

Abstracts and Summary of Publications on GUT, its Mathematics and Applications

The articles below are arranged in the order of completion, not on the basis of date of publication, to avoid the technical problem of referencing. A number of publications were delayed considerably, some as much as five years. This series of publications constitutes the Grand Unified Theory (GUT), its Mathematics and applications and the much broader Grand Unification of Natural Dynamics (GUND). GUND encompasses macro and quantum gravity and unites all physical systems from dark to visible and organic to inorganic.

(1) The Mathematics of Singularities. Trans. National Academy of Science and Technology (Philippines), Manila, 1992, pp. 141 - 153.

Abstract. This is the initial development of the generalized fractal that provides the essential mathematics for the study of dark matter. It shows how a curve of any length can be shrunk into an infinitesimal neighborhood of a point with its length preserved, the essence of black hole formation. The paper paves the way for the development of the superstring as a physical concept and the basic constituent of dark matter. Its axial projection is a rapid sinusoidal curve. Shrinking it towards infinitesimal neighborhood enhances its frequency and raises its latent energy indefinitely. A black hole is massive concentration of non-agitated superstrings that accumulates in the eye of a cosmological vortex.

(2) Probabilistic Mathematics and Applications to Dynamic Systems Including Fermat's Last Theorem. Proc. 2nd International Conference on Dynamical Systems and Applications, Dynamic Publishers, Inc., Atlanta, 1996, pp. 147 - 152.

Abstract. The paper characterizes undecidability and establishes that Fermat's last theorem is undecidable. It proposes probabilistic proof for undecidable propositions. Moreover, the paper has an introduction to the solution of the gravitational n-body problem presented at the World Congress of Nonlinear Analysts, that same year and published in *Nonlinear Analysis* the following later.

(3). Exact Solutions of Fermat's Equation (Definitive Resolution of Fermat's Last Theorem (FLT)). *Nonlinear Studies*, **5**(2), 1998, pp. 227 - 254.

Abstract. The inability to resolve this problem for 360 years is attributed to the inadequacy of the underlying fields of FLT, namely, foundations, number theory, the real number system and analysis. Their critique is undertaken with special focus on Wiles' 127-page proof of this conjecture that bears all the weakness of classical mathematics. The first major findings are: (1) FLT is undecidable in arithmetic, the *reals*, and \mathbb{R}^n , $n > 1$, (2) the underlying fields are ill-defined and, therefore, FLT itself is ill-defined, and (3) the characterization of undecidable propositions. It follows that FLT is not just undecidable, it does not make sense in these spaces. Rectification includes reconstruction of the real number system without the trichotomy and completeness axioms. The new space, called the new real number system yields countable counterexamples to FLT proving that it is false.. It resolves all the problems, paradoxes, contradictions and unanswered questions of the underlying fields except the Bieberbach conjecture and the Riemann hypothesis.

(4) The Solution of the Gravitational n-Body Problem. Presented at the 2nd World Congress of Nonlinear Analysts, Athens, 1996 and published in the special issue of *Nonlinear Analysis*, Series A: Theory, Methods and Applications, **30**(8), Dec., 1997, pp. 5021 – 5032.

Abstract. The existence of long-standing unsolved problem reveals the inadequacy of the underlying fields, in this case, mathematics and physics. A thorough critique of both is undertaken. The main weakness of mathematics lies in its foundations stemming from lack of insights coming from recent discoveries such the sources of ambiguity and lack of clarity regarding its subject matter. Its critique led to the reconstruction of the contradiction-free new real number system with new elements that models basic physical concepts such as the basic constituent of matter, the concepts of time and distance and our universe as a super...super galaxy. The main critique of physics is the inadequacy of computational modeling (previously called mathematical modeling) that simply describes the appearances of nature. Consequently it has left long-standing problems unsolved and fundamental questions unresolved such as what the basic constituent of matter and the structure of the electron are. The remedy is the introduction of qualitative modeling (formerly called dynamic modelling) that explains nature in terms of its laws. This was the crucial factor in the solution of the n-body and turbulence problem (four years later) and resolution of the fundamental questions. Their solution and resolution required the discovery of the initial 11 laws of nature that anchored the early formulation of GUT called the flux theory of gravitation.

(5) Superstring loop dynamics and applications to astronomy and biology. Nonlinear Analysis, Series A: Theory, Methods and Applications, **35**(8), (1999); pp. 959 - 985.

Abstract. The paper refines the fundamental physical principles of (4), includes four biological principles and introduces (a) the dark number as the qualitative model of the superstring, (b) the mathematics of its conversion to visible matter, (c) matter-anti-matter dynamics, (d) applications to astronomy and biology and (e) the new nonstandard analysis. It provides, for the first time, explanation of two recent spectaculars from space made possible by the Hubble telescope: (i) jet outflow of hot gas from the cores of nascent stars and galaxies and (ii) the "cannibalizing" activity of giant galaxies, including our Milky Way, that prey on its smaller satellite galaxies. Also, for the first time, the paper links brain waves to dark matter, provides insights on the functions of the brain, including learning, memory and intelligence, and proposes therapy for control of brain malfunctions like autism.

(6) The flux theory of gravitation. Proc., 2nd International Conference on Tools for Mathematical Modeling, 1999, St. Petersburg State Technical University, St. Petersburg; pp. 74 – 89.

Abstract. The paper summarizes recent verification and applications of the then flux theory of gravitation to the study of the Cosmos, the solar system and other applications but adds a new element to it: the role of the brain in the control of cancer.

(7) Quantum Gravity. Proc. Third International Conference on Dynamic Systems and Applications, 26 - 29 May 1999, released 2001, pp. 201 – 208.

Abstract. Quantum gravity is the dynamics of vortices induced by primal flux spin. It is distinguished from macro gravity as dynamics of fluxes of superstrings. Quantum gravity encompasses quantum mechanics but extends its domain to dark matter. It explains the genesis of the atom where the toroidal fluxes of the protons in the nucleus induce coherent flux around it; the latter draws electrons into orbit, flux-pressure complementarity. Quantum gravity explains all forces and interactions of nature at the biological, molecular, atomic and primal levels including electromagnetism, matter-anti-matter interaction, surface tension, osmosis and capillary action in the cells of living organisms as well as primal coupling and formation of the atom. The main laws

of nature governing quantum gravity are energy conservation, flux compatibility and flux-low-pressure complementarity.

(8) Set-valued Differential Equations and Applications to Quantum Gravity. Proc. 2nd International Conf. on Differential Equations, St. Petersburg, 2000; pp. 74 – 86.

Abstract. The paper starts with the practical problem of solving differential equation of the form $dy/dx = f(x)$, where $f(x)$ has the forms

$$f(x) = \sin^n 1/x, f(x) = \cos^n 1/x, f(x) = (\sin^n 1/x)\cos^m 1/x,$$

and n and m are positive integers and the functions have set-valued limits at the origin. The notions of probability distribution over the set-values and the integral with respect to it are introduced to devise the generalized integral for set-valued functions. Then the integral is applied to calculations on prima and photons whose axial projections are set-valued.

(9) Turbulence: Theory, Verification and Applications. Proc. 3rd World Congress of Nonlinear Analyst, Catania, 2000, published in the special issue of Nonlinear Analysis, Series A: Theory, Methods and Applications, **47**(2001), pp. 5955 – 5966.

Abstract. The paper poses the turbulence problem: given the standard dynamics find a model that has predictive capability with respect to its internal and external dynamics and future state. The desired model is the theory of turbulence, as subtheory of FTG, anchored on 12 of its fundamental principles. The theory is applied to the study of earthquake, volcanic activity, tornado, typhoon and lightning. The major results are as follows: (1) Solves the turbulence problem and explains the dynamics of these earthly turbulence.

(2) Establishes correlation between solar eclipse, earthquakes and volcanic activity. (3) Provides the basis for generating the technology to terminate tornado, control typhoon partially and monitor seismic and volcanic activity that can be the basis for prediction. (4) Establishes the dynamic relationship between under-ocean volcanic activity, *el niño*, typhoon and drought.

(10) Chaos, Turbulence and Fractal. Indian J. Pure and Applied Mathematics, **32**(10), pp. 1539 – 1551. (In the original paper this article is incorrectly titled, The flux theory of gravitation IV: The theory of intelligence and evolution).

Abstract. The turbulence problem in (9) is generalized to the modeling problem: find a model for a physical system that has predictive capability on its internal, external and future states. The paper starts with a criticism of computational modeling namely:

(1) Computational model is static and unaffected by and not sensitive to emerging boundary conditions including interaction with other dynamic systems;

(2) It simply describes superficial dynamics but lacks predictive capability;

(3) Computation on the model simply reveals behavior of the mathematical space the model belongs to and has nothing to do with the physical dynamic system it models; in general computation, provides insights on differential equations and the real numbers;

(4) Local behavior, especially, at micro scale has no causal relationship with global behavior; for instance, the second law of thermodynamics that predicts increasing entropy for closed physical system is valid only locally; our universe has moved from the chaos of the Big Bang to the high level of order we now enjoy including biological order; therefore, the first law of thermodynamics is reversed globally.

(5) A differential equation – indispensable in computational modeling – and its solution have only local validity, a basic principle in the theory of differential equations. Conventional modeling is inadequate for dealing with ambiguous sets including chaos, turbulence and fractal; it

is shown also that the real line is chaos. This paper identifies ambiguous sets and their common thread of uncertainty and identifies appropriate approaches for dealing with them. Among the ambiguous sets are large and infinite sets (being large and small depending on context), small and large numbers, micro component of turbulence, chaos and limit set of fractal. Deterministic mathematics do not apply to ambiguous sets. This paper proves, for the first time, that the real line is chaos.

The alternative to computational modeling is qualitative modeling, i.e., physical theory anchored on the laws of nature at both fundamental states – dark and visible. Physical theory is not developed by computation alone but is based on synthesis of the collective human experience and accumulated scientific knowledge. The main tool for qualitative modeling is qualitative or noncomputational mathematics defined broadly as the complement of computational mathematics. The paper also summarizes the new mathematics required by FTG that, together with some computational mathematics, e.g., Pontrjagin maximum principle, constitutes its mathematical component.

(11) Theory of intelligence and evolution. Indian Journal of Pure and Applied Mathematics, **33** (1) 2002, 24 pages.

Abstract. The 10 fundamental biological principles are added to FTG's 22 laws of nature and fundamental mathematical and general principles to anchor the theory of intelligence and evolution. This is the first scientific explanation of rationality in terms of brain wave dynamics. Brain waves are basic cosmic or electromagnetic waves encoded with information stored in or modeled by neural cluster vibration. A concept or unit of thought is modeled by specific neural network. Its vibration wiggles and encodes concept on a band of basic cosmic waves. The paper places the brain at central control of all bodily functions with brain waves as medium of command.

(12) The mathematics of the new physics. Applied Mathematics and Computation, **130**(1), 145 – 169.

Abstract. With the terminating decimals as base space subject to the axioms of the so-called complete ordered field, \mathbb{R}^* , $+$, \times , without the axiom of choice or its variants, the standard topology is introduced. The space is extended and completed to what is called the new real line with the standard topology. The reconstructed new real line, \mathbb{R}^* , $+$, \times , has two new elements called dark and unbounded numbers. The domain of the additive and multiplicative operations is also extended to the new real line, \mathbb{R}^* , $+$, \times . The new real line is further extended to the new nonstandard analysis. The paper refines and extends the counterexamples to FLT to a combination of countable integers and new integers (now called decimal integers). The new arithmetic is also introduced as well as basic arithmetic of twin naturals, new integers and new nonstandard analysis. The integers and new integers are shown to be isomorphic; in this isomorphism 0 corresponds to the equivalence class of dark numbers represented by d^* . This isomorphism establishes that both the integers and the new integers are Peano naturals. It is from this class of numbers that the counterexamples to FLT are constructed.

(13) From macro to quantum gravity. Problems of Nonlinear Analysis in Engineering Systems, **7**(1) 2002; pp. 56 – 78.

Abstract. The paper summarizes the work that starts with the solution of the gravitational n-body problem and proceeds to develop gravitation in the large, that is, gravitation at the astronomical scale. It is extended to gravity at the atomic and biological scales called quantum gravity to form the flux theory of gravitation; it explains surface tension in liquids as gravity at the molecular

scale. The laws of nature are refined and some of the mathematics of the superstring and black hole excerpted from [14,15] are as follows:

Theorem 1. A curve of any length can be deformed continuously into an oscillation in an infinitesimal neighborhood of a point with length preserved or even enhanced.

Theorem 2. Given oscillatory curve K of any length, real number $\epsilon > 0$ and line segment AB , there exists continuous deformation of K into a fine oscillatory curve inside some ϵ -neighborhood of a line segment which preserves the length k of K .

Theorem 2 generalizes Theorem 1 since the segment AB can be confined to an arbitrary neighborhood.

Theorem 3. Given any oscillatory curve K , there exists continuous deformation of K , with length preserved, into an arbitrarily small neighborhood.

Theorem 4. Let K be oscillatory curve of any length k and let $b > 0$, $\epsilon = b/2 < K/2$. One can shrink oscillatory curve K into arbitrarily small neighborhood its length and amplitude satisfying $k/2^{n+2} < k/2^{n+1} \leq \epsilon \leq k/2^n$

This piece of mathematics captures the behavior of superstrings and is the mathematical basis of black hole formation. Since the energy of an oscillatory motion (e.g., superstring flux) is proportional to frequency and infinitesimal oscillation has great frequency this deformation is energy enhancing and there is no upper bound for the amount of latent energy in a superstring. Finally, the paper has graphics of the well known prima, simple and composite, including the quark, proton, and neutron, nucleus, basic cosmic waves and cosmic waves of Types I, II and III. It has also graphics of generalized fractal.

The paper summarizes all previous papers by the author on gravitation. It notes, for the first time, that the theory unites the three principal dynamics of our universe, namely, macro and quantum gravity and cosmic waves where the last dynamics spans the first two. It explains all interactions of matter at the primal, atomic and biological scales including electromagnetism, matter-anti-matter interaction, surface tension, osmosis and capillarity action in the cells of living organisms. The paper also explains all forms of clustering including the genesis of the atom and molecules and stellar and galactic formation. It introduces three kinds of cosmic shock waves: (1) Type I that includes brain waves, i.e., basic cosmic waves encoded with information from neural cluster, (2) Type II cosmic waves, e.g., shock waves from grinding of tectonic plates, stellar storms, stellar and galactic core turbulence and hot volcanic lava flow (used in predicting eruption) and (3) Type III cosmic waves, e.g., shock waves from nuclear and thermonuclear explosions and cosmic explosions such as collisions of stars called supernova and the Big Bang. Types II and III cosmic waves have the same internal fractal structure but differ in orientation with respect to their respective radius of propagation. The latter's axis is normal to the radius of propagation.

The paper also formulates the fractal-reverse-fractal model of our universe from the super...super galaxy through the superstring.

(14) Vortex interaction. Problems of Nonlinear Analysis in Engineering Systems, 7(2) 2002; pp. 30 –44.

Abstract. The paper develops the fractal-reverse-fractal algorithm that allows one to locate, from any cosmological body, any other cosmological body belonging to any cosmological vortex of our universe.

(15) The new mathematics and physics. Applied Mathematics and Computation, 138(1), 2002 127 – 149.

Abstract. The paper summarizes the new mathematics and FTG and some astonishing results of mathematics. It has detailed critique of J. M. Henle's non-nonstandard analysis (Mathematics

Intelligencer, 1999) and includes the resolution of the unsolved problems, paradoxes, contradictions, puzzles, counterexamples, contradictions and unanswered questions of mathematics, physics, astronomy and cosmology except the Bieberbach conjecture and Riemann hypothesis. Among the more notable problems, paradoxes and counterexamples resolved and summarized here are: FLT, Goldbach's conjecture, Brouwer's counterexample to the dichotomy axiom, Banach-Tarski paradox and the natural ordering of the new real line.

(16) Macro and quantum gravity, cosmic waves and applications. Applied Mathematics and Computation, **139**(1), 2003, 23 – 36.

Abstract. The paper summarizes all previous results on the subject in the Series [18 – 35] on the subject and extends them as follows:

(a) Explanation of the accelerated rapid radial expansion of our universe from the standpoint of FTG.

(b) Verification of Hubble's law in terms of the accelerated radial expansion of our universe including an explanation of this phenomenon.

(c) Counterexamples to Einstein's and Newton's law of gravitation, namely, cosmic debris such as the asteroids and the thin rings of the larger planets of the solar system.

(d) Lays down the cosmological history and destiny of our universe.

(e) Explains the primordial black hole that exploded as Big Bang as the destiny of the core of a previous universe and points to evidences of the existence of universes other than ours.

(17) Columbia: The crossroads for science To appear as an article in the coming book, The Mathematics of Nature. , Global Journal of Mathematical Sciences.

Abstract. Available relevant facts and information are assembled to show that present knowledge is inadequate to explain the break-up of the Columbia Space Shuttle. GUT is applied to its final flight to explain the break-up and build what amounts to an enriched theory of turbulence as subtheory of GUT. Three new laws of nature were discovered in the course of the application of FTG to this problem, namely, the principle of resonance, the existence of micro component of turbulence and the threshold of speed difference at interface for generation of seismic waves that caused the softening of the malleable materials that led to the break up and crash. A program of theoretical and applied research, testing of materials and re-design of the spacecraft is recommended to overcome harsh conditions of re-entry into the atmosphere.

(18) Dynamic (now qualitative) Modeling and Applications. Proceedings, 4th International Conference on Tools for Mathematical Modeling, St. Petersburg, 2003, 167 – 182.

Abstract. Axiomatizes turbulence using dynamic modeling that makes gravity part of its dynamics. It includes comprehensive explanation of why the Columbia Space Shuttle crashed in February 2003.

(19) Foundations of Analysis and the New Arithmetic. Nonlinear Analysis and Phenomena, **3**(2), 2003, 13 pages.

Abstract. The paper reconstructs the real number system as decimals into the new real number system without the trichotomy and completeness axioms using the basic integers as building blocks (taking this as one of the axioms) and well-defined by two more axioms – the addition and multiplication tables of basic arithmetic. Taking the constructivist requirement that a real number is well-defined only by its digits, that is, when they are known or computable, we are able to build the new real number system without contradictions and paradoxes. Among the findings are:

the standard real numbers (the decimals) are finite but unbounded (precise definition of countably infinite), therefore, discrete, free from contradictions, have natural ordering and enriched by the unique dark and unbounded numbers d^* and u^* , respectively. This new construction suits the needs of computing, especially, computer simulation, and physics since nature is discrete in view of the recent discovery of the basic constituent of matter, the superstring.

(20) Dynamic Modeling of Chaos and Turbulence. Plenary lecture at 4th World Congress of Nonlinear Analysts, Orlando, 2004, *Nonlinear Analysis*, **63**(5-7), 2005, e519-e532.

Abstract. Applies dynamic modeling to chaos and turbulence as part of the standard dynamics and builds up the flux theory of gravitation as a general theory of turbulence. It uses Hubble's law to compute the present rate of radial expansion of our universe which is 10^{20} km/sec or 10^{15} times the speed of light. This is the rate at which matter in our universe, including the galaxies is radially dispersing outward, refuting Einstein's upper limit for the speed of matter. Moreover, calculation from the Hubble shows that our universe is accelerating at the rate of 10^{-10} km/sec². The paper also explains the black hole as massive cluster of non-agitated infinitesimal superstrings collected by the eye of a macro vortex such as star or galaxy. Left alone, a superstring, which is nested fractal fluxes of superstrings, shrinks towards infinitesimal superstring. This dynamics occurs in the calm, low-pressure region of the eye of a macro vortex. It explains that a black hole does not suck matter; it is the eye that nurtures and builds it up that does. Gravitational attraction itself is due to the suction by vortex eye. The opposite dynamics is, when a semi-agitated superstring is hit by cosmic shock wave of suitable energy, it converts to visible matter called primum such as quark, electron and positron. Furthermore, the paper reveals prototypes of technology that converts dark matter to useful kinetic energy such as electricity and magnetic levitation presently used to power bullet trains. (The values obtained here are based on current estimate of the age of our universe of 14.7 billion years; in a later – The mathematics of GUT – paper using the using the initial calculated age of our universe of 8 billion the reasonable values were obtained: rate of expansion: 840 km/sec; acceleration, 1/100 km/secsec)

(21) The New Frontiers of Mathematics and Science, Part I. Theoretical Construction and Resolution of Issues, Problems and Unanswered Questions, *Nonlinear Analysis and Phenomena*, Vol I, January 2004, pp.1 – 26.

Abstract. The paper has the most detailed elaboration to-date of dynamic modeling that led to the development of quantum and macro gravity. It well-defines and explains ill-defined physical concepts and phenomena such as quark, atom, black hole, dark matter and supernova.

(22) The pillars of the new physics and some updates. *Nonlinear Studies*, **14**(3), 2007, pp 241 – 260.

Abstract. This paper summarizes the pillars of FTG, updates and uses FTG to identify and rectify the errors of physics and highlights new applications and explains the disastrous finite flight of the Columbia Space Shuttle.

(23) The physics of the mind, submitted, The Science of Healing Outcomes

Abstract. This paper explores the physics behind thought and sensation and its implications for mathematics, physics and math-science education. It explains telekinesis and other amazing capability of the mind such as that displayed by what psychologists call moronic genius who computes huge numbers without knowing how that happens. Most of all, it describes how

information is encoded, how they are recalled to the creative-integrative region for thought and creativity.

(24) The New Frontiers of Mathematics and Science, Part II. The new real number system: Introduction to the New Nonstandard Analysis. Nonlinear Analysis and Phenomena, Vol. II, January, 2005, pp. 15 – 30.

Abstract. This is the first formal construction of the new real number system \mathbf{R}^* , $+$, $'$, using only three simple axioms: (1) \mathbf{R}^* contains the basic integers 0, 1, ..., 9; and (2) the addition and (3) multiplication tables of basic arithmetic, and its extension to the new nonstandard analysis and limit in Bolzano-Weierstrass sense (which is ill-defined) is replaced by intuitive limit, that is, representation of a decimal by its standard Cauchy sequence and approximating any decimal to any level of accuracy by the k th term of its Cauchy sequence. The new real number system is finite but unbounded and, therefore, discrete, has no contradiction, has natural ordering and is enriched by the unique dark number d^* and unbounded number u^* and the new integers. The integers are embedded in \mathbf{R}^* which rectifies the fundamental flaw of number theory, that of having no valid axiomatization of the integers. In the new nonstandard analysis, every function is discrete. This suits the needs of computing, especially, computer simulation.

(25) Function value, g-limit and discrete optimization. Integrated in the paper, The new real number system and discrete calculus and computation, Neural, Parallel and Scientific Computation, **5**(4), 2008, 25 pages.

Abstract. The paper devises appropriate mathematics for computing and discrete optimization including the introduction of the g -norm. The g -norm of a decimal is the decimal itself. The final section summarizes the novel features of discrete calculus and resolves and explains some of the paradoxes of mathematics.

[26] Dynamic Modeling and the new mathematics and physics. Neural, Parallel and Scientific Computations, **15**(4), 527 – 538.

Abstract. Surveys the classical and new mathematics involved in the new physics, i.e., GUT, and highlights the role of the new mathematics.

(27) The origin and evolution of biological species. Submitted, The Science of Healing Outcome (a medical journal).

Abstract. The paper identifies brain waves as the medium for the replication of the genetic content of biological species. It illustrates intelligence and organization of and division of labor in lower species and their further advancement and defense against predators and ruminants that pasture on them in the case of plant species, e.g., plant species that produce toxins. It points to sensation as the basis of intelligence that allows a biological species to respond to the environment, survive and advance itself. It illustrates, with many examples, how species protect itself from other species that feed on it. It also points out that instinct is genetically determined and explains how it is actualized in plants and animals.

(28) Learning, recollection and creativity. To appear as an article in the coming book, The Mathematics of Nature.

Abstract. Identifies five learning principles and provides the physical basis for these functions of the brain.

(29) Extending the reach of computation. Applied Mathematics Letters, **21**(10), 2008, 1074-1081.

Abstract. The paper applies the new real number system to discrete computation and quantum algebra.

(30) The theory of everything. Journal of Nonlinear Analysis and Phenomena, Volume II, No. 2, July, 2005, 44 pages (the author's submission for his nomination to the Nobel Prize for Physics, 2005).

Abstract. This is an expository paper that summarizes and consolidates the new physics developed in the flux theory of gravitation. The theory unifies all the forces and interactions of nature from dark matter through quantum and macro gravity and cosmology. (This was this host's submission for his nomination for the Nobel Prize for Physics, 2005)

(31) Dynamic and mathematical models of physics. Proceedings of the 6th International Conference of Dynamics Systems, 2008; pp. 164 – 169.

Abstract. Provides dynamic and mathematical models of basic physical concepts, particularly, the photon, quark, neutrino, electron, proton, neutron and the nucleus.

(32) By-passing Chaos With a Theory of Turbulence and Development. An article in the book, Finance Stochastics, World Scientific, London, 2001, by E. Perez, D. Bonzo (Eds.),.

Abstract. This is the first axiomatic treatment of a new area of social science, namely, development science. It uses the same technique in the axiomatization of physics undertaken in the Series. Fundamental social principles are identified to anchor development science. Based on this theory, strategic positioning employed for the purpose of establishing scientific, trade, economic and technological equity between the Third World and the developed world, particularly, the developed countries. This is the strategy for generating and accumulating tremendous accumulation of value to reach the threshold for industrial development.

(33) Qualitative Model of the Atom, its Components and Origin in the Early Universe, in press, Nonlinear Analysis and phenomena, Series B: Real Word Applications.

Abstract. This paper is the first qualitative model of the atom and its components as well as its origin in our early universe. The atom's components – proton, neutron (with its neutrino) and electron – are built on the prima, units of visible matter. Their qualitative models are obtained using some laws of nature. They yield new information such as the mass of the neutrino and how heavy isotopes of an atom form as well as the arrangement of the nucleons. It clarifies some presently unresolved issues such as what happens in thermonuclear explosion and whether it can be controlled to generate energy. It also explains the wave-particle duality of the primum and photon, metal fatigue, matter-anti-matter interaction and brittle and malleable materials and reviews the early phase of the development of our universe up to the formation of the first atom.

(34) The mathematics of the grand unified theory. Keynote address at the 5th World Congress of Nonlinear Analysis, July 2 – 9, Orlando, Florida, in press, Nonlinear Analysis, Series A: Theory, Methods and Applications.

Abstract. This paper surveys the mathematics of the Grand Unified Theory and highlights the new real number system \mathbf{R}^* .

(35) The new real number system and discrete computation and calculus. In press, Neural, Parallel and Scientific Computation.

Abstract: The paper points out the inconsistency and ambiguity of the field axioms of the real number system and notes that the only clearly defined and consistent mathematical model of the real numbers is the set of terminating decimals. Inconsistency collapses a mathematical system since every statement in it is contradicted by another. The inconsistency in the real number system comes from the trichotomy and completeness axioms to which counterexamples have been found. To remove the inconsistency and ambiguity the real numbers are built on the additive and multiplicative identities 0, 1 and addition and multiplication tables of elementary arithmetic as its axioms that define the operations addition and multiplication, respectively. Then using 0 and 1 the terminating decimals are defined on which the nonterminating decimals are defined for the first time (prior to this the nonterminating decimals were simply arrays of digits most of which unknown). The g-norm is introduced where the g-norm of a decimal is itself. Then the g-closure of the terminating is the new real number system \mathbf{R}^* that includes the nonterminating decimal and the set-valued nonstandard number d^* called dark number which is a continuum. Then the decimals are joined together by the continuum d^* so that \mathbf{R}^* is a continuum. It is non-Archimedean and non-Hausdorff but its subset of decimals countably infinite, hence, discrete, Archimedean and Hausdorff.

Highlighted in this paper are the counterexamples to FLT that prove it false and the proof of Goldbach's conjecture.

(36) The grand unified theory. Nonlinear Analysis, Series A: Theory, Methods and Applications **69**(3), 2008, 823 – 831. The paper is a contribution to the felicitation volume, special issue of Nonlinear Analysis on the occasion of 85th birth anniversary of Professor V. Lakshmikantham, founder of the broad and rapidly expanding field of nonlinear analysis and Editor-in-Chief of many renowned scientific journals.

Abstract. The paper is the first formal formulation and presents an overview of the Grand Unified Theory, introduces the ten most important natural laws and surveys the mathematics related to GUT's development and applications with more detail on the author's recent contribution, the new real number system.

(37) The generalized integral and derivative as dual of Schwarz distribution, in press, Nonlinear Studies.

Abstract. The paper develops the generalized integral and derivative of set-valued function called wild oscillation using rapid oscillation for approximation and deriving the probability distribution of wild oscillation as set-valued function for purposes of generalized integration. It applies the generalized integral to calculation on the photon.

(38) Global geology and oceanography. Submitted, Problems of Nonlinear Analysis in Engineering Systems.

Abstract. The paper develops the theory based on GUT and applies it to lay down the cosmological history of Earth. It explains the reversal of the Earth's magnetic flux during its 25,000-year cycle and the regular reversal of Indian Ocean current with the Summer and Winter Solstices.

(39) Revisiting the hybrid real number system, *Nonlinear Analysis: Hybrid Systems*, **3(2)** May 2009, 101-107.

Abstract. The new real number system is combined with Ancient Indian thought to develop the hybrid real numbers.

40. The cosmology of our universe, submitted, *Problems of Nonlinear Analysis in Engineering Systems*.

Abstract. Lays down the cosmology of our universe as a special universe whose birth at Cosmic Burst was triggered by the Big Bang. Based on macro gravity, the evolution of its core and trek back to its destiny as black hole in the eye of its super...super galaxy is laid down.

(41) Qualitative modeling for complex systems, in press, *Problems of Nonlinear Analysis in Engineering Systems*.

Abstract. Abstract. The paper introduces qualitative modeling for analyzing complex systems and solving complex problems and explaining natural phenomena in terms of natural laws. Its power is demonstrated by its role in discovering the basic constituent of matter, the key to the solution of the gravitational n-body and turbulence problems. Qualitative modeling is applied to the equally difficult problem of development using a similar approach: discovering the relevant laws of society and production. The latter includes laws governing creation, accumulation, distribution and utilization of surplus. Then a theory of development is devised for formulating a strategy for development of underdeveloped countries. It notes that while the problem of underdeveloped countries is underproduction, i.e., scarcity of social surplus, the problem of developed countries is just the opposite: overproduction of commodities that cannot be disposed in the markets leading to periodic disruption in the global economy called recession or depression in its worst form. These opposites provide basis for symbiotic relationship that is availed of to devise a strategy for development of the underdeveloped countries based on advanced scientific knowledge provided by the Grand Unified Theory to generate appropriate technology.

(42) The origin and evolution of biological species and applications to genetic engineering. Submitted, *Indian Journal of Pure and Applied Mathematics*.

Abstract. The paper identifies the gene as the crucial factor in the evolution of biological species. The gene projects brain waves that convert the superstrings to the tissues of living organisms in the cellular membrane. The paper applies this new knowledge and proposes genetic modification, alteration and sterilization as treatment of genetic diseases such as cystic fibrosis, cancer, systemic lupus erythematosus, diabetes, muscular dystrophy and mental disorder like depression.

(43) Mathematical Models on the way from Superstring to Photon (Co-authored with V. V. Gudkov, Professor of Mathematics, Department of Computer Science and Mathematics, University of Latvia). *Nonlinear Analysis*, 3(2002), pp. 375 - 382.

Abstract. The paper applies FTG to the physical dynamics of prima (elementary particles of quantum mechanics) and their clusters and interactions. The prima considered are the electron, up and down quarks (the second author uses right and left quarks, respectively, to stress the invariance of toroidal flux spin and induced flux under radial deformation, translation and rotation) and coupled prima like the neutrino, proton, neutron and the nucleus of an atom. The basic mathematical model of a segment of superstring is the helix as solution of the harmonic

wave equation. Any primal cluster and interaction can be modeled by suitable combination of deformation, translation, rotation, reflection and attachment. The paper has data on the tremendous latent energy of dark matter. For example, a cubic meter of dark matter (vacuum of quantum mechanics) has latent energy content of 10^{18} kilograms that is convertible to kinetic energy using Einstein's mass-energy equivalence equation. A fundamental physical principle FTG is utilized here to suite the requirement of quantum gravity, namely, the flux compatibility principle that governs primal clustering and interaction.

(44) The Helix and Other Optimal Configurations of Matter and Applications (Co-authored with V. V. Gudkov). **Nonlinear Analysis and Phenomena** Vol. III, No. 2, 2006.

Abstract. The paper provides both qualitative and computational models of the common prima like the proton and neutron.

II. Books and Monographs

(45) Introduction to Qualitative Control Theory. Kalikasan Press, Manila, 1991, 151 pages.

Abstract. This is the first development of qualitative or noncomputational mathematics applied to control theory. It focuses on the properties of relaxed trajectories and makes slight improvement of L. C. Young's integrated Pontrjagin maximum principle.

(46) On the undecidability of Fermat's last theorem, monograph published by the Press Center, University of the Philippines Los Baños, 1993. 40 pages

Abstract. The first broad sweep of the partial resolution of this problem which establishes its undecidability, reformulates it as a problem in \mathbf{R}^3 and provides the probabilistic solution to the reformulated problem. The question of truth of FLT is not considered here.

(47) Diophantus: Introduction to Mathematical Philosophy (With Resolution of Fermat and Other Applications). Kalikasan Press, Manila, 1993, 156 pages.

Abstract. The resolution referred to here is probabilistic solution that says: with probability 1, FLT is true when $n > 2$. The book makes a thorough critique-rectification of mathematics including lack of awareness of the loss of certainty in infinite and very large spaces in mathematical and scientific pursuit. It introduces a totally new mathematical perspective. Several counterexamples to the axiom of choice are given. The calculus of set-valued functions is more fully developed and applied to oscillatory differential equations. A general theory of fractal provides some of the basic requirements towards the solution of the gravitational n-body problem. The book has the first partial resolution of Fermat's last theorem as undecidable in arithmetic, the reals and the Euclidean plane and the probabilistic solution of the reformulated problem in \mathbf{R}^3 . It points the way for dealing with undecidable proposition (proposition having no deterministic proof): the use of probabilistic mathematics. A critique of Wiles' initial offering of 1993 made it to the appendix while the book was in press. It is the first to point out that Wiles' main error is lack of insights from recent discoveries in mathematics such as characterization of undecidable propositions and the loss of certainty in infinite or very large spaces.

(48) The Hybrid Grand Unified Theory, co-authored with V. Lakshmikantham and S. Leela and published by Atlantis (a division of Elsevier Science, Ltd.), 2009; 185 pages.

Abstract. The book updates the foundations of mathematics and applies the new real number system to develop the hybrid real number system. The main chapter, The Grand Unified Theory, formulates builds GUT on macro and quantum gravity using the new methodology of qualitative modeling. Then both qualitative mathematics and GUT are applied to develop the theory of turbulence and physics of the mind. The book concludes with an overview of the grand unified hybrid system that combines modern and ancient scientific thought.

(49) Book in progress: The Mathematics of Nature With Applications.

Abstract. All motions and configurations or forms of matter are called physical systems. In this sense basic cosmic or electromagnetic waves generated by the normal vibration of atomic nuclei and seismic waves generated by the micro component of turbulence at its interface, e.g., at the boundary of two tectonic plates, are physical systems. They are propagated across dark matter by the latter's synchronized vibration. Physical systems and their interactions and all the forces of nature such as charge and gravity are natural dynamics. An example of interaction between two physical systems is superposition of the vibration characteristics of a wave on another of the same order of magnitude of wavelength to produce a composite wave. This is the mechanism by which the symptom of a genetic disease such as cystic fibrosis is neutralized by a neutralizer that produces a composite with the defective gene minus the harmful symptom. Also included in the category of natural dynamics is conversion from dark to visible matter and *vice versa* and from one physical system to another as well as their generation, transfer or conduction and utilization

The mathematics of the natural dynamics consists of classical and new mathematics and the former includes the theories of generalized curves and surfaces and their applications. A generalized curve computationally models the path of an elementary particle, profile of cosmic wave, the spiral path of a falling body into the core of a cosmological vortex, e.g., galaxy, and the superstring, basic constituent of matter. The generalized surface models the expanding cosmic wave and the Cosmic Sphere before the Cosmic Burst at $t = 1.5$ billion years from the initial Big Bang. Included also under classical mathematics is the solution of Hubble's equation although its recent explanation comes not from computation but from qualitative modeling. The more recent classical mathematics of the natural dynamics are the integrated Pontrjagin maximum principle and the qualitative-computational models of a simple primum (elementary particle) and photon, namely, helical spiral with sinusoidal cylindrical envelope and rapid oscillation with sinusoidal envelope of even power.

The new mathematics includes the rectified foundations, qualitative component of the solution of the gravitational n-body problem, the new real number system and its applications, quantum algebra, generalized fractals and applications, the generalized integral and derivative with applications and, most important of all for our purposes, qualitative mathematics, the main component of qualitative or noncomputational modeling that explains nature and its appearances in terms of its laws, and its applications. We place the birth of the new mathematics and qualitative modeling in 1997, the date of publication of the solution of the gravitational n-body problem where qualitative modeling was introduced for the first time to provide its qualitative solution while the integrated Pontrjagin maximum principle provided its computational solution.

The new real number system \mathbf{R}^* is a continuum that models physical time and distance and its subspace of decimals is countably infinite, discrete and linearly ordered by the lexicographic ordering. $\mathbf{R}^* \times \mathbf{R}^* \times \mathbf{R}^*$ models the physical space of the timeless and boundless Universe of dark and visible matter that contains our universe as a local bubble in it and other universes similar to ours the existence of which has considerable evidence. The decimal numeral system being countably infinite and discrete subspace of \mathbf{R}^* is suitable for the purposes of natural science, since nature is discrete, as well as computer science, especially, for simulation. It also models the metric system. The nonstandard new real number d^* qualitatively models the limit set of the nested fractal superstring which is a superstring and a continuum, and its nonstandard d-

sequence also qualitatively models its nested fractal sequence of toroidal fluxes. The new real number system is built on the additive and multiplicative identities 0, 1 and the addition and multiplication tables of arithmetic instead of the field axioms which have been found to be inconsistent, counterexamples to the trichotomy axiom having been constructed by Felix Brouwer and the author..

Physics, the most advanced natural science, relies on computation and measurement for computational modeling to describe natural phenomena to which it owes its great achievements, especially, in the generation of high technology. However, with this methodology alone there remain long standing unsolved problems and unresolved fundamental questions, such as the gravitational n-body [4] and turbulence problems and what the basic constituent of matter and structure of the electron are. In some cases computation and measurement cannot even describe complicated phenomena or configuration of matter such as chaos, generalized fractal and black hole. The discovery of dark matter in the 80s, i.e., matter that is not directly observable and known only by its impact on visible or ordinary matter, capped by the discovery of its basic constituent in 1997, the superstring, places physical system in the category of complex systems, i.e., systems that cannot be analyzed, understood, explained or described by computation and measurement. That is why it has been necessary to complement computational modeling by noncomputational or qualitative modeling whose principal tool, naturally, is qualitative mathematics. It is particularly suited to biology which is mainly complex although computation is being brought in to a limited extent. For example, the question of how the brain and the gene do their functions, e.g., giving command to execute athletic game and producing the tissues of the body in the case of the gene or why and how cancer spreads rapidly in the human cells can only be answered by qualitative mathematics.

What is qualitative mathematics? Consider this daily activity of a mathematician or scientist: making conclusions, visualizing, trial and error, thinking backwards, thought experimenting, engaging in creative activity, intuition and imagination, negating what is known to find out what is possible, altering premises to draw out new conclusions and all other techniques that one brings into research to stamp it with his own style. We put all of them under qualitative mathematics. It was used for the first time to discover the initial 11 natural laws required for the solution of the gravitational n-body problem and discovery of the superstring. The solution points to a new approach to solving a physical problem: devise the appropriate physical theory (a mathematical space whose axioms are laws of nature) that provides the solution. Qualitative mathematics includes abstract mathematical spaces, foundations of mathematics and physics and the search for the laws of nature. It was the crucial factor in the solution of the gravitational n-body and turbulence problems and the discovery of the superstring .

Since we have broadened our sources of information and relaxed restrictions on approach and methodology and extended the latter beyond present computational modeling, we have tightened the filter of admissibility through the critique-rectification of the foundations of mathematics and physics in order to contain ambiguity (i.e., approximate it by certainty) and avoid errors and contradictions by raising the standards for construction of a mathematical space, particularly, physical theory.

Our main application of qualitative modeling is the theoretical development of the three pillars of the natural dynamics: quantum and macro gravity and thermodynamics. Other applications are the development of the theory of turbulence (geological and atmospheric sciences) explanation of the disastrous final flight of the Columbia Space Shuttle (atmospheric and space sciences) where three new laws of nature were discovered and the articles, "The origin and evolution of biological species" (an update of Darwin's theory of evolution, biology) and "The physics of the mind" (physical psychology), and "Genetic alteration, modification and sterilization with applications to genetic engineering (medicine) and applications to mathematics and science education).

(50) Book in progress: The Grand Unification of Natural Dynamics. Co-authored with Vladimir Gudkov of Latvia and Christopher Jesudason of Malaysia with the host as Editor..

Abstract. *Dynamics* in this paper is all-encompassing and includes not only the forces and interactions of nature but also the dynamics of physical systems including cosmic waves, photons and our universe. The crucial new element is qualitative modeling first introduced in 1997 to solve the gravitational n-body problem. It also paved the way for the discovery of the basic constituent of matter, the superstring, required for the solution. Its main tool is qualitative or noncomputational mathematics that includes abstract mathematical spaces and the search for the laws of nature. Qualitative modeling *explains* nature and its dynamics in terms of its laws. In contrast, mathematical or computational modeling *describes* nature mathematically, its main tools computation and measurement. Thus, qualitative modeling raises scientific knowledge to a new level that provides insights into how nature works. It is based on rational thought and analysis and computational modeling on intuition. Being complementary, one is indispensable to the other in solving a physical problem. Moreover, qualitative modeling changes the task of the scientist from postulating mathematical equations that describe natural phenomena and solving them to searching for the appropriate laws of nature that explain them. Furthermore, it makes physical theory (a mathematical space whose premises or axioms are laws of nature) a practical tool for devising technology.

Naturally, this new methodology provides explanation of reality and its appearances that allows solution of previously unsolved problems and, in some cases, corrects present misinterpretation. For example, it explains why the atom smashing tradition of the last 50 years in search of the basic constituent of matter did not prosper. The same is true of the search for controlled thermonuclear reaction.

In contrast to the mathematics of nature that focuses on the mathematics of GUT, this book builds on the complementarity of qualitative and computational mathematics. Thus, it integrates the qualitative and computational models of macro and quantum gravity and thermodynamics and electro-chemical thermodynamics.

The first chapter presents the mathematical and physical foundations of GUND and surveys the major mathematics of nature, i.e., mathematics used in the natural sciences, but focuses on the new real number system that provides qualitative models of physical concepts, e.g., physical space as continuum. Chapter II is basic formulation of quantum gravity, one of the pillars of GUND, the others macro gravity and thermodynamics. The discovery of the superstring and conversion of dark to visible matter and *vice versa* using appropriate laws of nature are summarized. Chapter III develops the cosmology of our universe based on macro gravity. The rest consists of computational models of the three pillars of GUND and chemistry as part of quantum gravity. The correspondence between qualitative and computational models of physical concepts and instances of duality between macro and quantum gravity as part of the symmetry of nature are highlighted. Also identified is the behavior of physical systems that does not depend on individual properties of atoms and molecules, e.g., pressure and temperature.

I owe much of my achievements to others:

R. A. Favila and M. Sambandham opened the doors to mathematics and science; L. C. Young inspired and trained me well and V. Lakshmikantham discovered and walked me over to the frontiers of science and mathematics.

Regrets?

I could have trained world-class scientists and mathematicians and contributed a great deal to national development if only the leadership knew better.

My biggest regret, however, is that unlike in China, India and Vietnam where the leaders have a vision of development that they turned into a material force for progress and prosperity, we have had only caretakers since the Commonwealth period to the present.

