Ideas and Mathematical Models about Symmetry, Dynamism, Anticipation

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Abstract
The antique study of geometric properties of symmetries continued by algebra with the group theory, and then with matrix calculus. The present paper illustrates new trends in the study of symmetry concept and its implication in explanation of the matter structure and of the evolutionary phenomena from nature. It is well known that in 2008 the Nobel Prize in Physics was awarded for the discovery of the mechanism of spontaneous broken symmetry in subatomic physics. As an introduction to the necessity to study symmetry not for static states only, but also for dynamic systems, the paper presents the philosophical concept of the symmetry of senses in the profound matter. For the dynamical systems, the definition of the symmetry by anticipation and retardation belong to the author. Certain cases when the symmetrical evolution of two conjugate systems is broken are indicated in a mathematical model.
Keywords: symmetry, asymmetry, orthosenses, symmetry by anticipation and retardation

1. Introduction

Since millenaries the symmetry of figures was imposed in the aesthetic and pragmatic peoples concerns. The principle of symmetry has been introduced as a scientific concept in the 6th century B.C. by the Greek philosopher Anaximandre, related to the form of the Earth and the position in Universe, this having a radial symmetry. But the first systematic studies on the symmetry began in the 19th century, when the researches on crystals were been extended on the symmetrical polyhedrons. The study of geometric properties of symmetries is continued by algebra in the same 19th century with the group theory, and then, in the 20th century, with the matrix calculus. Scientific chemists, physicists, aestheticians contributed with studies about symmetry. In the last decades of the 20th century, studies about symmetry appeared in the mathematical linguistics.

In the researches published since the last decades of the 20th century and the beginning of the third millenary, in scientific studies the importance of the two complementary concepts, symmetry and asymmetry is emphasized. These entities are used in many branches of science and practical applications.

I quote some relevant domains.

- In biomedical informatics, the analysis of the symmetry and asymmetry is implicated in computer aided diagnosis (Sheena Xin Liu, 2009)
- Medical studies introduce the quantification of asymmetry and the calculation of the symmetry index as a common objective in both research and clinical setting

(Gouwanda, Senanayake, 2011). We find also that in neuro-imaging application a way to perform the knowledge integration is to uncover symmetry/asymmetry information from the corresponding regions of the head and to explore its implication to positive clinical findings (Xin Liu, 2009). The study of skeletal asymmetry leads to important conclusions in medical practice (Davis, Shikano, Main, Hailston, Michel, Sathian, 2006).

- In genetics, a very interesting study published in Computing Anticipatory Systems, AIP Conference Proceedings, 2007 refers to "Nature's Code and the Universal Rewrite System in Nature" (Hill, Rowlands, 2008). The idea is that "Biological concepts, such as translation, transcription, replication, the genetic code and the grouping of amino acids" would benefit by the theory of "Platonic solids, pentagonal symmetry and Fibonacci numbers" which have significant roles in organizing Nature's code".
- In neurology and psychology, facial expressions and hemispheric asymmetry is linked of the brain development (Nagy, 2011).
- The social life is examined from the symmetry/asymmetry point of view, when two systems are face to face, for example, in a military theory, the situations which lead to war (Bulz, 2009). This article was quoted by the Journal Dynamics of Asymmetry Conflict. The dynamics of the economic and financial life are also view as an alternation symmetry/asymmetry. The economic and financial life is analysed with the alternation symmetry-asymmetry (Coronel-Brizio, Hernández-Montoya, Huerta-Quintanilla, Rodríguez-Achach, 2007), or "Exploring the concept of asymmetry: A typology for analysing customer–supplier relationships" (Johnsen, Ford, 2008).
- In crystallography, new studies and interpretations are published, some of them using as mathematical model elements of Dirac Algebra.
- Mathematical linguistics, this relative new branch of mathematics takes into consideration the importance of symmetry in languages (Marcus, 1989; Marcus, Paun, 1994).

2. Concept of orthosenses and their symmetry

The above quoted domains and researches regard static aspects of the studied systems, and as mathematical instruments used are geometry and algebra. The dynamism of systems asks to give into consideration the variable time and functions of time.

In a precedent paper (Otlacan, 2009) I treated about symmetry and I thought that this one, representing harmony, might be the most important and impressive feature of the nature. I begun to look for mathematical elements which could bring asymmetry to the evolution of the variables introduced in equations after I red about some results of theoretical and experimental physics and some interpretations of these theories in a philosophical thinking.

First of all, my attention was held by the philosophical reflections of Mihai Draganescu about symmetry of senses in the profound matter or of the depth of existence. In the following lines I shall present the opinion of this author, from his essay "Symmetry and asymmetry of senses" (Draganescu, 1993): The symmetry is "the simplest, beautiful and true order". But it does not offer explanations for the phenomena

in movement, being only a frame for the development of dynamic processes, because it is too static. The symmetry is not the source of development and progress. The symmetry has priority, but not for a long time, and co-exists with its complementary, the asymmetry. The break of symmetry and the passing to an asymmetry assure the progress and dynamism of phenomena.

Here, it is necessary to present the meaning of this concept and of the structure that was described by Mihai Drăgănescu. The profound matter is presented by two components: *informatter* and *orthomater* (named also *lumatia*). *Informatter* is the informational matter, and here information is presented as being a phenomenological specific physic process, as a physical sensibility. Processes from *informatter* are named *orthosenses*. An *orthosense* engendered by fluctuation into *informatter* leads to a structure in this one and so to the construction of certain laws of physic universe; this universe is formed by coupling of the *lumatia* and structured *informatter*; this coupling itself maintains the structure on *informatter*. A part of *informatter* remains unstructured and it is available for new structures. Because of *informatter*, the profoundness of the material world is able to be the substratum of infinite possibilities of the matter activities. *Informatter* is not a conscious entity and it does not contain intelligence, but it is an ingredient of any living organism; this one has access to information by intro-opening. *Orthomatter* (*lumatia*), as a component of the profound matter, is no-structured and it cannot be structured by itself, but only by *informatter*. *Orthomatter* is a matter with an energetic feature and remains in an immobility and total equilibrium without the second principle, the *informatter*. *Orthomatter* and *informatter* constitute the fundamental matrix of the world (Drăgănescu, 1990). The *orthosense* is defined as a phenomenological process into the *informatter*, it is phenomenological information. An *orthosense* can appear from itself in *informatter* or can be generated by an intro-opening of the organism towards the *informatter*. A universe has a set of *orhosenses* at its basis and in a formal mode these are displayed by the dimensions of the state of elementary particles; these *orthosenses* exist because of the couple *informatter – orthomatter* and without this couple they disappear by a phenomenon of relaxation.

I added a comparison from the banal, daily life: the egg with its two components, the glair and the yolk. The glair contains the energy, the food for the development of the embryo, therefore for the life that exists in the yolk, this one containing the genetic information. So the egg is a very universe and it can be presented as the couple of *informatter* and *orthomatter*.

Mihai Drăgănescu sees into *informatter* the motion as being generated by the alternation symmetry – asymmetry for the configuration of *orthosenses*: "Generally, some senses can prevail other senses in an infra-conscious community can prevail others, for example those of good related those of evil and so it is produced an asymmetry of the distribution of senses face of all the possible axes" (Drăgănescu, 1993). Here I remark the apparition of the idea of dynamism: "Even it is possible that the senses of the infra-conscious collective produce new senses which influence organisms and minds by their interference or by characteristic processes, analogous to the multiply and non-linear resonances, by new phenomenological trends and creative processes". Mihai Drăgănescu writes about the thirst of senses, that is the symmetry of

senses, as a first principle and to which the second principle, the principle of selection of the senses (that is the asymmetry) is added. The couple of the two principles defines "the trend of becoming" (or formation). These trends are the consequence of the fundamental *orthosense*: To exist (*in sine, by sine, intro-sine*).

The concept of harmony is also treated by Mihai Drăgănescu. He affirms that the symmetry is not necessarily a harmony: "an only symmetry is beautiful, pure, but even from the fact that it is solitary it is not in harmony with something else... The harmony presumes harmonization of more factors". In connection with the above affirmation, I observe that a system can have harmony between its parts, while the symmetry refers to an isolated object or to all system at a fixed moment. Especially Drăgănescu refers to the aesthetic face of the phenomena of symmetry and harmony, and then to their impact upon the interior life of human and upon the social life (Drăgănescu, 1976).

This was a philosophical approach belonging to an engineer in electrotechnics and in informatics, Mihai Draganescu, who could be inspirited by the results published in physical reviews beginning the seventh decade of the 20thcentury.

The theory of symmetry/asymmetry in the physics research had the greatest echo and brought a Nobel Prize in 2008. So, in 1960 Yoichiro Nambu gives a mathematical model to describe the emergence of asymmetry at the subatomic level; in 1966 the nuclear physicist Andrei Sacharov (1921-1989, Nobel Peace Prize 1975) publishes the paper "Violation of CP invariance, C 4 Symmetry, and Baryon Asymmetry of the Universe" (Sacharov, 1967) and in 1979 the paper "Baryonic asymmetry of the Universe"; beginning with 1970, Makoto Kobayasshi and Toshihide Maskawa formulate a model that explains some break of the symmetry and they suggest the existence of some particles undiscovered yet, a third family of quarks. The importance of asymmetry is emphasized, but it is still a mystery what caused (produced) the primary asymmetry (sources: www.nobelprize.org/nobel_prizes/physics/2008, www.scientia.ro/nobel-2008).

3. The symmetrical/asymmetrical evolution of a couple of conjugate systems

Again I considered two systems associated with "conjugate retardation and anticipation variables" verifying the "mixed advanced – retarded differential equations" (Dubois, 2003):

$$\begin{aligned} \frac{dx}{dt} &= F[y(t+\tau)] - ax(t) \\ \frac{dy}{dt} &= G[x(t-\tau)] - by(t) \end{aligned} \tag{3.1}$$

The two functions on present time t, $x(t)$ and $y(t)$, signify the current states of the two systems: $a>0$, $b>0$ are constant numbers, $\tau > 0$ represents the "shift time", $t+\tau$ is a moment from the future, $t-\tau$ is from the past of the present time t.

The following particular case:

$$\begin{cases} x'(t) = y(t+\tau) - ax(t) \\ y'(t) = x(t-\tau) - by(t) \end{cases} \tag{3.2}$$

has the solution:

$$\begin{cases} x(t) = \dfrac{1}{a+r} e^{r(t+\tau)} \\ y(t) = e^{rt} \end{cases} \tag{3.3}$$

where r is one of the following two numbers:

$$r_1 = \frac{-(a+b)+\sqrt{\Delta}}{2},\ r_2 = \frac{-(a+b)-\sqrt{\Delta}}{2}, \text{with } \Delta = (a-b)^2 + 4 \tag{3.4}$$

(Otlacan, 2008, 2009).

We remark that $r_1 > 0$, $r_2 < 0$, therefore the exponential functions from (3.3) can represent an increasing as well an decreasing evolution, but in the same sense for both the functions. The ration of the two functions is a constant number:

$$\frac{x(t)}{y(t)} = \frac{e^{r\tau}}{a+r} \tag{3.5}$$

The conclusion is that the master system follows in a straight line its slave system and reciprocally. The two systems develop proportional states at every moment, so we can say that they have a symmetric behavior (Otlacan, 2009).

I interpreted the proportional evolution of the two trajectories as a sort of dynamic symmetry of the conjugate systems and so I introduced the following definition:

Definition. *The symmetry by anticipation and retardation is the evolution of a pair of dynamic conjugate with anticipation and retardation systems expressed by the all time proportionality of their state functions.*

We expect to such kind of symmetry or harmony because of the mathematical model given by the equations (3.2) respects a duality of the variables x and y and a symmetry in respect to the time, reflected in the future $t+\tau$ of a system and in the past $t-\tau$ of the another system.

But it is improbable that in the evolution of the master system (at least) does not intervene something else, from its part or from the third system and so the first equation (3.2) has another term also.

Considerations are done in two cases:

1. The master system changes its state taking into consideration a piece of information $y(\tau)$ about the slave system at a fixed moment, but gives an impulse. This is the case from the following equations:

$$\begin{cases} x'(t) = y(\tau) - ax(t) + A\delta(0) \\ y'(t) = x(-\tau) - by(t) \end{cases} \tag{3.6}$$

Here $\delta(0)$ is the Dirac's distribution centered at $t=0$, that is the pseudo-function defined on $(-\infty, +\infty)$ by $\delta(t) = 0$ for $t \neq 0$, $\delta(0) = +\infty$, and integral from $-\infty$ to $+\infty$ is equal to 1.

Let us apply Laplace transform to the first equation (3.6), with

$$L[x(t)] = \int_{-\infty}^{+\infty} e^{-pt} x(t)dt \,,\; L[x(t)]=X(p),\; L[x'(t)]= pX(p) - x(0),\; L[\delta(0)]=1. \tag{3.7}$$

The equation become

$$pX(p) - x(0) + aX(p) = \frac{y(\tau)}{p} + A \tag{3.8}$$

$$X(p) = \frac{y(\tau)}{a}\left[\frac{1}{p} - \frac{1}{p+a}\right] + \frac{x(0)+A}{p+a} \tag{3.9}$$

Applying the inverse transform, L^{-1}, we obtain the function $x(t)$:

$$x(t) = \frac{y(\tau)}{a} + \left[x(0) - \frac{y(\tau)}{a}\right]e^{-at} + Ae^{-at} \tag{3.10}$$

The value of the master system state increases if its movement receives an impulse of magnitude A at the present moment, but this value decreases when the time elapses. The impulse being done at the present moment $t=0$, it is normal to suppose that the past values remain unchanged and we have the same function $y(t)$ for the slave system.

2. If we use the equation with a constant intervention from the master system, considering the following equations:

$$\begin{cases} x'(t) = y(\tau) - ax(t) + C \\ y'(t) = x(-\tau) - by(t) \end{cases} \tag{3.11}$$

Here C is a constant number. The general solution is the following:

$$x(t) = \frac{y(\tau) + C}{a} + Ke^{-at} \tag{3.12}$$

At t=0, we determine the constant K and so the solution will be the following:

$$x(t) = \frac{y(\tau)}{a} + \left[x(0) - \frac{y(\tau)}{a} \right] e^{-at} + \frac{C}{a}(1 - e^{-at}) \tag{3.13}$$

The state evolution of the master system has another function.

Observation. The difference between the solutions results from the role of $\delta(0)$. While the function $f(t) = C$, $t \in [0,+\infty)$, designates a constant intervention all the time, the distribution $A\delta(0)$ represents the fact that the impulse is given only at the present moment $t = 0$.

In conclusion, the two systems, correlated by anticipation and retardation, have an asymmetrical movement (Otlacan, 2009).

A more general case could be described by the equations:

$$\begin{cases} x'(t) = y(\tau) - ax(t) + f(t) \\ y'(t) = x(-\tau) - by(t) \end{cases} \tag{3.14}$$

Without doubt, this case will introduce the asymmetry also.

4. Conclusion

The pair (master system, slave system) can form a whole characterized by aesthetic equilibrium, this being the symmetry by anticipation and retardation. That position is a balance of the two contrasting parts and it is assimilated with the symmetry. But while the known definition of symmetry implies correspondence in the form, size, arrangement, etc. of parts, also viewed as proportion or harmony or balance (Webster dictionary) considers static objects, our study subject is represented by dynamical systems.

In the field of the dynamical systems the periodical phenomena could be considered as having symmetries. But perfect periodicity is not manifested in natural systems or in those of human economic, social, financial life. Earlier or later, some forces intervene to break the periodicity and so to break the symmetry also.

A question could be moot: if the alternation symmetry / asymmetry is the basis of the dynamism in all natural media, inclusively in the social life, in what conditions this alternation will assure the stability, this situation preferred by human society?

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