Analogy, Temporality, and Information In a Dynamic System

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Abstract— ***Tha nature of analogy in dynamic system: structure and function. Relation between classical and quantum information in dynamic systems. Holographic transformation of DNA as a final selfsimilar structure and its analogy to quantum system description. Temporality. Analogy between quantum and holography in dynamic systems: two experiments.***

Index Terms— ***structure coding, analogy failure, functional genomics, digital holography.***

1. Introduction

ANALOGY has been used since ancient times (Vitruvius) as a tool to enable and extend understanding. But its novel applications in functional genomics exhibit serious flaws [1]. Thus there is a question where are its limits in general such as in describing ontology in information theory, or whether truth can be revealed by using analogies on experimental data.

Vladimir Arnold states in an interview that mathematics is a part of physics where experiments are cheap. We can use analogy and extend this statement by putting that philosophy is a part of science where experiments are cheaper than in mathematics. Thus what is philosophy telling us about experiments, analogy, truth discovery and information that can be gained from an analogy?

Accoding to Ludwig Wittgenstein theory in science is intricately connected to language [2], introducing the cultural context of the scientist to any theoretical investigation. But according to Gianbattista Vico culture is directly connected to individual and collective myth(s) [3]. Taking each branch of science as a specific cultural medium one can only hypothesize how the information obtained from an analogy is projected to different branches of science.

Thus first of all we have to put forward the question of truth.

As stated by Martin Heidegger it is superflouos to hypothesize that something like truth exists [4]. If we exist, he puts, we exist in truth, we are ourselves and among the world the existing one, and the existence, which we are not, is discovered to us [4 ibid]. Thus our existence is connected by truth and it enables our path toward making assumptions (analogies). What governs this path? According to Heidegger the structure of essence of Dasein is based on temporality, enabling ontology [4, ibid pp 323].

How can temporality explain analogy failure in exact science?

By at least ignoring temporality!

I will first describe the nature of analogy in Part 2, then its failure in functional genomics in Part 3, and then discuss the relation between classical and quantum information in dynamic systems in Part 4. An analogy between digital holography and a near-holographic behavior of some dynamic system will be proposed in Part 5. A short discussion will be added as a summary of questions to be delt with in further investigations.

2. Analogy

By definition an analogy is the perception of similarity of two objects or processes based on similarity between the two in a subset of their traits, leading to the inference that if the two share some features, they will probably share (some) others [1].

An analogy can be used in many different ways tending finally to two extrema:

i) Functional identity, such as the case of two identical parts of DNA exhibiting functional equivalency

ii) Parable identity or surface superiority [5], such as the case of electromagnetic waves described as pairs of mechanical gears as given by Clark Maxwell; by not having a better analogy we are forced to „believe“ in such mechanical picture of the electromagnetics until now.

The theory of analogy has been investigated in cognitive science and resulted in gaining successful answers in broad terms but lacking in detailed answers between the existing theories and actual process models [5].

Similarities in meaning such as in the case of Maxwell model stem from similarities in mutual movements although the „gears“ in the case of electromagnetic wave are „growing“. Practically we do not know what is the essential structural part responsible for „growing gears“ in mechanical analogy of the electromagnetic wave.

Representation of the analogy should reconcile both the data retrieval and semantic mappings in the build-up of the analogy. The success of an

Manuscript received March 18, 2007.

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analogy can be measured by similarity metric derived from its linguistic environment (LSA, [5]), although insufficient for structural alignement in analogy [5]. Regarding the data processing in analogy one can not but observe its computational simlicity as compared to effectiveLSA analysis which is time consuming [6].

3. Critics of Functional Identity From a Complete Analogy

In order to obtain functional annotation contemporary biophysics generally attempts to relate chemical sequence to biological fittness using a doctrine of functional equivalence [1]. This doctrine seeks to write a linguistic construct from analogy sequence having a similar (or identical) chemical structure under the assumption that the two proteins with identical chemical structure have identical functions. Thus homologous proteins are assumed to have equivalent functions. This transfer of functional language is used in functional explanation of the new protein. But this has been found as a failure long before the genomics revolution [1].

The same is true for ortologs. Here the doctrine of homology that implies equivalency is restricted to a subset of homologs that diverged in the most recent common ancestor of two species sharing the homologs. But by axiom two species living in the same space cannot have identical survival strategies. This implies that two ortologous proteins might not contribute to functional fitness in exactly the same way in two species inducing the temporality as a factor.

As found in the leptin gene, responsible for obesity in mouse, the episode of evolution involved many nonsynonymous substitutions in the gene thus making it a false ortolog for humans and inducing the problem of nonlocality in genes.

Thus a complete analogy is sometimes a false functional identity.

4. Classical and Quantum Structure of Information In a Dynamic System

Classical measure of information is based on probability and informational entropy of codes associated to each state of a dynamic system. Such measure expresses structural variability of a system. The state of biological system can be expressed as a linear combination of base state in a Hilbert space [7]. The quantum measure thus obtained expresses a functional variability. Hereby quantum variablity measure relates to the function between states because it continually measures neighbouring state distances [7].

When isomorphysm exists between states of matter and states (codes) of information we can understand new ways to characterize and measure system information as well according to its states of matter [8]. The question arrises about the type of isomorphysms for dynamic system described with d variables. Approximation(s) of isomorphysm(s) can be sometimes given by sums of functions that depend on groups of just a few variables up to a given number k, k<<d [9].

Two systems are therefore tractable iff their corresponding differential equations show the same basic features in their phase space. Tractability means that we can compute an ε-approximation by using $n(\varepsilon, d)$ function values, where $n(\varepsilon, d)$ depends polynomially on ε^{-1} and d [9]. Hereby strong tractability means that $n(\varepsilon, d)$ is independent on d and polynomially dependent on ε^{-1}. Usually there is no isomorhysm between state of matter and state of information or at least we do not know how to numerically code the basic material element such as a DNA base [10]. Then the isomorhysm is at least binary intractable, meaning that for one information state there are many possible outcomes depending on process temporary coding.

On the other side the unmeasurability of absolute phase of electromagnetic wave leads the quantum model to partition ensemble falacy (PEF) [11]. This unobservability includes equivalency (UIE) for small phase differences in incoherent dynamic systems. Any attempt of such dynamic world model based on such fact is governed by this phenomenon, that is

$$UIE > PEF \quad (4.1)$$

The other question is what about a coherent world assumption.

5. Information In a Coherent Dynamic System

There exists an opinion given by Hameroff and Rasmussen that coherent signals flow in neurons and their cytoskeletal networks [12]. These signals exhibit non-local connections in time and space ubiquitous to time evolution of spatially extended dynamic systems in nature. Such systems have selfsimilar fractal geometry [12]. Selfsimilarity implies that subunits of a system resemble the whole in shape. On the smallest scale measure such a dynamic system is also a DNA. If it behaves coherently then a near holographic structural behavior is at the core of the dynamic system.

By relaxing a DNA using digital holography one can analyse the resulting DNA hologram and later return back its content to the reconstructed DNA by means of inverse holography [10].

Experiments on small parts of digitaly coded DNA of the Esch. coli have shown that even the smallest changes in any part of the DNA can produce observable changes in hologram differences thus implying that any change of any part of a DNA can be a significant one.

Experiments with coherent electromagnetic excitation of seed grain have shown increase in grain vitality by increasing sprouting and greenes of plants [13].

6. DISCUSSION

It seems that temporality is a main clue in analysing complex changes in dynamic systems. These systems can be living beings with their complex DNA structures. Involving temporality through analogy cannot be applied in a direct way like in classical dynamic systems. It is mandatory to include even the smallest changes developed during the time progress and incorporated in functional changes in a weird quantal way.

The simplest possible analogy of such approximation is the holography concept of a dynamic system because it violates the insensitivity of the tractability in classical dynamic system. But here some questions remain to be answered:

- how to code elemental structural components such as expressing DNA bases in quantitative way; basically we have used the Gaussian distribution function because of its rich information content?

- how can we start studying a basic living structure: as a hologram, as its inverse or as both at the same time?

- how to use the digital holography – as a complete transformation or as a partial one – we have used only amplitude holograms and completely avoided its phase parts?

- how to imagine system relaxations: we have supposed that the whole dynamic system relaxes at one time – the other authors like Hameroff have supposed only serial relaxations although extremely fast; our experiments with seed grains exposed to laser beam of very low power (1-5 mW) have exhibited significant changes in seed behavior [13].

ACKNOWLEDGMENT

Author is grateful to the Ministry of Science Education and Sport of the Republic of Croatia for financial support of the investigations.

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