto-Charon pair. In the context of macroquantum phenomena of condensed matter physics, one could argue whether these pairs indeed correspond to macroobject counterpart of Cooper pairs [16]. While this conjecture remains open for discussion, we predict that more paired-objects similar to these planetoids will be found beyond Kuiper belt. This will be interesting for future observation.

Furthermore, while our previous prediction only limits new planetoids finding until n=9 of Jovian planets (outer solar system), it seems that there are more than sufficient reasons to expect that more planetoids are to be found in the near future. Therefore it is recommended to extend further the same quantization method to larger n values. For prediction purpose, we have included in Table 1 new expected orbits based on the same celestial quantization as described above. For Jovian planets corresponding to n=10 and n=11, our prediction yields likelihood to find orbits around 113.81 AU and 137.71 AU, respectively. It is recommended therefore, to find new objects around these predicted orbits.

In this note, we revised our preceding article suggesting that Sedna corresponds to orbit distance 86AU, and included recently found planetoids in the outer solar system as reported by Brown *et al*. While our previous prediction only limits new planet finding until n=9 corresponding to outer solar system, it seems that there are reasons to expect that more planetoids are to be found. While in the present note, we argue in favor of superfluid-quantized vortices, it does not mean to be the only plausible approach. Instead, we consider this discovery as a new milestone to lead us to find better cosmological theories, in particular taking into consideration some recent remarkable observation of exoplanets as predicted by wave mechanics approach.

Acknowledgment

Special thanks go to Profs. C. Castro, M. Pitkanen, R.M. Kiehn and A Rubcic for their insightful suggestion and remarks.

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First version, Aug. 5th 2005. 1st revised, Aug. 18th 2005.

Numerical solution of Schrödinger equation with PT-symmetric periodic potential, and its Gamow integral

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Abstract
In a number of preceding papers we introduced a new PT-symmetric periodic potential, derived from biquaternion radial Klein-Gordon equation. In the present paper we will review our preceding result, and continue with numerical solution of Gamow integral for that periodic potential. And then we also compare with other periodic potentials which are already known, such as Posch-Teller or Rosen-Morse potential. We also discuss a number of recent development in the context of condensed matter nuclear science, in particular those experiments which are carried out by Prof. A. Takahashi and his team from Kobe University. There is hint to describe his team's experiment as 'mesofusion' (or mesoscopic fusion). We then analyze possibility to enhance the performance of Takahashi's mesofusion experiment under external pulse field. Further experiments are of course recommended in order to verify or refute the propositions outlined herein.

a. Introduction

In a number of preceding papers we introduced a new PT-symmetric periodic potential, derived from biquaternion radial Klein-Gordon equation. [1][2] In the present paper we will review our preceding result, and continue with numerical solution of Gamow integral for that periodic potential. And then we also compare with other periodic potentials which are already known, such as Posch-Teller or Rosen-Morse potential [9][10][11].

We also discuss a number of recent development in the context of condensed matter nuclear science, in particular those experiments which are carried out by Prof. A. Takahashi and his team from Kobe University [6][7]. There is hint to describe his team's experiment as 'mesofusion' (from mesoscopic fusion). We then analyze possibility to enhance the performance of Takahashi's mesofusion experiment under external pulse field.

Further experiments are recommended in order to verify or refute the propositions outlined herein.

b. PT-symmetric periodic potential and its Gamow integral

In this section, first we will review our preceding result on the periodic potential based on radial Klein-Gordon equation, and then we discuss its numerical solution for Gamow integral.

There were some attempts in literature to introduce new type of symmetries in Quantum Mechanics, beyond the well-known CPT symmetry, chiral symmetry etc. In this regards, in recent years there are new interests on a special symmetry in physical systems, called PT-symmetry with various ramifications.

It has been argued elsewhere that it is plausible to derive a new PT-symmetric Quantum Mechanics (PT-QM) which is characterized by a PT-symmetric potential [3][4]:

$$V(x) = V(-x) \,. \quad (1)$$

One particular example of such PT-symmetric potential can be found in sinusoidal-form potential:

$$V = \sin\alpha \,. \quad (2)$$

PT-symmetric harmonic oscillator can be written accordingly [3]. Znojil has argued too [4] that condition (1) will yield Hulthen potential:

$$V(\xi) = \frac{A}{\left(1-e^{2i\xi}\right)^2} + \frac{B}{\left(1-e^{2i\xi}\right)} \,. \quad (3)$$

In our preceding paper [2][5], we argue that it is possible to write biquaternionic extension of Klein-Gordon equation as follows:

$$\left[\left(\frac{\partial^2}{\partial t^2} - \nabla^2\right) + i\left(\frac{\partial^2}{\partial t^2} - \nabla^2\right)\right]\varphi(x,t) = -m^2\varphi(x,t) \,, \quad (4)$$

Or this equation can be rewritten as:

$$\left(\Diamond\bar{\Diamond} + m^2\right)\varphi(x,t) = 0 \,, \quad (5)$$

Provided we use this definition:

$$\begin{aligned} \Diamond = \nabla^q + i\nabla^q &= \left(-i\frac{\partial}{\partial t} + e_1\frac{\partial}{\partial x} + e_2\frac{\partial}{\partial y} + e_3\frac{\partial}{\partial z}\right) \\ &+ i\left(-i\frac{\partial}{\partial T} + e_1\frac{\partial}{\partial X} + e_2\frac{\partial}{\partial Y} + e_3\frac{\partial}{\partial Z}\right) \end{aligned} \quad (6)$$

Where e_1, e_2, e_3 are *quaternion imaginary units* obeying (with ordinary quaternion symbols: e_1=i, e_2=j , e_3 =k):

$$\begin{aligned} &i^2 = j^2 = k^2 = -1 \,,\ ij = -ji = k \,, \\ &jk = -kj = i \,, ki = -ik = j \,. \end{aligned} \quad (7)$$

And quaternion *Nabla operator* is defined as [2][5]:

$$\nabla^q = -i\frac{\partial}{\partial t} + e_1\frac{\partial}{\partial x} + e_2\frac{\partial}{\partial y} + e_3\frac{\partial}{\partial z} \quad (8)$$

Note that equation (8) already included partial time-differentiation.

Therefore one can expect to use the same method described above to find solution of radial biquaternion KGE [2][5].

First, the standard Klein-Gordon equation reads:

$$\left(\frac{\partial^2}{\partial t^2}-\nabla^2\right)\varphi(x,t)=-m^2\varphi(x,t)\,. \tag{9}$$

At this point we can introduce polar coordinate by using the following transformation:

$$\nabla=\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial}{\partial r}\right)-\frac{\ell^2}{r^2}\,. \tag{10}$$

Therefore by introducing this transformation (10) into (9) one gets (by setting $\ell=0$):

$$\left(\frac{1}{r^2}\frac{\partial}{\partial r}\left(r^2\frac{\partial}{\partial r}\right)+m^2\right)\varphi(x,t)=0\,. \tag{11}$$

Using similar method (10)-(11) applied to equation (5), then one gets radial solution of BQKGE for 1-dimensional condition [2][5]:

$$\left(\frac{1}{r^2}\frac{\partial}{\partial r}\left(\frac{\partial}{\partial r}\right)-\frac{1}{r^2}\frac{\partial}{\partial r}\left(\frac{\partial}{\partial r}\right)+m^2\right)\varphi(x,t)=0\,, \tag{12}$$

Using Maxima computer package we find solution of (12) as a new potential taking the form of sinusoidal potential:

$$y=k_1\sin\left(\frac{|m|r}{\sqrt{-i-1}}\right)+k_2\cos\left(\frac{|m|r}{\sqrt{-i-1}}\right), \tag{13}$$

Where k_1 and k_2 are parameters to be determined. Now if we set k_2 =0, then we obtain the potential function in the form of PT-symmetric periodic potential (2):

$$V=k_1\sin(\alpha)\,, \tag{14}$$

Where $\alpha=\left(\frac{|m|r}{\sqrt{-i-1}}\right)$.

In a recent paper [8], we interpret and compare this result from the viewpoint of EQPET/TSC model which has been suggested by Prof. Takahashi in order to explain some phenomena related to Condensed matter nuclear Science (CMNS).

c. Schrödinger equation and Gamow integral of PT-symmetric periodic potential

Now let us consider a PT-Symmetric potential of the form:

$$V=k_1.\sin(\beta.r)\,, \tag{15}$$

where

$$\beta=\frac{|m|}{\sqrt{-i-1}}\,. \tag{16}$$

Hence, the respective Schrödinger equation with this potential can be written as follows:

$$\Psi''(r) = -k^2(r).\Psi(r) \tag{17}$$

Where

$$k(r) = \frac{2m}{\hbar^2}[E - V(r)] = \frac{2m}{\hbar^2}[E - k_1.\sin(b.r)] \tag{18}$$

For the purpose of finding Gamow function, in area near x=a we can choose linear approximation for Coulomb potential, such that:

$$V(x) - E = -\alpha(x-a), \tag{19}$$

Substitution to Schrödinger equation yields:

$$\Psi'' + \frac{2m\alpha}{\hbar^2}(x-a)\Psi = 0 \tag{20}$$

which can be solved by virtue of Airy function.

In principle, the Gamow function can be derived as follows:

$$\frac{d^2y}{dx^2} + P(x)y = 0 \tag{21}$$

Separating the variables and integrating, yields:

$$\int \frac{d^2y}{y} = \int -P(x).dx \tag{22}$$

Or

$$y.dy = \exp(-\int P(x).dx) + \mathrm{C}) \tag{23}$$

To find solution of Gamow function, therefore the integral below must be evaluated:

$$\gamma = \sqrt{\frac{2m}{\hbar^2}[V(x) - E]} \tag{24}$$

The general expression of Gamow function then is defined by:

$$\Gamma \approx \frac{1}{\eta^2} = \exp(-2\int_a^b \gamma(x)dx) \tag{25}$$

Therefore it should be clear that we can find different solutions for any given form of potential. In the present paper we will only consider a few potential, namely Takahashi's block-type potential (he called it STTBA model), and our PT-symmetric periodic potential. Rosen-Morse potential will be compared for the results only.

c.1. Takahashi's STTBA-block-type potential

For the case of Takahashi experiment [3][4][5], we can use b=5.6fm, and r_0=5fm, where the Gamow function is given by:

$$\Gamma = 0.218\sqrt{\mu}.\int_{r0}^{b}(V_b - E_d)^{1/2}.dr \qquad (26)$$

Where he obtained V_b=0.256 MeV.

c.2. PT-symmetric periodic potential (14)

Here we assume that E=V_b=0.257MeV. Therefore the integral becomes:

$$\Gamma = 0.218\sqrt{\mu}.\int_{r0}^{b}(k_1 \sin(\beta r) - 0.257)^{1/2}.dr \qquad (27)$$

By setting boundary conditions:

(a) at r=0 then Vo=-Vb—0.257 MeV
(b) at r=5.6fm then V1=$k_1 \sin(br) - 0.257$=0.257Mev,therefore one can find estimate of m.
(c) Using this procedure solution of the equation (11) can be found.

The interpretation of this Gamow function is the tunneling rate of the fusion reaction of cluster of deuterium (with the given data) corresponding to Takahashi data, with the difference that here we consider a PT-symmetric periodic potential.

c.3. Rosen-Morse potential [8]

Another type of potential which may be considered here is known as Rosen-Morse potential [9][10]:

$$v = -2b.\cot|z| + a(a+a).\csc^2|z|, \qquad (28)$$

Where z=r/d. Therefore the Gamow function can be written, respectively:

$$\Gamma = 0.218\sqrt{\mu}.\int_{r0}^{b}((-2b.\cot|z| + a(a+a).\csc^2|z|) - 0.257)^{1/2}.dr \qquad (29)$$

(This section is not complete yet).

Some new findings indicating Condensed matter nuclear science and Mesofusion

In this section, we can mention that the most obvious objection against cold fusion is that the Coulomb wall between two nuclei makes the mentioned processes extremely unlikely to happen at low temperature. We can also mention here that there are three known reaction types in thermo fusion:

a. D+D → ^{4}He+γ (23.8 MeV)
b. D+D → ^{3}He+n
c. D+D → ^{3}He+p

In this regards we would like to mention here some clear reasons why cold fusion cannot be analyzed in the classical framework of fission or 'thermo' fusion:

a. No gamma rays are seen;
b. The flux of energetic neutron is much lower than expected on basis of the heat production rate;
c. Lack of signature of D-D reaction;
d. Isotopes of Helium and also tritium accumulate to the Pd samples;
e. Cold fusion appears to occur more effective in Pd nano-particles [6][7];
f. The ratio of x to D atoms to Pd atoms in Pd particle must be in the critical range [0.85,0.90] for the process to occur.

Other strict experimental conditions may also be considered before we can expect repeatability of this process. In this regards, a recent experiment in Arata Hall, Osaka University, on May 22 2008 by Arata has clearly demonstrated that this process did happen. Because the experiment took place at Arata-Zhang laboratory, it then was referred to as Arata-Zhang experiment [6]. Other teams also produced excellent results, for example Prof. Takahashi and his Kobe University team [7].

The basic element of Takahashi's series of experiments is that a periodic potential of the Bloch wave type, as shown in the Figure 1 below.

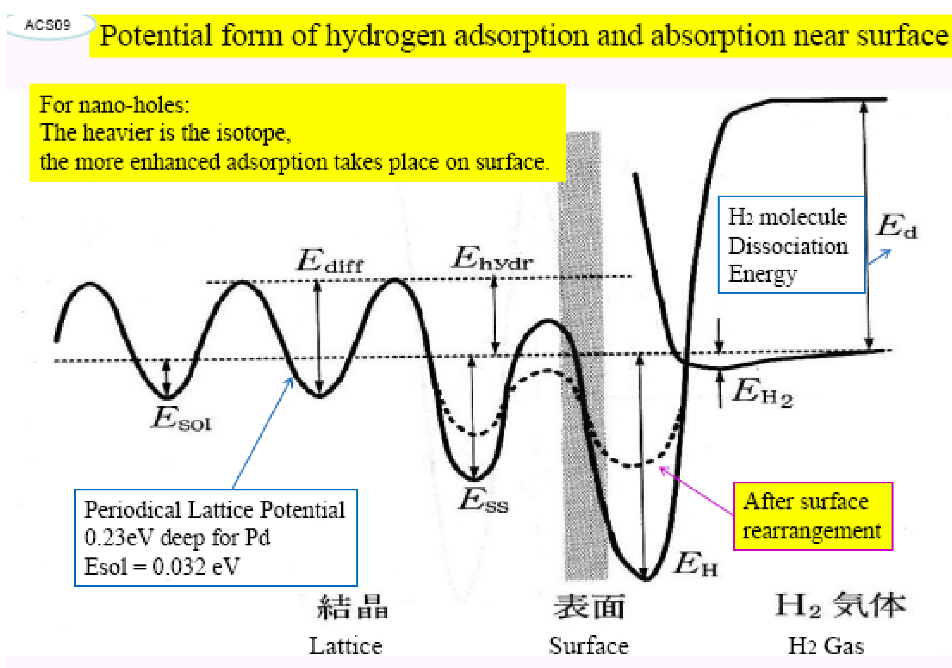

Figure 1. Lattice periodic potential used by Takahashi et al. [7]

From another line of reasoning, one can also consider this possibility of low-temperature fusion. Consider the heat production in our Earth, that some researchers consider it produced by nuclear fission or fusion. But considering that the Earth is lacking uranium (by statistical distribution), chance is that fission is unlikely, but the temperature inside the Earth is clearly much lower than the Sun, therefore the hotfusion is also unlikely to happen. Therefore apparently we can infer that inside the Earth, the heat is produced either as Condensate Nuclear transmutation (CMNS), or other types of low-energy nuclear reaction (LENR).

In other words, if we would like to keep ourselves a bit open-minded, then there other questions too which we don't find quick answer even in the natural processes surrounding us. This would mean as an indication that new types of transmutation processes should be taken into consideration as a possibility.

In this regards perhaps it would be useful to discuss a possible categorization of these new possibilities beyond standard (thermo) fusion process:

a. <u>CANR:</u> or chemically aided nuclear reaction, which essentially uses special types of chemical substance or enzymes [8]. For instance, see hydrino experiments (hydrino.org). Other chemists may prefer to use isoprenoids to create this new effect.
b. <u>LENR:</u> low-energy nuclear reaction [8], or some researchers may prefer to call it 'Lattice fusion Reaction', that is perhaps a more proper name for cold-fusion and other types of deuterium reaction which happens far below the Gamow energy. The name 'lattice fusion' also implies that the process includes neutron in some kind of solid-state physics. An indication that the fusion associated to LENR is outside the domain of standard fusion processes is lack of signature of D-D reaction, which would mean that perhaps the process is much more complicated (for instance Takahashi considered tetra-deuterium model). There is also indication of lacking of neutron emission during this process [7]. We will discuss more on these issues in subsequent section.
c. <u>Mesofusion (or mesoscopic fusion):</u> this belongs to experiments which can be associated to nano-Pd samples for instance by Takahashi and his team in Japan [6]. While this term is not well accepted yet, in our opinion this type of reactions will be much more common in particular for industrial applications, since nanometer devices are much more manageable rather than materials at the order of lepton or hadron scale.

Concluding remarks: Next steps

We would like to conclude this note with a number of some kinds of wish-list.

First of all, a rigorous theoretical framework is clearly on demand. This for instance, will include both to clarify the distinction between Mesofusion and Chromodynamics fusion, and also to consider new type of potentials.

And then, in terms of experiments it appears to be more interesting to introduce new types of tools in order to enhance the performance of these Mesofusion or Chromodynamics fusions. For instance, perhaps it would be interesting to see whether the performance can be improved by introducing either laser or external electromagnetic pulse, just like what has been done in the conventional thermo fusion.

All of these remarks are written here to emphasize that based on recent publication [5]-[8], we are clearly in the beginning of observing new types of fusion technologies, by harnessing our knowledge of hadron and chromodynamics theory.

Acknowledgement

The first author would like to thank to Profs. A. Yefremov and M. Fil'chenkov for kind hospitality extended to him in the Institute of Gravitation and Cosmology, PFUR. Special thanks to Profs. Y.P. Rybakov and N. Samsonenko for excellent guide on Quantum Chromodynamics theory; and to Prof. A. Takahashi for recent discussion on the Pd/PdO experiments with his team.

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- 1st draft: 24 may 2009, 2nd draft: 26 may 2009.

From fractality of quantum mechanics to Bohr-Sommerfeld's quantization of planetary orbit distance

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Abstract

In the present paper, we use periodic orbit quantization as suggested by Bohr-Sommerfeld in order to analyze quantization in astrophysical phenomena, i.e. planetary orbit distances. It is known that one can deduce Bohr-Sommerfeld quantization rules from Burger's turbulence [4], and recently such an approach leads to a subfield in physics known as quantum turbulence [5]. Further recommendation for generalizing Bohr-Sommerfeld quantization rules is also mentioned.

Introduction

It is known that quantum mechanics exhibits fractality at d_F=2, and an extensive report has been written on this subject and its related issues [1]. Moreover, a fractal solution of time-dependent Schrodinger equation has been suggested some time ago by Datta [2]. On the other side, if one takes a look at planetesimals in the case of planetary system formation, interstellar gas and dust in the case of star formation, the description of the trajectories of these bodies is in the shape of non-differentiable curves, and we obtain fractal curves with fractal dimension 2 [3]. This coincidence between fractality of quantum mechanics and fractal dimension of astrophysical phenomena seems to suggest that we can expect to use quantum mechanical methods such as wave mechanics and periodic orbit quantization to analyze astrophysical phenomena. Such an analysis has been carried out for example by Nottale and Celerier [3] in order to describe these phenomena from the viewpoint of macroscopic Schrodinger equation.

In the present paper, we use periodic orbit quantization as suggested by Bohr-Sommerfeld in order to analyze quantization in astrophysical phenomena, i.e. planetary orbit distances. It is known that one can deduce Bohr-Sommerfeld quantization rules from Burger's turbulence [4], and recently such an approach leads to a subfield in physics known as quantum turbulence [5]. Therefore, turbulence phenomena can also yield quantization, which also seems to suggest that turbulence and quantized vortice is a fractal phenomenon.

We will present Bohr-Sommerfeld quantization rules for planetary orbit distances, which will obtain the same result with a formula based on macroscopic Schrodinger equation.

Further recommendation for generalizing Bohr-Sommerfeld quantization rules is also mentioned.

Bohr-Sommerfeld quantization rules and planetary orbit distances

It was suggested in [6] and [7] that Bohr-Sommerfeld quantization rules can yield an explanation of planetary orbit distances of the solar system and exoplanets. Here, we begin with Bohr-Sommerfeld's conjecture of quantization of angular momentum. As we know, for the wavefunction to be well defined and unique, the momenta must satisfy Bohr-Sommerfeld's quantization condition:

$$\oint_{\Gamma} p.dx = 2\pi.n\hbar, \tag{1}$$

for any closed classical orbit Γ. For the free particle of unit mass on the unit sphere the left-hand side is:

$$\int_0^T v^2.d\tau = \omega^2.T = 2\pi.\omega, \tag{2}$$

Where $T = \frac{2\pi}{\omega}$ is the period of the orbit. Hence the quantization rule amounts to quantization of the rotation frequency (the angular momentum): $\omega = n\hbar$. Then we can write the force balance relation of Newton's equation of motion:

$$\frac{GMm}{r^2} = \frac{mv^2}{r}. \tag{3}$$

Using Bohr-Sommerfeld's hypothesis of quantization of angular momentum (2), a new constant g was introduced:

$$mvr = \frac{ng}{2\pi}. \tag{4}$$

Just like in the elementary Bohr theory (just before Schrodinger), this pair of equations yields a known simple solution for the orbit radius for any quantum number of the form:

$$r = \frac{n^2.g^2}{4\pi^2.GMm^2}, \tag{5}$$

or

$$r = \frac{n^2.GM}{v_o^2}, \quad (6)$$

Where r, n, G, M, v_0 represents orbit radii (semimajor axes), quantum number (n=1,2,3,...), Newton gravitation constant, and mass of the nucleus of orbit, and specific velocity, respectively. In equation (6), we denote:

$$v_0 = \frac{2\pi}{g} GMm. \quad (7)$$

The value of m and g in equation (7) are adjustable parameters.

Interestingly, we can remark here that equation (6) is exactly the same with what is obtained by Nottale using his Schrodinger-Newton formula [8]. Therefore here we can verify that the result is the same, either one uses Bohr-Sommerfeld quantization rules or Schrodinger-Newton equation. The applicability of equation (6) includes that one can predict new exoplanets (extrasolar planets) with remarkable result.
Furthermore, one can find a neat correspondence between Bohr-Sommerfeld quantization rules and motion of quantized vortice in condensed-matter systems, especially in superfluid helium [9]. In this regards, a fractional Schrodinger equation has been used to derive two-fluid hydrodynamical equations for describing the motion of superfluid helium in the fractal dimension space [10]. Therefore, it appears that fractional Schrodinger equation corresponds to superfluid helium in fractal dimension space.

Discussion and results

With the help of equation (6) one can describe planetary orbit distances of both the inner planets and Jovian planets in the solar system [7]. See Table 1. Moreover, we were able to predict three new planets in the outer-side of Pluto. This new prediction of three planets beyond the orbit distance of Pluto is made based on our method called CSV (Cantorian Superfluid Vortex) [7].

Table 1: Comparison of prediction and observed orbit distance of planets in Solar system (in 0.1AU unit)

Object	No.	Titius-Bode	Nottale [8]	CSV [7]	Observed	Δ (%)
	1		0.4	0.43		
	2		1.7	1.71		
Mercury	3	4	3.9	3.85	3.87	0.52
Venus	4	7	6.8	6.84	7.32	6.50
Earth	5	10	10.7	10.70	10.0	-6.95

Object	No.	Titius-Bode	Nottale [8]	CSV [7]	Observed	Δ (%)
Mars	6	16	15.4	15.4	15.24	-1.05
Hungarias	7		21.0	20.96	20.99	0.14
Asteroid	8		27.4	27.38	27.0	1.40
Camilla	9		34.7	34.6	31.5	-10.00
Jupiter	2	52		45.52	52.03	12.51
Saturn	3	100		102.4	95.39	-7.38
Uranus	4	196		182.1	191.9	5.11
Neptune	5			284.5	301	5.48
Pluto	6	388		409.7	395	-3.72
2003EL61	7			557.7	520	-7.24
(Sedna)	8	722		728.4	(760)	(4.16)
2003UB31	9			921.8	970	4.96
Unobserv.	10			1138.1		
Unobserv.	11			1377.1		

For inner planets, our prediction values are very similar to Nottale's (1996) values, starting from n = 3 for Mercury; for n = 7 Nottale reported minor object called Hungarias. It is worth noting here, we don't have to invoke several *ad hoc* quantum numbers to predict orbits of Venus and Earth as Neto *et al*. (2002) did [7]. We also note here that the proposed method results in prediction of orbit values, which are within a 7% error range compared to observed values, except for Jupiter which is within a 12.51% error range.
The departure of our predicted values compared to Nottale's predicted values (1996, 1997, 2001) appear in outer planet orbits starting from n = 7. We proposed some new predictions of the possible presence of three outer planets beyond Pluto (for n = 7, n = 8, n = 9) [7]. It is very interesting to remark here, that this prediction is in good agreement with Brown-Trujillo's finding (March 2004, July 2005) of planetoids in the Kuiper belt [13][14][15]. Although we are not sure yet of the orbit of Sedna, the discovery of 2003EL61 and 2003UB31 are apparently in quite good agreement with our prediction of planetary orbit distances based on CSV model.
Therefore, we can conclude that while our method as described herein may be interpreted as an oversimplification of the real planetary migration process which took place sometime in the past, at least it could provide us with useful tool for prediction [6b]. Now we also provide new prediction of other planetoids which are likely to be observed in the near future (around 113.8AU and 137.7 AU). It is recommended to use this prediction as guide to finding new objects (in the inner Oort Cloud).
What we would like to emphasize here is that the quantization method does not have to be the *true* description of reality with regards to celestial phenomena. As always this method could explain some phenomena, while perhaps lacks explanation for other phenomena. But

at least it can be used to predict something quantitatively, i.e. measurable (exoplanets, and new planetoids in the outer solar system etc.).
In the mean time, a correspondence between Bohr-Sommerfeld quantization rules and Gutzwiller trace formula has been shown in [11], indicating that the Bohr-Sommerfeld quantization rules may be used also for complex systems. Moreover, a recent theory extends Bohr-Sommerfeld rules to a full quantum theory [12].

Concluding remarks

In the present paper, we use periodic orbit quantization as suggested by Bohr-Sommerfeld in order to analyze quantization in astrophysical phenomena, i.e. planetary orbit distances. It is known that one can deduce Bohr-Sommerfeld quantization rules from Burger's turbulence [4], and recently such an approach leads to a subfield in physics known as quantum turbulence [5].

We presented Bohr-Sommerfeld quantization rules for planetary orbit distances, which will obtain the same result with a formula based on macroscopic Schrodinger equation.

Further recommendation for generalizing Bohr-Sommerfeld quantization rules is also mentioned.

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On Primordial rotation of the Universe, Hydrodynamics, Vortices and angular momenta of celestial objects

Victor Christianto[1]

Abstract

In the present paper, we make some comments on a recent paper by Sivaram & Arun in *The Open Astronomy Journal* 2012, 5, 7-11 with title: 'Primordial rotation of the Universe, Hydrodynamics, Vortices and angular momenta of celestial objects', where they put forth an interesting idea on the origin of rotation of stars and galaxies based on torsion gravity. We extend further their results by hypothesizing the presence of quantized vortices in relation with the torsion vector. If the hypothesis is proven and observed, then it can be used to explain numerous unexplainable phenomena in galaxies etc. The quantization of circulation can be generalized to be Bohr-Sommerfeld quantization rules, which are found useful to describe quantization in astrophysical phenomena, i.e. planetary orbit distances. Further recommendation for observation of the proposed quantized vortices of superfluid helium in astrophysical objects is also mentioned.

Introduction

Two recent papers by Sivaram & Arun, one in *The Open Astronomy Journal* 2012, 5, 7-11 [1], and one in arXiv [2] are found very interesting. They are able to arrive at the observed value of effective cosmological constant by considering background torsion in the teleparallel gravity. According to them: "*the background torsion due to a universal spin density not only gives rise to angular momenta of all structures but also provides a background centrifugal term acting as a repulsive gravity accelerating the universe, with spin density acting as effective cosmological constant*."[1] The torsion is given by [1, p.10]:

$$Q = \frac{4\pi G\sigma}{c^3} \approx 10^{-28}\,cm^{-1}, \qquad (1)$$

And the background curvature [1, p.10] is given by:

$$Q^2 \approx 10^{-56}\,cm^{-2}. \qquad (2)$$

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In the meantime, a recent review of dark energy theories in the literature (including *teleparallel gravity*) has been given in [4], and present problems in the standard model general relativistic cosmology are discussed by Starkman [5]. These seem to suggest that a torsion model of effective cosmological constant based on teleparallel gravity as suggested by Sivaram and Arun (2012) seems very promising as a description of phenomena related to accelerated expansion of the Universe usually attributed to *'dark energy'* (as alternative to cosmological constant explanation).

However, Sivaram & Arun do not make further proposition concerning the connection between quantized vortices (Onsager-Feynman's rule) and the torsion vector. It will be shown here, that such a connection appears possible.

Here we present Bohr-Sommerfeld quantization rules for planetary orbit distances, which results in a good quantitative description of planetary orbit distance in the solar system [6][6b][7]. Then we find an expression which relates the torsion vector and quantized vortices from the viewpoint of Bohr-Sommerfeld quantization rules [3].

Further observation of the proposed quantized vortices of superfluid helium in astro-physical objects is recommended.

Bohr-Sommerfeld quantization rules and quantized vortices

The quantization of circulation for nonrelativistic superfluid is given by [1][3]:

$$\oint v dr = N \frac{\hbar}{m_s} \tag{3}$$

Where $N, \hbar, m_s$ represents winding number, reduced Planck constant, and superfluid particle's mass, respectively [3]. And the total number of vortices is given by [1]:

$$N = \frac{\omega .2\pi r^2 m}{\hbar} \tag{4}$$

And based on the above equation (4), Sivaram & Arun [1] are able to give an estimate of the number of galaxies in the universe, along with an estimate of the number stars in a galaxy.

However, they do not give explanation between the quantization of circulation (3) and the quantization of angular momentum. According to Fischer [3], the quantization of angular momentum is a relativistic extension of quantization of circulation, and therefore it yields Bohr-Sommerfeld quantization rules.

Furthermore, it was suggested in [6] and [7] that Bohr-Sommerfeld quantization rules can yield an explanation of planetary orbit distances of the solar system and exoplanets. Here, we begin with Bohr-Sommerfeld's conjecture of quantization of angular momentum. As we know, for the wavefunction to be well defined and unique, the momenta must satisfy Bohr-Sommerfeld's quantization condition:

$$\oint_{\Gamma} p.dx = 2\pi.n\hbar, \tag{5}$$

for any closed classical orbit Γ. For the free particle of unit mass on the unit sphere the left-hand side is:

$$\int_0^T v^2.d\tau = \omega^2.T = 2\pi.\omega, \tag{6}$$

Where $T = \frac{2\pi}{\omega}$ is the period of the orbit. Hence the quantization rule amounts to quantization of the rotation frequency (the angular momentum): $\omega = n\hbar$. Then we can write the force balance relation of Newton's equation of motion:

$$\frac{GMm}{r^2} = \frac{mv^2}{r}. \tag{7}$$

Using Bohr-Sommerfeld's hypothesis of quantization of angular momentum (6), a new constant g was introduced:

$$mvr = \frac{ng}{2\pi}. \tag{8}$$

Just like in the elementary Bohr theory (just before Schrodinger), this pair of equations yields a known simple solution for the orbit radius for any quantum number of the form:

$$r = \frac{n^2.g^2}{4\pi^2.GMm^2}, \tag{9}$$

or

$$r = \frac{n^2.GM}{v_o^2}, \tag{10}$$

Where r, n, G, M, v_o represents orbit radii (semimajor axes), quantum number (n=1,2,3,…), Newton gravitation constant, and mass of the nucleus of orbit, and specific velocity, respectively. In equation (10), we denote:

$$v_0 = \frac{2\pi}{g} GMm. \qquad (11)$$

The value of m and g in equation (11) are adjustable parameters.

Interestingly, we can remark here that equation (10) is exactly the same with what is obtained by Nottale using his Schrodinger-Newton formula [8]. Therefore here we can verify that the result is the same, either one uses Bohr-Sommerfeld quantization rules or Schrodinger-Newton equation. The applicability of equation (10) includes that one can predict new exoplanets (extrasolar planets) with remarkable result.
Therefore, one can find a neat correspondence between Bohr-Sommerfeld quantization rules and motion of quantized vortices in condensed-matter systems, especially in superfluid helium [3]. Here we propose a conjecture that Bohr-Sommerfeld quantization rules also provide a good description for the motion of galaxies, therefore they should be included in the expression of torsion vector. We will discuss an expression of torsion vector of quantized vortices in the next section.

Torsion and quantized vortices

We cite here a rather old paper of Garcia de Andrade & Sivaram, 1998 [9], where they discuss propagation torsion model for quantized vortices. They consider the torsion to be propagating and it can be expressed as derivative of scalar field:

$$Q = \nabla \phi. \qquad (12)$$

Therefore $\oint Q dS$ can be written as [9]:

$$\oint Q dS = \oint \nabla \phi dS = \int \nabla (\nabla \phi) dV \cong \int \nabla^2 \phi dV. \qquad (13)$$

Also $\oint Q dS$ must have dimensions of length, and thus quantized as [9]:

$$\oint Q dS \cong \frac{n\hbar c}{M} \qquad (14)$$

Now we invoke a result from the preceding section discussing Bohr-Sommerfeld quantization rules. Assuming that Bohr-Sommerfeld quantization rules also govern the galaxies motion as well as stars motion, then we can insert equation (11) into equation (14), to yield a new expression:

$$\oint Q dS \cong \frac{n\hbar c.2\pi Gm}{v_0 g} \qquad (15)$$

Therefore, we submit a viewpoint that the torsion vector is also a quantized quantity, and it is a function of Planck constant, speed of light, Newton gravitation constant, vortex particle's mass, a specific velocity and an adjustable parameter, g. It is interesting to find out whether this proposition agrees with observation data or not.

The above proposition (15) connects torsion vector with gravitation constant, which seems to give a torsion description of gravitation. There are numerous other models to describe alternative or modified gravitation theories, for instance Wang is able to derive Newton's second law and Schrodinger equation from fluid mechanical dynamics. [10][11]

In the mean time, for discussion of galaxy disk formation, see [12]. And [13] gives alternative vortices argument for dark matter.

The proposed quantization of circulation as suggested by Sivaram and Arun [1] is based on a conjecture that the universe is formed by superfluid or condensed matter. For models describing further this proposition, see discussion in Brook [14].

Concluding remarks

In the present paper, we make some comments on a recent paper by Sivaram & Arun in *The Open Astronomy Journal* 2012, 5, 7-11 where they put forth an interesting idea on the origin of rotation of stars and galaxies based on torsion gravity. We extend further their results by hypothesizing the presence of quantized vortices in relation with the torsion vector. If the hypothesis is proven and observed, then it can be used to explain numerous unexplainable phenomena in galaxies etc.

Further recommendation for observation of the proposed quantized vortices of superfluid helium in astrophysical objects is also mentioned.

VC, November 15th, 2012, email: victorchristianto@gmail.com

Published in *Prespacetime Journal*, December 2012, http://www.prespacetime.com

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Grand design, intelligent designer, or simply God:

Stephen Hawking and his hoax*

3 sep 2010

There are a number of good reasons to say that big bang support evolution theory's idea of creation by pure statistical chance alone. And that is why: some people do think that big bang can happen out of nothing. That standpoint of view, albeit not new, are reiterated by stephen hawking from Cambridge, in his latest book: the grand design.[1][2]

Another middle-point of view, if you are believer of middle-viewpoint, is that there is a substantial amount of complexity which is irreducible in nature, sufficient enough to say that there must be the Grand Intelligent Designer, according to Behe and a host of other proponents of ID.[3][4] But still they do not want to admit that there should be God who are behind those flawless creations.

Now if you are really an astronomy person, you can free your mind of those emotional baggage from philosophical school or other pseudo-teacher who do not prove anything in their life, and start to think afresh from data:

a. If big bang is true, then the universe stabilize and evolve to become more and more structured, but that is in contradiction to the basic proposition of second law of thermodynamics, that entropy is created continuously along the time. Using this argument alone, which stephen hawking should be more adept because he is famous for his black hole entropy which has never been observed, then one can argue that big bang create entropy along the course of time, and by doing so the universe is eventually getting more and more inherently chaotic. This is in contradiction with big bang proponents' own proposition.

b. Furthermore, typical of philosopher like stephen hawking (even if he said that philosophy is dead), he only wish to have his words heard, regardless without sufficient proof. For you to know, according to black hole proponents, there should be blackhole inside the galaxy center of our Milky way. But despite there is very large mass inside the Milky way center, its center remains bright,[5] that is enough disproof for all hypotheses of black hole by stephen hawking.

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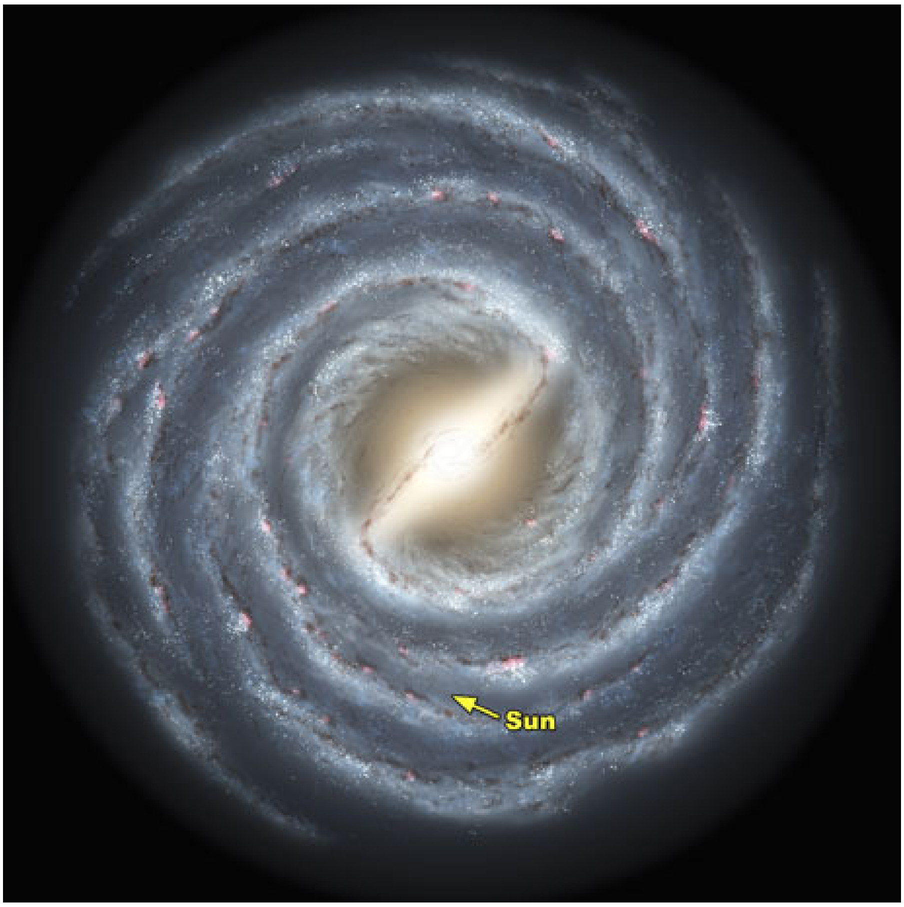

Picture. milky way center show a bar and bright center, and not a black hole. url:
http://news.nationalgeographic.com/news/2005/08/0817_050817_milkywaybar.html

c. If you are honest astronomer, there is growing consensus of the universal law which suggest not only irreducible complexity, but also scale-organization (note that this time we do not use self-organization terminology or s.o.c.). By scale organization we mean that there is seemingly organization across different scales, which can be characterized for instance by hausdorff dimension ~2, for instance across different astrophysics observation.[6] There is also hint pointing toward ordering in nature, for instance quantization of planets both in solar system and beyond (exoplanets) which seem to suggest that the Grand Designer, means clearly God, do create and recreate the universe.[7]

d. Some other clever physicist like Erwin Schrodinger has suggested that there should be negative-entropy in order to resolve the contradiction of entropy in the big bang and time progress, but nobody seem to observe the negative entropy until now.

e. Similar hausdorff measure can be found in quantum mechanics. Feynman already mentioned that quantum mechanics are characterized by dimension ~2. See the work of Ord, Nottale, and others for they are already completing their program concerning scale relativity theory.[7]

f. Even if your calculation points to something, which this time we should verify if stephen hawking calculate his own proposition, saying that you can create something out of nothing is not only ridiculous but awkward, just the same way as you always think of black hole which do not exist.

g. Hawking apparently argue in his last book, that based on quantum theory then the universe has multiverse-history, but that is only if we accept the notion of sum-over-history and path-integral quantum mechanics. The meaning is that what he says is full of 'ifs', furthermore hawking's model is full of fine-tuning of parameters (quote: "We discuss how the laws of our particular universe are extraordinarily finely tuned so as to allow for our existence…"), just like what M-theory proponents are busy trying in order they can explain elementary particles (especially particle masses) . Do not be misguided by hawking only because he often poke you with philosophical questions, because this guy has not the same quality of Einstein to ponder things deeply even with simple thinking-experiments (hawking apparently lack this quality, he only cite and recite Einstein's questions and reinterpret that questions to what he likes to think). The result of quantization model in astrophysics, suggest that the distance between the Sun and Earth, for instance is not result of anthropic principle, but can be derived from a wave-equation model.[7] Actually, anthropic principle is another circular logic type of thinking, kind of thinking which an old guy tend to use to fool a young student.

h. Another remarkable coincidence is that the Cosmic Microwave Background Temperature, that is 2.73 degree Kelvin, are surprisingly resemble menger sponge dimension. In other words, the Cosmos may look like a big sponge just like what Zel'dovich outlined a few years ago.[8]

i. Of course, microbiologist or paleontologist or philanthropist like bill gates perhaps has their own way to say whether they prefer to be believers of God or not. And even if you are a philosophy student, then you may have risk to get your grade scaled down only because you admit that you do not swallow all evolution garbage.

Finally, to quote last comment by Paul Sheldon in [1]:

"I choose to believe in a God that is so kind as to permit me to understand without dismissing me with “Just because I said so”. Such a God does do something in the universe: he is what Jaim Ginnott called a good teacher/student. My faith says I and the entire research community are manifestations of God."

What can we conclude from enormous number of astronomic observation? Apparently, if one is humble enough, then one can say along with the Psalm 19:1 : “The heavens declare the glory of God; and the firmament sheweth His handy work.” And that: “God looked down from heaven upon the children of men, to see if there were any that did understand, that did seek God.” (Psalm 53:2).

Sept. 3, 2010. Revised 1: sept. 4, 2010

love, Jesus Christ

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Gravitational Schrödinger equation from Ginzburg-Landau equation, and its noncommutative spacetime coordinate representation

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Despite known analogy between condensed matter physics and various cosmological phenomena, a neat linkage between low-energy superfluid and celestial quantization is not yet widely accepted in literature. In the present article we argue that gravitational Schrödinger equation could be derived from time-dependent Ginzburg-Landau (or Gross-Pitaevskii) that is commonly used to describe superfluid dynamics. The solution for celestial quantization takes the same form with Nottale equation. Provided this proposed solution corresponds to the facts, and then it could be used as alternative solution to predict celestial orbits from quantized superfluid vortice dynamics. Furthermore, we also discuss a representation of the wavefunction solution using noncommutative spacetime coordinate. Some implications of this solution were discussed particularly in the context of offering a plausible explanation of the physical origin of quantization of motion of celestial objects.

Keywords: superfluidity, Bose-Einstein condensate, vortices, gravitation, celestial quantization

Introduction

There has been a growing interest in some recent literatures to consider gravity as scalar field from boson condensation [1]. This conjecture corresponds to recent proposals suggesting that there is neat linkage between condensed matter physics and various cosmological phenomena [2,3]. In this regard, it is worth noting here that some authors have described celestial quantization from the viewpoint of gravitational Schrödinger-type wave equation [4]. Considering that known analogy between condensed matter physics and various cosmological phenomena, then it seems also plausible to describe such a celestial quantization from the viewpoint of condensed-matter physics, for instance using Gross-Pitaevskii (GP) or Ginzburg-Landau wave equation.

In the present article, we derived gravitational Schrödinger-type wave equation from various equations known in condensed matter physics, including Gross-Pitaevskii (GP) equation and also time-dependent Ginzburg-Landau (TDGL) wave equation. This method could be regarded as 'inverse' way from method discussed in Berger's article [5], suggesting that it is possible to extend Schrödinger equation to TDGL using De Broglie potential. Provided this neat linkage from TDGL/GPE and Schrödinger equation is verified by observation, then it seems to support a previous conjecture of a *plausible linkage between celestial quantization and quantized vortices* [4]. And then we discuss some issues related to describing cosmological phenomena in terms of diffusion theory of gravitational Schrödinger-type equation, though this issue has been discussed in the preceding articles [3,8,9]. Furthermore, following our argument that it is possible to find noncommutative representation of the wavefunction [4], and then we will discuss a plausible interpretation of the gravitational

Schrödinger equation in terms of *noncommutative spacetime* coordinate. This extension to noncommutative coordinate perhaps will be found useful for further research. And if this proposition corresponds to the astrophysical facts, then it can be used to explain the origin of quantization in astrophysics [7][8].

An alternative method to find solution of gravitational Schrödinger-type equations

The present author acknowledged that the proposed method on relating cosmological phenomena with condensed-matter/low-energy physics has not been widely accepted yet, though some of these approaches have been used to predict phenomena corresponding to neutron stars [12,39]. Furthermore, there is also a deeper question concerning the appropriateness of using and solving gravitational Schrödinger-type equations for depicting cosmological phenomena, beyond what is called as Wheeler-DeWitt (WDW) equation. It should be noted here that our derivation method is somewhat different from Neto *et al.*'s approach [14], because we use Legendre polynomials approach.

Now we are going to find solution of the most basic form of Schrödinger-type equation using Legendre polynomials, from which we will obtain the same expression with known Nottale's quantization equation [11]. We start with noting that Schrödinger equation is derived from a wave of the form:

$$\Psi = a.\sin 2px / l \quad (1)$$

By deriving twice equation (1), then we get the most basic form of Schrödinger equation:

$$d^2\Psi / dx^2 + A.\Psi = 0 \quad (2)$$

where for planetary orbits, it can be shown [13, 5] that we get:

$$A = 4\pi / \lambda^2 = \omega^2 / v^2 = m\omega^2 /(2.KE) \qquad (3)$$

Solution of equation (2) is given by:

$$\chi = C_1.\exp(\rho / 2) + C \; .\exp(-\rho / 2) \qquad (4)$$

But we shall reject the first term because it will result in infinity for large distance (ρ>>0). This suggests solution of the form [14]:

$$\chi = F(\rho).\exp(-\rho / 2) \qquad (5)$$

Substituting (5) into (2), we get:

$$d^2F / d\rho^2 - dF / d\rho + A.F = 0 \qquad (6)$$

Now we shall find the series solution to (6) and put:

$$F = \sum_{p=1}^{\infty} a_p . \rho^p \qquad (7)$$

The lower limit of this summation is p=1 rather than p=0, otherwise F and therefore χ would not be zero at ρ=0. Thus [14]:

$$dF / d\rho = \sum_{p=1}^{\infty} p.a_p . \rho^{p-1} \qquad (8)$$

$$d^2F / d\rho^2 = \sum_{p=1}^{\infty} (p+1) p.a_{p+1} . \rho^{p-1} \qquad (9)$$

$$F / \rho^2 = a_1 . \rho^{-1} + \sum_{p=1}^{\infty} .a_{p+1} . \rho^{p-1} \qquad (10)$$

By inserting these equations (7), (8), (9), and (10) into equation (6), and observing that *each power of* ρ *mush vanish*, and by inserting our defiition of variable A from equation (3) and inserting the kinetic energy definition $KE = GMm/2r$, and then we could find the expression for orbital radii which is similar to Nottale's equation [11]:

$$r_o = n^2.GM / v_o^2 \qquad (11)$$

Therefore we observed that a solution using Legendre polynomials yields the same expression with Nottale's quantization equation [11]. It is also obvious that some assumptions must be invoked in order to find the proper asymptotic solution.

On celestial quantization from GPE and TDGL

In a preceding article we provided simplified derivation of equation of quantization of planetary orbit distance based on Bohr-Sommerfeld hypothesis of quantization of angular momentum [4], which could be considered as 'retro' version of Bohr-Sommerfeld quantization method in microphysics. As shown above, similar quantization result can be derived from generalized Schrödinger-Newton equation suggested by L. Nottale [11].

But this Schrödinger-type wave equation does not exactly correspond to the superfluid theory or condensed matter, therefore in the present article we will derive Schrödinger-type wave equation based on GP/TDGL equation, which is commonly used to describe superfluid medium [3]. It will be shown that the previous solution (11) based on gravitational Schrödinger-type equation is only an approximation of a more general GP/TDGL equation, becauses it neglects nonlinear effects like temperature dependent or screening potential. This conjecture of quantum vortice dynamics also corresponds to hypothesis by Winterberg of superfluid phonon-roton as Planckian quantum vacuum aether [9].

First, we will discuss how to get Schrödinger-type equation from GP equation, and then from TDGL. At subsequent section we will discuss other nonlinear Schrödinger-type equation from Chern-Simons theory.

a. Gross-Pitaevskii equation (GPE)

As we know, superfluid medium is usually described using GP equation, or sometimes known as nonlinear Landau-Ginzburg equation or nonlinear Schrödinger equation (NLSE) [12,2]. In the GP theory the ground state and weakly excited states of a Bose gas are described by the condensate wave function ψ=a.exp(iϕ) which is a solution of the nonlinear Schrödinger equation [6]:

$$i\hbar.\partial \psi / \partial t = -\hbar^2 / 2m.\nabla^2 \psi + V\,|\psi|^2\,\psi \qquad (12)$$

where V is the amplitude of two-particle interaction.

It has been argued [6], that two-fluid hydrodynamics relations can be derived from the hydrodynamics of an ideal fluid in presence of thermally excited *sound waves*, i.e. phonon scattering by a vortex line. In order to obtain a complete system of equations of the two-fluid theory, one should take into consideration phonon-phonon interaction, which is essential for the phonon distribution function being close to the equilibrium Planck distribution. It was shown in [1], that this sound wave of boson condensate system consists of phonons with *sound velocity* of $c_s^{\,2} = \partial P / \partial (m\rho) = \pi''\rho / m$.

Furthermore, the phonon scattering by a vortex line is analogous to the so-called Aharonov effect for electrons scattered by a magnetic-flux tube, which analogy becomes more evident if one rewrites the sound equation [6] in presence of the vortex as:

$$k^2 \varphi - \left(-i\vec{\nabla} + k\vec{v}_v / c_s\right)^2 \varphi = 0 \qquad (13)$$

But the stationery Schrödinger equation for an electron in presence of the magnetic flux confined to a thin tube is given by [6]:

$$E\,\psi(\vec{r}) = 1/2m.\left(-i\hbar\vec{\nabla} - e\vec{A}/c\right)^2 \psi(\vec{r}) \qquad (14)$$

Here ψ is the electron wave function with energy E and the electromagnetic vector potential is connected with the magnetic flux ϕ by the relation similar to that for the velocity $\vec{v}_v$ around the vortex line [6]:

$$\vec{A} = \Phi.\left[\hat{z}x\vec{r}\,\right] / 2\pi r^2 \qquad (15)$$

In other words, we have outlined a logical mapping [6]: (i) from GP (NLSE) equation to the two-fluid hydrodynamics; (ii) from hydrodynamics to the phonon scattering equation; (iii) from phonon scattering to electron scattered by magnetic-flux tube, and (iv) from electron scattering back to the stationery Schrödinger equation. Now it is worthnoting here, that there is *exact solution* of Aharonov effect for electrons obtained by the partial wave expansion. To find the solution of equation (14), partial-wave amplitudes ψ_l should satisfy equations in the cylindrical system of coordinates (r,φ) [6]:

$$d^2\boldsymbol{y}_l / dr^2 + 1/r.d\boldsymbol{y}_l / dr - (1-\boldsymbol{g})^2.\boldsymbol{y}_l / r^2 + k^2.\boldsymbol{y}_l = 0 \tag{16}$$

where

$$E = k^2\hbar^2 / 2m \tag{17}$$

or

$$k^2 = 2m.KE/\hbar^2 = 1/\boldsymbol{l}^2 \tag{18}$$

where KE, $\hbar$, $\boldsymbol{l}$ denotes the kinetic energy of the system, Planck constant and wavelength, respectively. From this equation (16), then we shall find a solution, which at large distances has an *asymptotic* character expressed in exponential form of ψ=α.exp(β), which is typical solution of Schrödinger-type equation; where α and β are functions of some constants.

Because equation (16) is an ordinary differential equation in planar cylindrical system of coordinates, we consider that this equation corresponds to the celestial quantization if we insert proper values of Newtonian equation [4]. Therefore in the subsequent derivation we will not follow the standard partial wave analysis method as described in [6], but instead we will use a method to find solution of ordinary differential equation of Schrödinger equation: $a=n^2.GM/v_o^2$, which is in accordance with Nottale's solution [11]. Here a, n, G, M, v_o, represents semimajor axes, quantum number (n=1,2,3,…), Newton gravitation constant, mass of nucleus of gravitation field, and specific velocity, respectively.

Solution of equation (16) is given by $\psi_1(r,\varphi)= R(r).F(\phi)$. Inserting this relation into (16), and separating the $F(\phi)$ terms, then we get the *ground state* expression of the system ($m^2=0$ case):

$$d^2R/dr^2 + 1/r.(dR/dr) - [(1-g)^2/r^2 + k^2].R = 0 \qquad (19)$$

The solution for R(r) is given by :

$$R(r) = [e^{-a.r} + e^{a.r}] \qquad (19a)$$

In order to get the sought-after *asymptotic* solution for equation (16), we only use the negative expression of R(r), otherwise the solution will diverge to infinity at large distance r:

$$R(r) = e^{-a.r} \qquad (20)$$

Therefore

$$dR(r)/dr = -a.e^{-a.r} \qquad (21)$$

$$d^2R(r)/dr^2 = a^2.e^{-a.r} \qquad (22)$$

Inserting (19a)-(22) into equation (19) and eliminating the exponential term $e^{-a.r}$, yield:

$$a^2 = 1/r^2.\{ar + (1-g)^2 - r^2k^2\} \qquad (23)$$

Because equation (23) must be right for any value of r, then the right hand side of equation (23) between the {} brackets must equal to zero:

$$ar + (1-g)^2 - r^2k^2 = 0 \qquad (24)$$

Maple solution for equation (24) is included in the Appendix section, which yields for g :

$$g = 1 \pm \sqrt{a^2r^2 - ar + k^2r^2} \qquad (25)$$

The remaining part is similar to equation (10)-(11), by inserting kinetic energy definition for gravitational potential.

Therefore we conclude that the right term between the {} brackets yields a secondary effect to the equation of celestial quantization, except for some condition where this extra term vanishes. To this author's knowledge, this secondary effect has never been derived before; neither in Nottale [11], nor Neto *et al*. [13]. In our method, the secondary effect comes directly from the partial wave analysis expression of GP equation.

Therefore we obtain a generalised form of the equation of celestial quantization [11], which has taken into consideration the secondary interaction effect of GPE. The expected value for γ can be estimated by equating the right term between the {} brackets to one.[1] However, it is not too clear in what kind of conditions this right term in the bracket will disappear, therefore we are going to discuss another approach for deriving gravitational Schrödinger-type equation, i.e. using TDGL (time-dependent Ginzburg-Landau equation).

b. Time-dependent Ginzburg-Landau equation (TDGL)

It is known that Ginzburg-Landau (TDGL) equation is more *consistent* with known analogy between superfluidity and cosmological phenomena [2][3], and TDGL could also describe vortex nucleation in rotating superfluid [19]. According to Gross, Pitaevskii, Ginzburg, wavefunction of N bosons of a reduced mass m* can be described as [20]:

$$-(\hbar^2/2m^*).\nabla^2 y + k|y|^2 y = i\hbar.\partial y/\partial t \tag{26}$$

It is worthnoting here that this equation is quite similar to Jones' nonlinear Schrödinger equation to describe gravitational systems [21]. For some conditions, it is possible to replace the potential energy term in equation (26) by Hulthen potential. This substitution yields:

$$-(\hbar^2/2m^*).\nabla^2 y + V_{Hulthen}.y = i\hbar.\partial y/\partial t \tag{27}$$

where

$$V_{Hulthen} = -Ze^2.\boldsymbol{d}.e^{-dr}/(1-e^{-dr}) \qquad (28)$$

This equation (27) has a pair of exact solutions. It could be shown that for small values of $\boldsymbol{d}$, the Hulthen potential (28) approximates the effective Coulomb potential, in particular for large radius:

$$V^{eff}_{Coulomb} = -e^2/r + \ell(\ell+1).\hbar^2/(2mr^2) \qquad (29)$$

Inserting (29) into equation (27) yields:

$$-\hbar^2\nabla^2 y/2m^* + \left[-e^2/r + \ell(\ell+1).\hbar^2/(2mr^2)\right].y = i\hbar.\partial y/\partial t \qquad (30)$$

While this equation is interesting to describe neutron model, calculation shows that introducing this Hulthen effect (28) into gravitational equation will yield different result only at the order of 10^{-39} m compared to prediction using equation (11), which is of course negligible. Therefore, we conclude that for most celestial quantization problems the result of TDGL with Hulthen potential (28) is *essentially* the same with the result derived from equation (11).

Some implications to cosmology model

The approach described in the previous section using arguments based on condensed matter physics also implies that the linear and point-like topological defects also induce an effective metric, which can be interesting for the theory of gravitation. In this regards, the vortex can be considered as cosmic spinning string.[2]

Another question can be asked here, i.e. to how extent GP equation could be regarded as *exact representation* of cosmological phenomena, because there are arguments suggesting that GP equation is only an approximation [23]. For instance, Castro *et al.* [22] argued that GP equation of NLSE has some weakness, i.e. it does not meet Weinberg homogeneity condition.

Therefore, it becomes obvious that there is also a typical question concerning whether such Schrödinger-type wave function expression corresponds to vortices description in hydrodynamics. In this regard, it seems worth here to consider a more rigorous approach based on Chern-Simons hydrodynamics. Pashaev & Lee [24] reformulated the case of Abelian Chern-Simons gauge field interacting with Nonlinear Schrodinger field as planar Madelung fluid. In this regard, the Chern-Simons Gauss law has simple physical meaning of creation of the local vorticity for the fluid flow; which appears very similar to Kiehn's derivation using Navier-Stokes argument [17,27]. Then Pashaev & Lee [24] obtained the following nonlinear wave equation:

$$iD_0\Psi + D^2\Psi/2m - U\Psi = (1-\hbar^2)/2m.(\Delta|\Psi|.\Psi/|\Psi|) \tag{31}$$

where

$$D_0 = \partial + \in /c.A_0 \tag{32}$$

$$D = \nabla + \in /c.A \tag{33}$$

Then in terms of a new wave function

$$\boldsymbol{c} = \sqrt{\boldsymbol{r}}.\exp(iS/\hbar) \tag{34}$$

they recovered the standard linear Schrödinger equation:

$$i\hbar D_0\boldsymbol{c} + D^2\boldsymbol{c}.\hbar/2m - U\boldsymbol{c} = 0 \tag{35}$$

Thus they concluded that for $\hbar \neq 0$ equation (34) is gauge equivalent to the Schrödinger equation, while for $\hbar = 0$ it reduces to nonlinear wave equation of classical mechanics. The semiclassical limit has been applied to defocusing NLSE [24]:

$$i\hbar\partial_t\boldsymbol{c} + \Delta\boldsymbol{c}.\hbar^2/2m + 2g|\boldsymbol{c}|^2\boldsymbol{c} = 0 \tag{36}$$

which provides an analytical tool to describe shockwave in nonlinear optics and vortices in superfluid. In the formal semiclassical limit $\hbar \to 0$ (before shocks), *one neglects the quantum potential and fluid becomes the Euler system*. Introducing the local velocity field:

$$V = 1/m.[\nabla S + e/c.A] \tag{37}$$

And then they obtained a hydrodynamical model defined by two equations:

$$\partial V/\partial t + (V\nabla)V = -\nabla(-2g\boldsymbol{r} - \hbar^2/2m.\Delta\sqrt{\boldsymbol{r}}/\sqrt{\boldsymbol{r}})/m \qquad (38)$$

$$\nabla x V = e^2\boldsymbol{r}/(m\boldsymbol{k}c^2) \qquad (39)$$

Therefore we concluded that a more rigorous representation of quantum fluid admits vortice configuration. It is perhaps interesting to remark here, that these equations differ appreciably from Nottale's basic Euler-Newton equations [11]:

$$m.(\partial/\partial t + V.\nabla)V = -V(\boldsymbol{f} + Q) \qquad (40)$$

$$\partial\boldsymbol{r}/\partial t + div(\boldsymbol{r}V) = 0 \qquad (41)$$

$$\Delta\boldsymbol{f} = -4\boldsymbol{p}G\boldsymbol{r} \qquad (42)$$

which of course neglect vortice configuration.

Upon generalizing the solution derived above, we could expect to see some plausible consequences in cosmology. For instance, that (i) there should be a kind of Magnus-Iordanskii type force observed in astrophysical phenomena, and (ii) that there should be *hollow tubes* inside the center of spinning large celestial bodies, for instance in the Sun and also large planets, including this Earth;[3] (iii) the universe is also very likely to rotate, in accord with recent observation by Nodland & Ralston [25];[4] (iv) the notion of gravitational constant could be related to cosmological temperature [3]; and (v) there exists *ergoregions* in the rotating centers of celestial objects where phonon particles are continuously created [26]. This phenomenon of phonon creation in the ergoregions may offer a rational basis of the observed continuous expansion of the universe. However, it shall be noted here that all of these plausible consequences to cosmology require further research.

Furthermore, some recent observations have concluded that our universe has fractality property. For clarity, the number of galaxies N(r) within a sphere of radius r, centered on any galaxy, is not proportional to r^3 as would be expected of a homogeneous distribution. Instead N(r) is proportional to r^D, where D is approximately equal to 2, which is symptomatic to distribution with fractal dimension D. It is interesting to note, for D=2, the cosmological gravitational redshift gives the linear distance-redshift relation and becomes an observable phenomenon [28]. This property is indicated by its Hausdorff dimension, which can be computed to be within the range of 1.6 ~ 2.0 up to the scale of 200 Mpc. Furthermore, transition to homogeneity distribution has not been found yet. In this regard, P.W.Anderson *et al*. [29] also remarked: "*These findings (of clustering and void formation) have become increasingly difficult to reconcile with standard cosmological theories, in which the approach to homogeneity at large-scales is central element.*" It is worth noting here that perhaps this fractality property can be explained using boson condensate model with non-integer dimension. It has been argued that such a boson condensate system exhibits Hausdorff dimension d_H~2 [30]. There is also article arguing in favor of relating the fractal dimension with fluctuation graph [31]:

$$D = 2 - \alpha / 2 \quad \text{for } \alpha \leq 2 \tag{43}$$

where α is the time decay exponent. Furthermore, it was shown recently that an extended version of *GP equation admits self-similar* solutions and also it corresponds to Hausdorff dimension d_H~2 [23], which seems to confirm our hypothesis that there is exact correspondence between cosmological phenomena and condensed matter physics [1,2].

Therefore this Hausdorff dimension argument seems to be a plausible restriction for a good cosmology theoretical model: *Any cosmology theory which cannot exhibit fractality property from its intrinsic parameters perhaps is not adequate to explain inhomogeneity of large scale structures in universe.*

It is also worthnoting here, that an alternative argument in favor of cosmology with d_H~2 has been considered recently by Roscoe [30], which corresponds to Mach principle. While his argument seems very encouraging and perhaps it is also deeply interwoven with arguments presented herein, it shall be noted that his argument suggests the universe *must* have a fractal dimension d_H~2, while in the context of condensed matter physics it can fluctuates around 1.6~2.0 as observed [7]. Furthermore, by making an allusion to Newton's argument, Roscoe also did not consider any physical origin of such fractal distribution of masses in the universe, except that it corresponds to the nature of quantum vacuum aether. Nonetheless, Roscoe's conjecture on the presence of universal clock is very interesting.

Furthermore, if the equation of quantization of celestial motion derived herein from GPE/TDGL equation corresponds to the observed astrophysical facts, then it implies that it seems possible now to conduct a set of laboratory experiments as replica of some cosmological objects [2], provided we take into consideration proper scale modeling (similitude) theories.

Noncommutative spacetime representation

In this section we are going to discuss an alternative representation of the abovementioned Schrödinger equation using noncommutative spacetime coordinate, based on Vancea [33]. According to Vancea, the stationary Schrödinger equation is constructed by analogy with the commutation case an has the following form [33]:

$$H(x,p)*\Psi(x)=E.\Psi(x) \tag{44}$$

Here the wavefunction Ψ belongs to the noncommutative algebra, A_*. If explicit form of Schrödinger equation is given by [33]:

$$\left[-\hbar/2M.\sum_{m=1}^{2N}\partial_m^2+V\right]*\Psi=E\Psi \tag{45}$$

where V(x) is an arbitrary function from A_* and M is the mass of particle. The star product in the kinetic term is equal to the commutative product. Therefore, following the commutative case, the coordinates x^s for k=1,2,…,2N is a variable, and the coordinate x^k for is fixed. Equation (45) could be rewritten in the form [33]:

$$\left[-\hbar^2\partial_k{}^2/2M+V_k*\Psi\right](x)=E\Psi(x) \tag{46}$$

Supposed that there are two solutions of the equation (45) denoted by Ψ_k and $\tilde{\Psi}_k$. Then they are linearly dependent, i.e. there are two nonzero complex numbers c_k and $\tilde{c}_k$, such that the following relations hold simultaneously

$$\Psi_k=-\tilde{c}_k/c_k.\tilde{\Psi}_k \tag{47a}$$

$$\partial_k\Psi_k=-\tilde{c}_k/c_k.\partial_k\tilde{\Psi}_k \tag{47b}$$

Now, by introducing the quantum prepotential defined as in the commutative case by the following relation

$$\tilde{\Psi}_k\equiv\partial F^k\left[\Psi_k\right]/\partial\Psi_k \tag{48}$$

Then the relation between noncommutative coordinate x^k and wavefunction has the following form;

$$x^k=F^k\left[\Psi_k\right]-\tilde{\Psi}_k/2*\Psi_k-f^k\left(x^s\right) \tag{49}$$

This result appears interesting because now our gravitational wavefunction (11) could be given spacetime coordinate representation. This would be interesting subject for further study of the connection between condensed matter wavefunction (GPE/TDGL) and spacetime metric.

Concluding remarks

In the present article, we derived an alternative derivation of celestial quantization equation based on GPE/TDGL equation. It was shown that the obtained solution is also applicable to describe various phenomena in cosmology, including inhomogeneity and clustering formation. In this regard, fractality property emerges naturally from the theoretical model instead of invoked; and it corresponds to the observed value [7] of Hausdorff dimension ranging from 1.6~2.0 in universe up to the scale of 200 Mpc.

It could be expected therefore that in the near future there will be more rigorous approach to describe this fractality phenomena both in boson condensate and also in astrophysics, from which we can obtain a coherent picture of their interaction. Another interesting issue for future research in this regard, is extending the solution derived herein to include superfluid turbulence and also finding its implications in astrophysics.

Acknowledgement

Special thanks go to Profs. C. Castro, RM. Kiehn, M. Pitkanen, and E. Bakhoum for various insightful discussions. Thanks also to anonymous referee for sending a Maple solution for equation (24).

1st draft: May 23rd, 2005.

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Appendix

Thanks to a note by anonymous referee, a Maple solution is included here to find solution of Schrodinger type radial equation from GPE (24). This solution indicates that for an exponential solution to present, this requires that extra term of GPE must vanish.

```
> #Partial Wave analysis
> restart;
>  with (linalg):

> R:=exp(-(alpha*r));
D1R:=diff(R,r);D2R:=diff(D1R,r);
```

$$R := \mathbf{e}^{(-\alpha\, r)}$$

$$D1R := -\alpha\, \mathbf{e}^{(-\alpha\, r)}$$

$$D2R := \alpha^2\, \mathbf{e}^{(-\alpha\, r)}$$

Formulate the partial wave equation referenced from Sonin[6]

```
> SCHEQ:=D2R+D1R/r-(1-g)^2*R/r^2+(k)^2*R;
```

$$SCHEQ := \alpha^2\, \mathbf{e}^{(-\alpha\, r)} - \frac{\alpha\, \mathbf{e}^{(-\alpha\, r)}}{r} - \frac{(1-g)^2\, \mathbf{e}^{(-\alpha\, r)}}{r^2} + k^2\, \mathbf{e}^{(-\alpha\, r)}$$

```
> XX1:=factor(SCHEQ);
```

$$XX1 := \frac{e^{(-\alpha r)} (\alpha^2 r^2 - \alpha r - 1 + 2g - g^2 + k^2 r^2)}{r^2}$$

```
For the assumed exponential solution to be true,
the bracket must vanish.
HENCE: the roots of the quadratic equation are:
EITHER (solving for g)
```

> **GG:=solve(XX1,g);KK:=solve(XX1,k);AA:=solve(XX1,alpha);**

>

$$GG := 1 + \sqrt{\alpha^2 r^2 - \alpha r + k^2 r^2}, 1 - \sqrt{\alpha^2 r^2 - \alpha r + k^2 r^2}$$

```
or (solving for k)
```

$$KK := \frac{\sqrt{-\alpha^2 r^2 + \alpha r + 1 - 2g + g^2}}{r}, -\frac{\sqrt{-\alpha^2 r^2 + \alpha r + 1 - 2g + g^2}}{r}$$

```
or (solving for alpha)
```

$$AA := \frac{\frac{1}{2} + \frac{1}{2}\sqrt{5 - 8g + 4g^2 - 4k^2 r^2}}{r}, \frac{\frac{1}{2} - \frac{1}{2}\sqrt{5 - 8g + 4g^2 - 4k^2 r^2}}{r}$$

End note:

[1] Another expression for γ was described in Ref. [37]:

$$g = 16\sqrt{2p}.Ana^{3}.(a_{h}/a).\sqrt{T_{c}\ /T}.\sqrt{\hbar w/k_{B}.T}$$

though it is not yet clear whether this expression could be directly used for cosmological phenomena.

[2] This author acknowledged Prof. C. Castro and Prof. C. Beck for suggesting that there is plausible correspondence between superfluid vortice model and (random) string theory.

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