Several papers and topics for teaming and co-authoring consideration MJD last edit 10.Oct.2018

These are here only abstracts and summaries, or simply a few notes in the general direction of such. There is other material – written, diagrams and figures, also experimental results in some cases.

Some of these pertain to more general and theoretical topics of mutual interest discussion, and/or collaboration in the past (2017-2018), and some are rather new areas, particularly those which involve (or can involve) game theory and game applications. The general (suggested) titles here are:

[1] Generalized approach to control of turbulence and other uncertainty-behaviors in physical media

[2] Mapping Complex Robotic System State-Spaces into Computing Surfaces for Randomized Algorithmic Control Processes

[3] Quantized transitions between turbulent states at different energy levels and different metrics (scales of observation)

[4] Turbulence Transition Phases and Potential Values for Aircraft Design and Operation

[5] Use of the massive data in social network traffic in order to obtain improved assessment of crowd-think and crowd-feel for making predictions pertinent to large numbers of people/agents.

[6] Gaming, trading, and mass-market e-commerce as the avenue to widespread use and growth of both Turing-based and trans-Turing biology-inspired quantum computing.

[7] Applications of SPSA and (in general) stochastic modeling and control theory to games

[8] Incompletable state-space models and non-linear control methods in multi-player games

[9] Noise in quantum systems and at larger scales can be useful in prediction, control and optimization

[10] Using socially popular games to design complex robotic machines and systems

[11] Topological Representation of System State Spaces and Geometric Mapping and Computation with Topological Information Resonance (As a Fundamental Process in Nature)

[1]

Generalized approach to control of turbulence and other uncertainty-behaviors in physical media

The aim is to define a formal method for representing systems (initially, physical objects such as aircraft, ships, other vehicles)that move within environment-spaces (such as air or water) in which there are different types of uncertainty of which formal turbulence is one. However, we want to be able to address other uncertain, non-0linear, and potentially catastrophic (in both the positive as well as the negative senses) processes and events within that media (environment) interacting with the object-system.

The model is based upon treatment of systems as defined topological structures embedded within a moving medium which represents that part of the system state-space which can experience turbulence and related non-linear phenomena.

Each system that is so embedded may be considered as a composite set of geometrical objects. Call such a system an object-system. This could be a physical system like an airplane, ship, automobile, some type of robot, or it could be something that is not a physical object, but we concentrate first on the physical systems. It has a topology, but it may be composed of many different simpler parts (e.g., wings, fuselage, other appendages). An object-system is denoted by Ω.

The medium=space is that in which Ω operates.

Disturbances and significant departures from a range of behavior (…) --- *see handwritten notes in red notepad*

[2]

Mapping Complex Robotic System State-Spaces into Computing Surfaces for Randomized Algorithmic Control Processes

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Version 1.0 04.August.2018
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Abstract

Turbulence, noise and stress affecting mechanical systems operating in aerodynamic and hydrodynamic environments subject to unpredictable and non-linear media behaviors has been studied, modeled and experimentally controlled using randomization and stochastic models such as SPSA, CAM, and local network voting protocols. Sensor and control architectures have been developed for system components such as wings, fins propellers and fuselage structures of aircraft, ships, submarines and automobiles. We consider the more general problems of complex multi-function robots with multi-axis arms and other moving components, and also cooperative systems composed of a number of such robots operating together. System state-space parameters pertaining to physical structures and movements are mapped to a set of abstract computing surfaces which represent sets of concurrent or sequential functions and operations. These are treated as information fields which are then processed using stochastic approximation methods to determine limits, exceeding of limits, and countermeasures that can be applied, for many different parameter sets and relationships. Such functional sets may exist concurrently and also with unpredictability given the complex nature of the robotic tasks and with uncertainties due to physical environments and conditions in which these robots and their components may be operating. The resulting information processing model holds promise for more efficient modeling, control and in particular resource optimization and fault tolerance. This model can be applied to control tasks for individual components (e.g., arms, grippers, motorized parts and structural assemblies) as well as for robots as integral units within cooperative networks engaged in tasks such as object manipulation, parts assembly, and other constructive tasks. A generalized version of the model offers the capability to design and potentially retrofit robotic systems with sensors and actuators that can extend the durable life of the unit and provide for greater efficiency and fault tolerance in operations. Such a model can be valuable for robot systems operating in remote and extreme-condition environments such as space, high-altitudes, or deep-sea, or in operations involving mining, manufacturing, and hazardous environments.

Introduction

Robot systems may be considered as individual machines with multiple components and also as groups of machines that are performing tasks together in manners where each robot device is a component of the whole system network with respect to those tasks. Robot r_1 may have one arm apparatus or several, and each may have a multiplicity of components such as extenders, joints, grippers, and interchangeable parts such as drills and bits, saws, or sensors. A team of robots $r_1 \ldots r_n$ assigned to a manufacturing or assembly task may consist of several different robot units that must interact in ways that involve contact and/or shared tasks such as gripping, pushing, pulling, and other force applications with respect to some target object(s).

All machines and their components may be treated as sets of functions or operations that involve changes in measurable physical states of those components that are involved in particular functions, such as temperature, pressure, tension, torsion, friction. Thus there can be produced a functional map of the robot system. This map describes, for any given point in time or in location, or with reference to particular operations, the significant states and their relations with others. For instance, given a set of robots r_i and target objects t_j:

Unit r_1 is in contact with unit r_3 and with target t_1

Arm rod a_1 of unit r_1 has tension of x newtons

Arm rod b_2 of unit r_2 has torsion of x n/Pa

The Problem of Unpredictable Stress Effects with Multi-Component Systems

Problem statement for multi-component, multi-function robots and cooperative systems

Randomized and Stochastic Approaches to Turbulence and Noise

Prior work which is more focused on turbulence and aero-hydro-dynamics

The Functional-Structural Mapping Process and its algorithm

[3]

Quantized transitions between turbulent states at different energy levels and different metrics (scales of observation)

This is still somewhat at the level of a Conjecture since there is not yet a proof, mathematically, and there is barely a start at experimental evidence and mainly from some models (simulations).

Consider a turbulent flow (water, wind, smoke, blood, any kind of fluid, and even neural firings in certain regions and circumstances). The claim is that quantized (quantum step) transitions occur between different stages or types of turbulent states (degrees of turbulence) and that this quantized jump is something that pertains to two situations -

first, different amounts of energy put into the system from an external source – as energy input is increased, there will be some minor change in the turbulent behavior but then a sudden shift, almost like a transition state in matter;

second, different scales of observation (of spatial and temporal dimension, but mainly spatial is the topic here) – when the scale changes (think of it as zooming in and out), there will suddenly be a major shift, a quantum jump s it were, from one type of turbulence into another. Here we can make use of Reynolds numbers, for instance.

Moreover, there are the possibilities of non-dissipative, soliton-like relations between such transitions (the transitions from a to b to c to d are representable by a wave which is solitonic – low-dissipation).

[4]

Turbulence Transition Phases and Potential Values for Aircraft Design and Operation

Martin Dudziak, PhD

Research in the area of quantized transitions between turbulence states that are characterized by high degrees of non-linear stochastic dynamics now suggests that there may be techniques for improving both the predictability and control of such states, particularly the highly critical transitions that can create extreme vehicle stress and compromise vehicle safety and integrity. This is early-stage research based upon investigations into meta-stable structures within dynamic flows that create limits and bounds on transitions from one behavioral condition into another, thus providing a type of "quantization" between states that are characterized by high degrees of turbulent and chaotic internal dynamics. These investigations suggest the prospects of developing algorithms that can be applied to the design and the control systems (including both human and autonomous piloting systems) for a variety of aircraft and airborne machines. Analysis of probable interactions and consequences from interactions between an aircraft and various upcoming turbulence situations – both natural (e.g., weather formations) and man-made (e.g., intentional actions and countermeasures) – can potentially yield real-time solutions for altering an airborne vehicle's path, vehicle dynamics, or execution of effective airborne countermeasures, in order to preserve aircraft integrity and success of its mission. Improved understanding of how specific turbulence states can and cannot transform into different and more manageable states, or into less turbulent conditions, can be valuable in the design of diverse types of airborne vehicles and their control systems.

[5]

Turbulence and Asymmetrical Behavioral Changes in Social Networks – Understanding, Changing, Controlling with the Power of Noise

Use of the massive data in social network traffic in order to obtain improved assessment of crowd-think and crowd-feel for making predictions pertinent to large numbers of people/agents. This is part of the SELDON predictive analytics model. The objective is to have a faster and more "imaginative" method of detecting trends, dispositions, and likelihoods – especially for economic and political value.

[6]

Gaming, trading, and mass-market e-commerce as the avenue to widespread use and growth of both Turing-based and trans-Turing biology-inspired quantum computing.

Alternatively titled “Realistic applications and uses for quantum computing in gaming, trading and virtual reality environments.

Focus areas can include:
MMORPG (massively multiplayer online role-playing games) and E-Sports
Personal securities trading, including cryptocurrency “Forex” and arbitrage
Mass-market e-commerce with competitions, games, and options-based features
Mixed virtual-reality and real-world user experiences (UX) involving properties, trades, and communities
Some background and history on this, which can influence the specifics of the paper(s).\:

All those big companies, investment firms, and others (govt. agencies, yes, but they do not worry so much about the results from their grants and other forms of public investment) who have put huge $$4 into quantum computing (“QC”), particularly, are now at a common point of saying, thinking, wondering, “Where and when is the ‘Big Return’?” They are in much the same position as all those investors (actual investors, or corporations, typically large ones), who banked big $$$ into AI in the early 1980’s, then into RISC and other processors, and server architectures, and the early internet of the early 1990’s, and also neural networks (“NN”) and similar “different AI” in the early 1990’s as well.

In the case of AI and NN back then, it was a “bust” and things dropped off. In the case of computing hardware, there was finally a big “plus” in the way that the web and the internet in general developed, leading over the years to companies like Google, Amazon, and later the social networks (FB, Twitter, others), and finally the whole “cloud” phenomenon (which was not so different from parallel distributed and network computing back in the 80’s and 90’s). Suddenly and steadily they found their place for what they had invested money and time into. There were Returns.

With QC, we now are at a point where there are some semi-useful and mostly software-based and hybrid systems being experimentally introduced, but there is still no clear and evident Big Market for QC. It’s obviously not enough to have it used in encryption/decryption and it’s pretty clear and undeniable now that the standard Turing-based QC is not something that in any single-digit future years is going to fit into a space like mobile devices, IoT, small robots, etc.

So the backers of present-day QC are very “hungry” for an application area that looks even slightly Big by standards of mass-market, consumer-use, large-scale numbers of uses.

This is Gaming, and primarily of two types – the MMORPG and also E-Sports.

Given one company that is in this general “space” and where it is going, and given what is happening on the E-Sports world in particular, worldwide but especially in USA, also Korea, and now up-and-coming China, there could be a fruitful research and applications “track” that develops around the theme of this suggested paper.

[7]

Applications of SPSA and (in general) stochastic modeling and control theory to games

This is related to [6] above.

Game Types: focus on MMORPG and E-Sports games as opposed to others, but perhaps with some directed application toward “modified and enhanced game theory” for business and large-scale institutional use

Technology/Use Types: focus on refinement of player strategies and tactics, improved control of objects and environments (including 3D Virtual Reality, etc.), and improved ways to navigate through physical (VR or Real-World) environments – terrains, streets, urban settings, labyrinths, mazes, etc.

Sample games: Look at what is dominant now in E-Sports and in MMORPG. Specifically, there is one game type that may be worth considering, for the express purpose of funding the work.

[8]

Incompletable state-space models and non-linear control methods in multi-player games

In the contemporary computer-based game world there are significant differences from classical games due to complexities and uncertainties in how players and game-entities may behave. This leads to situations where modeling the overall game and individual player or team strategies is difficult due to exponentially increasing possibilities and uncertainties with regard to not only movements of play but long-term objectives defining what is valuable, or essential, in a final outcome. We examine the use of cybernetic methods that are particularly strong in dealing with fuzzy, uncertain state-space maps and propose some models that could be more effective in both game play and game design.

[9]

Noise in quantum systems and at larger scales can be useful in prediction, control and optimization

The "gist" of this is not intended to be specific to quantum computing or other quantum technologies (as broadly covered by "FET" and "QT" in the EU programs being promoted and talked-about).
We want to look at how changes (dynamics, meta-behaviors) in noise, and specifically decoherence between system elements – whether they are qubits or other macro-scale components (and not necessarily only in "computing" per se) - can be processed rapidly and efficiently (computationally speaking) into useful information about the behavior of the overall system or some specific components (elements) – and not necessarily only those that are "making all the noise." Noise can be of many forms, and one way to look at things is in terms of the dissonance or disharmony among parts that are communicating (sharing, exchanging) information (including simple physical energy, another form of inform-ation). When the system develops more or less noise in different parts of its process (operation) then this can be a place to which to apply stochastic and other randomized algorithms for identifying some particular parameters of interest, which can then be used to understand still other parameters than are either not usually intended to be observed, or even not directly observable. And in this process we can gain a faster, simpler, more reliable way to know what parameters need to be watched, or adjusted, in order to reduce the noise or keep it at some controllable minima.

[10]

Using socially popular games to design complex robotic machines and systems

Traditional engineering methods typically progress from problem statements to specifications to computer-based models with visualization and extensive simulation of projected operations, and finally to physical prototype construction and testing. Thus, the evolution of a new machine such as a 5-axis space-operations robot is highly structured and dependent upon a linear design process no matter how non-linear may be the system state space for the overall problem that the new engineering must accommodate. We introduce a twist to this through a deliberate "natural selection by play" process that is intended to accelerate as well as simplify the design process, with elimination of errors and retrials, and a reduction in system engineering costs. A game is designed such that it matches a real-world challenge. In our chosen example, this concerns a variety of manipulations performed on asteroids and space objects of different geometries and topographies by teams of cooperative as well as competitive robots. Machines may be autonomous, semi-autonomous or strongly controlled through human-machine interfaces (HMI). The game play is defined to accommodate many different realistic scenarios. Constraints are provided regarding machine attributes. The game draws a variety of personalities and styles of thinking about solving problems. Certain designs will illustrate particular positive and negative features that will be valuable to future fabricators. In the process several objectives are attained, including education and training in robot manipulation and control, and in other aspects of HMI. Furthermore, the games generate visibility, attention, and if properly managed, a flow of capital resources that can be applied to engineering problems of the sort that are otherwise difficult to support and sustain.

[11]

Topological Representation of System State Spaces and Geometric Mapping and Computation with Topological Information Resonance (As a Fundamental Process in Nature)

DRAFT NOTES DRAFT NOTES

Version 1. 27.July.2018
Mirnova Institute for Creative and Innovative Science
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Abstract (and main points) –

This is just a summary of what is going into this, aiming toward a proof of [1] or [2]:

[1] Any system, no matter how complex or uncertain, can be at least partially modeled (such that its main behaviors can be controlled and predicted – and this in some provable way, that it can be done so) through a topological representation that assigns system parameters to the following types of entities within an arbitrary and unique-to-the-system geometrical object which comprises a closed manifold and closed network in n dimensions:

- vertices (points)
- edges (lines)
- angles between vertices and lines
- functions specifying relations between 2 or more parameters which can be represented geometrically

Let S be any system, and m(S) be such a model. Let p[i] be any parameter within S that is contained within m(S). Let p[i] → g[i] denote the mapping of some parameter set to a geometrical set.

The model m(S) is that topological representation. Is it unique; i.e., only one possible m(S) for a given S? Probably not; there should be many possibilities. Some will be more accurate, more complete/comprehensive, than others. Is a given m(S) unique to only one S? Probably so.

[1.1] Any m(S) will under any circumstances of change remain within the same general topological class. In other words, however it changes, it stays within its topological type/class. If it is a certain polyhedron, it remains that polyhedron, howsoever distorted it may become.

[2] Can it be a Proof – in a manner that is not only consistent with but perhaps follows the logic of Gödel in his two principal "incompleteness" theorems – that there are systems – and ways to identify them – such that they CANNOT be modeled completely – "complete" in a rigorous sense, again with reference to Gödel – and that no combination of state-space parameters, no computational model, can be sufficiently certain as to cover all potential catastrophic-function aspects of the state-space? This is important to achieve, in order to show that something based upon alternative methods (e.g., [1], and incorporating randomization and stochastic approximation) is a satisfying and achievable alternative.

[3] Mapping of topologies – building upon [1], this addresses how to approximate a model that can be more reliable, even though "incomplete" – for systems that fall into the category addressed by [2].

The objective is to have a machine that can accept as input different models which consist of topologies and rules for transformations, and then this machine can undergo modifications which change its state and thus its topology, and these changes can be used to predict changes in the corresponding parts of

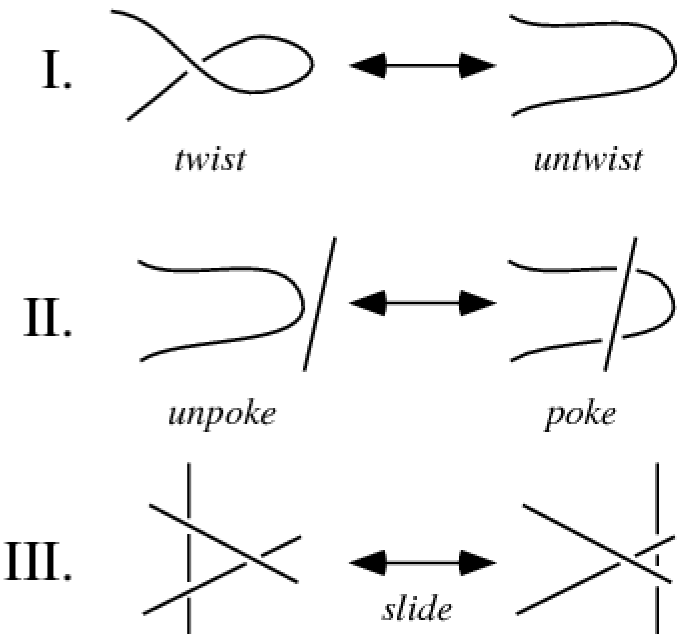
the original model. This machine must be able to adapt to many different models m(S). So its architecture must not be dependent upon any S or m(S).
[2.1] Any model m(S) has a defined topology and rules for operations (transformations). This may be mapped to another topology T that possesses different rules of operations, regardless of the system S for which m(S) is a model.
[2.2] Based upon the choice of T, there can be a correspondence between m(S) and T such that changes to T can in turn be mapped back to m(S).
[2.3] The "model of a model" (T) has the ability to change its topology in response to signals that may be electronically induced and controlled, such as with proteins that will change conformation in certain ways.
[2.4] Changes in T can be interpreted as changes in m(S) and from m(S) there can be interpretations made regarding system S.
So there need to be some constraints about how both source and destination are defined. For example, a sphere will not map to a torus or vice versa. But a closed space will map to another closed space of the same general type. A sphere to a sphere, a torus to a torus, etc.

> But about spheres and torii, we must consider that where R = radius from center to center of the ring and r = radius of the ring
>
> > R>r torus is regular type ("donut")
> >
> > R= r is horn type, with only narrow line in the middle but this is a real separation between the surfaces!
> >
> > R < r = spindle type, gradually approaching a sphere as R approaches 0.
> >
> > So in a way the two are convertible, although not in the "pure" topological sense. Somehow this is significant, as long as we keep that distinction in mind.

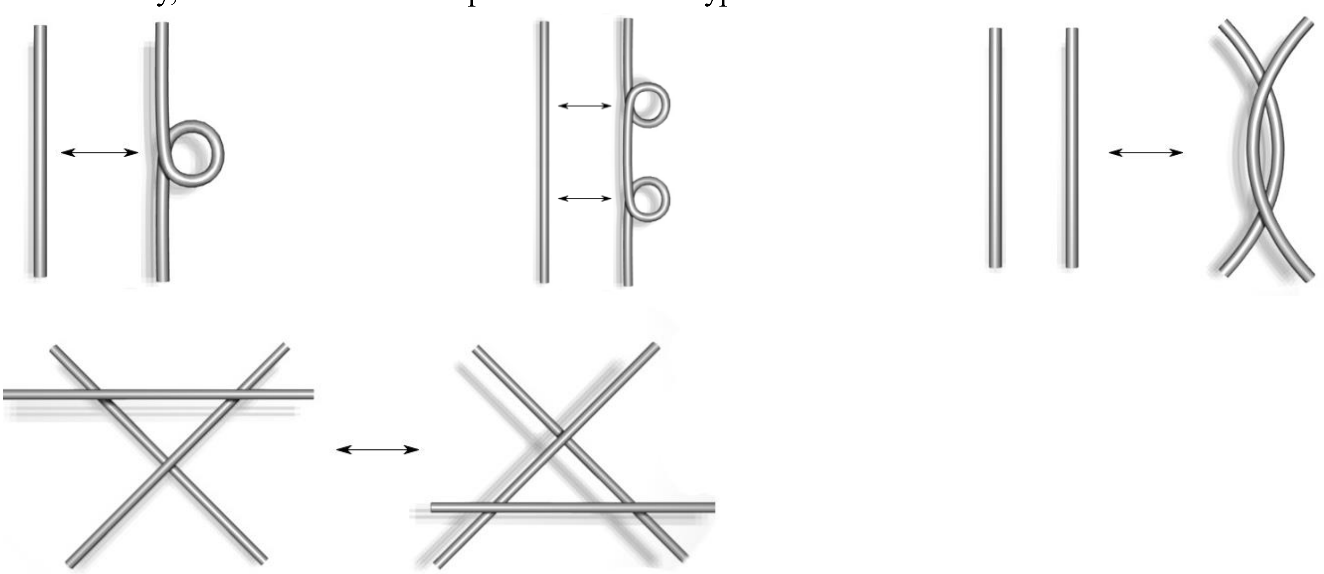
(What about purely 2D surfaces on which everything is mapped as points in the 3rd dimension?
So each representation is a type of landscape, but all on some flat base.)
This is a very important point. Some system S will evolve over time, and its model m(S) will change, and its topology will change according to the functions governing m(S). But that is all unique to how m(S) is defined. How can we compute using a topological information resonance (TIR) method the changes, similarities, bifurcations, catastrophes, all sorts of variations in m(S)? This is different from classical methods – we compute values of different functions, numerically, with some formulae, and after all the numeric calculations, we see what m(S) may be, and we make some conclusions, etc.
Instead, we want to map the (significant) features of m(S) to another topological framework tcp which is a physical structure that can be manipulated electromechanically/chemically so that its geometry changes over time, in a way that indicates how S will change over time. We want to create a configuration for tcp such that it reflects m(S) and the changes we introduce to tcp will be analogous to those that occur within system S.

<u>Other key points for here or later</u>:
§1 <u>Octonions</u> may be important or at least valuable for consideration with respect to how to represent relationships in topological information resonance representation 9e.g., [1] and [2] above). It also turns out that octonions may play a valuable role in the relationship modeling of basic particle physics as in the "Standard Model." (C. Furey, Cambridge, et al).
Somehow the rotations that can be done in octonion number space seem to connect with ways of representing relationships between different parameters and subsets of parameters that affect each other – again this seems to point toward knots and topological structures as ways of representing data about system states.

§2 The "Reidemeister moves" in knot theory may be important in not only fundamental particle physics and for trans-Turing, TIR/TCP type quantum computing (which is for GCM), but in the Topological Representation of state-spaces, as discussed and pointed-toward in earlier remarks here (e.g., [1] and [2]). Possibly these will matter in the topological deformations at the molecular-array level in TCP devices. Here we may be talking about not binary "qubits", but 2^2 state changes which can be detected, measured, counted, etc.



Alternatively, the "moves" can be represented as four types:



§3 String-net models may be very important for not only the evolution and emergence of spacetime and particles but also for the more general solution of problems (or the solution of general problems!) pertaining to state-spaces of systems that have deep, fundamental uncertainty and "Heisenberg-type" un-measurability conditions. I.e, where it is simply not possible to obtain certain values for x number of key parameters. See https://arxiv.org/pdf/cond-mat/0407140.pdf Do string-nets at the pre-particle quantum/Planck scale operate with a Fundamental Randomization Algorithm that is defined by something we could call the Implicate order or Quantum Potential (Bohm, Hiley, et al), and which is the source, the deriving logic, giving rise to Order, Structure, Form – and thus dimensionality and matter? See §5 below.

§4 Somehow all of the following ideas appear to be connected:
4.1 -- Our thinking of "rational" and "irrational" is somehow very misaligned, fundamentally flawed, and this is connected with basic human psychology and how we perceive things. The very word "irrational" is negative-sounding. It sounds somehow "incomplete" or "inexact." However, consider:
π is "irrational" and there is always a part of it that extends beyond any "cutoff" – and yet, a circle is real, finite, and a wheel rolls round and round and does repeat at the same point once every cycle.
And of course there are so many other "irrationals" in Nature – hypotenuse, epsilon, a host of values that connect with very firm, solid, definite functions and their representations as physical objects.

4.2 – Multiple, repeated twisting leads to topologies resembling explicit knot-making and any type of repeated knot-making gradually approaches the topology of a highly deformed sphere. But within such structures is a massive amount of information stored in each twist, each fold, each knot, within the overall structure. This could be a path for knowledge representation but more specifically for representing different parameters of a complex system space and the ways that they are both known to change and suspected of possibly changing, in the cases of those parameters that are too uncertain to be adequately measured or predicted by classical means.

4.3 Our human brain receives 3D information and rebuilds it all in a 2D array of neurons, but this is then used to general cognitive models of 3D objects.
Arguably, the "world out there" is 4D space (plus time, as a "5th" dimension). And that gets "captured as snapshots" of 3D frames, just as a photograph is a 2D representation of something we call "3D." But that information which comes into the eyes, gets transformed into signals that end up in a 2D array of neurons, and it from the changes and interactions and comparisons between all those 2D representations, that the cognitive elements of the brain generate models called "3D." And then further processing can allow the brain to create models of 4D spaces, and even models that have more than 4D. [See work by A. Tozzi and J. Peters on fMRI and Hypersphere models of the brain]

4.4 What can be learned from PERSPECTIVE? This refers to the contrast between *linear perspective* (the typical way we think, and also what is typical in "Western" art, developed in the renaissance in Italy), and *reverse perspective* (e.g., what is more common in Byzantine and Russian ikon painting). [Here, I have been lead more and deeper into the mathematical and art theory work of the great Pavel Florensky:
Imaginary numbers in Geometry (.Мнимости в геометрии. Расширение области двухмерных образов
геометрии.) devoted to the geometrical interpretation of Albert Einstein's theory of relativity. But Florensky goes much farther and deeper than contemporary mechanistic, reductionist science. (That is part of what got him in big trouble with the Soviet system at that time.)
We can look at a scene that is in a "reverse perspective" and our brains rearrange things so that it appears in the natural perspective! This is not only interesting – it points to how our brains are able to transform one system of parameters into another. And this does not take a lot of "calculation" in the process!