A model that presents the states of consciousness of Self and Others

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Abstract—Model, that comprises of multi agents and their relations or information states, and represents the states of consciousness of Self and Others, is presented. This multi-agents model and the arrangements made by information states are presented as an opportunity to make a model in artificial intelligence conscious for Self and Others. The model consists of agents and their complex relations, contributing in definition of mater and inner life. It gives how the conscious for self and physical is defined. In the paper is enclosed the model's basic description, attributes of the relations between agents, examples of states of consciousness for Self and 1-D bounded space. The time and space in unbounded continuum is presented as well as the most important structure, the biggest circle structure. Also, arrangements done by the relations of agents using the theory of groups and different representation of the arrangements with matrixes are given. Then, the qualification of the attributes of the relations is presented using the fuzzy granular membership functions, to attain representation of the category likeness or equivalence necessary in contribution of phenomena. As a conclusion are given some issues for future work.

Keywords— Artificial Intelligence, Consciousness, Direct Knowledge, Fuzzy Logic, Information States, Multi Agent Model, Self-reference.

I. INTRODUCTION

To present the consciousness as natural scientific phenomenon it has to be related with material world. It is stated that conscious can't be explained with existing natural laws of physics [6][7][12] and it is not functioning according to logical rules [5]. Consciousness represents the free will, directing the psychological function to the goal. Most of the mind operations are not related to consciousness, the neural firings are not perceived by conscious. Consciousness is a part of Self. The consciousness represents a free will [8][12], which in inner world is arbitrary choice for conscious aspects of self and other [1][2].

The proposed model in the paper is developed by C. Berner and extended by B. Percinkova.

II. MULTI-AGENTS MODEL AND THEIR INFORMATION STATES

The suggested model consists of agents and their information states or relations which are established according to their free will. The attributes of their relations are defined and using the qualification *likeness*, the state of consciousness if defined. This model explains the conscious of self as self-referenced approach and the conscious of matter.

The theory stands that everything it exists is a huge finite number of agents and their states of direct knowledge (relations) and states of indirect knowledge (relations) with other agents. Those agents chose to have a relation according to their free will and those relations define the basic physical categories like time, space, matter, etc. Those agents are inseparable, they are not a composition, they are elementary units.

Every agent in a relation with other agent, including it-self, can be in a state of direct or indirect knowledge with that agent, which doesn't means existing of conscious. But, an arrangement of relations of direct knowledge between the agents can define a conscious. Combining the attributes through relations, arrangements of conscious for self and mater, located in time and space, are described.

As a nomenclature, agents are presented with big alphabet letters and their information states are given with arrows.

A. Attributes of the agents

Every agent owns four attributes or properties which are defined as follows:
1. **Unity**- every agent is an entity
2. **Existence**- every agent exists even it doesn't have physical characteristics
3. **Acts**- every agent chose to be in a state of direct knowledge with other agent according to its free will
4. **Whoness**- every agent is different from others in what it is

This theory is based on existence of finite number of agents and their arbitrary relations based on other agent.

B. Information states in the model

Four combinations of relations between the agents can be set:
1. **Relations of direct knowledge** or A→B (A is in direct knowledge of B)
2. **Relations of indirect knowledge** or A→B→C (A is in indirect knowledge with C)
3. **Relations based on attribute unity** or D←A→B (because of the Unity of A, this two states are combined forming one new state for A, where the previous states are embedded)
4. **Relations based on likeness of the attributes** or some or all of the attributes are like or equivalent with their

corresponding ontological attributes. This is the most interesting relation and in the following part of the paper, it will be more explained.

C. Relations based on likeness of the attributes (4)

Only in cases when agent A is in direct or indirect knowledge of self, and all four attributes are like or equivalent with corresponding ontological attributes, then agent A is conscious of "existence of unity **who** acts". It that case, agent A is conscious of agent A (because of the attribute whoness), which is self-reference. This state is known as tacit knowledge or inner life. Consciousness for self, defined as direct knowledge, is non physical category. If consciousness for self is defined via direct or indirect knowledge in unbounded continuum, concerning other agents, it is experienced as physical category.

Consciousness for self as non physical category and defined with this theory is simply given in the following table:

TABLE 1
Consciousness for self as non physical category

(3)	Existence	Unity	Acts	Who is (or whoness) (1)
(4)				Who is (or whoness) (2)
(3) is like with (2)	√	√	√	√
(1) is conscious of (2)	Existence	Existence of unity	Existence of unity that acts	Existence of unity **who** acts

Legend: (1)- agent A; (2)- agent A; (3)- attribute of agent A; (4)- attribute of agent A.

Consciousness and physical are inextricably coupled. According to this theory, conscious for physical is when three of the attributes of agent A (unity, existence and acts) which are in state of direct knowledge with agent B, are like or equivalent with corresponding attribute B. For completeness, there is no direct knowledge of agent A with agent A, nor on agent B with agent A, nor on agent B with agent B.

Consciousness for physical defined with this theory is simply given in the following table:

TABLE 2
Consciousness for physical

(3)	Existence	Unity	Acts	Who is (or whoness) (1)
(4)				Who is (or whoness) (2)
(3) is like with (2)	√	√	√	
(1) is conscious of (2)	Existence	Existence of unity	Existence of unity that acts	Existence of unity **that** acts

Legend: (1)- agent A; (2)- agent B; (3)- attribute of agent A; (4)- attribute of agent B.

The difference between these two phenomena is that one acts according on free will (non physical category) and other acts because of some previous event (physical category).

III. MULTI-AGENTS MODEL AND ARRANGEMENTS

This model forms spatial arrangements defining some phenomena in bounded and unbounded continuum. So, going further, the relations make structures represented with the graph theory. The main objective of interest in the model is arrangements in circle structures. The most relevance is the biggest circle arrangement where are located most of the direct knowledge relations [1][2]. Every arrangement which is not part of the biggest circle structure is called baby universe.

With •, in the arrangement A→B• we are assigning individual consciousness of A for B but it is still not a phenomena.

If we have the arrangement A→W•→I•, agent A is in a state of direct knowledge of agent W and agent W is in state of direct knowledge of agent I and agent A is conscious of two states of consciousness (A →W•→I• and A→W•). These 2 states of consciousness are sub-states of only one state of consciousness for agent A because of its attribute Unity. These states are embedded in one state of consciousness. The embedded state of consciousness can be state of likeness or equivalence of some of the attributes on relations between the agents. In this one state of consciousness on A, existence of agent I is determine by existence of agent W, so these one state of consciousness is present moment of existence for A and the past moment of existence on W. With this linear arrangement time is defined.

$$W \rightarrow I\cdot \nearrow^{F\cdot}_{\searrow Z\cdot}$$
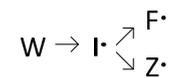
If we have arrangement , it differs with the previous in the structure of bifurcation where agents F• и Z• exist in the same time in the consciousness of agent W, because of its attribute Unity. In the sub-arrangements I•→F•and I•→Z•, there is no existence of time and agents F and Z are not located in the consciousness of W. With this non-linear arrangement, 1-D space is defined. On the similar way 2-D and 3-D are defined. Those arrangements are located in bounded continuum.

If the agent A is located in a circle structure, it can be consciousness of unbounded time continuum, same as movement on circle structure is infinite.

In the arrangement on Fig. 1, every agent is in state of individual consciousness on A•, W•, I•, F• in common present time. The sequence of events in common present time is different and unique for every of them:

$$A \rightarrow W\cdot \rightarrow I\cdot \rightarrow F\cdot \rightarrow A;$$
$$W \rightarrow I\cdot \rightarrow F\cdot \rightarrow A\cdot \rightarrow W;$$
$$I \rightarrow F\cdot \rightarrow A\cdot \rightarrow W\cdot \rightarrow I; \text{ and}$$
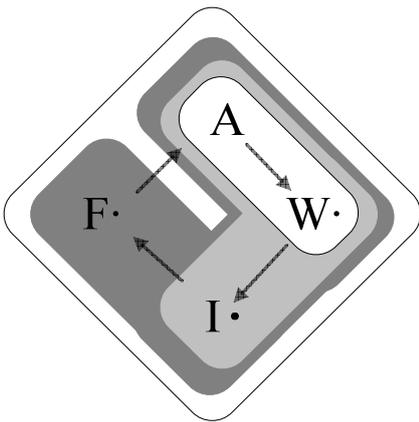$$F \rightarrow A\cdot \rightarrow W\cdot \rightarrow I\cdot \rightarrow F$$

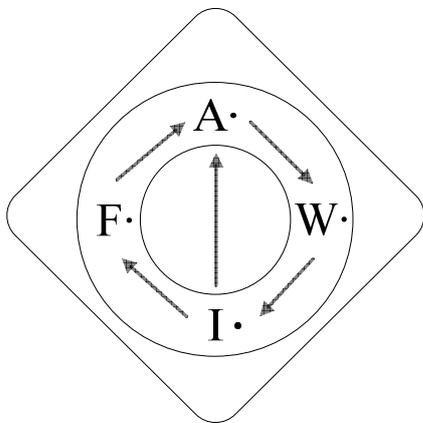Figure 1.Time sequence of agent A in a circle structure

Figure 2.Sequence of common time

On Figure 2, a time sequence of common time is given. Also, this circle structure includes bifurcation that produces consciousness on unbounded space continuum for every agent located in the circle structure. In the consciousness of every agent, quant of common time, obtained from the cross-over arrow, increases the dimension of space continuum.

In the theory, the shape is important and our interest is always closed circle structures.
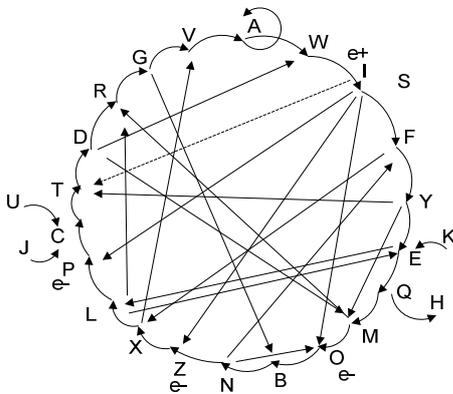

Figure 3.Typical configuration of information states on agents in the model with emphasizing on the giant circle structure

The most important is the biggest circle structure where the most agents and their relations are located. The biggest circle structure consists of many sub-arrangements, as shown on Figure 3. Baby universe is every sub-arrangement that is still not part of the giant arrangement.

According to the mathematical model [1][2], the most number of agents are mutually connected after $(\pi/2)N$ established relations. Such giant system is basis for state of individual consciousness for every agent in it. Total number of agents is noted with N, number of agents in the biggest circle structure is **n** and this number is very near to N. Number of agents that are not part of the biggest circle structure is N/e^K where **e** is natural logarithm and K is average number of relations per agent. This formula is produced by the mathematical model [2] and is based on the probability of relations in digraph with N agents. So, $n=N- N/e^K$ or this can be normalization given with $e^K=N/(N-n)$. The value for K can be obtained from the measured value of α which is the coupling constant for fermions and presents the power of electromagnetic interaction between the elementary particles.

Those arrangements are growing, including cross-over relations in the circle structures. Other phenomena are defined such as electron, muon and tau pairs. Some applications of this theory are also given in [1][2].
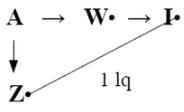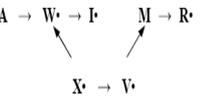
As the most interesting example and a confirmation of the theory is its implementation on big arrangements. The chronology of events is used to compute the time when inflationary curve joins the Standard Big Bang expansion. In the theory, the beginning of time was caused by agents as a whole in the proposed model, not denying a certain number of their information states or relations. Using the theory, a presentation of physical phenomena produced in the consciousness of the agents as their non denial increase can be done [18], starting with the first moment of time end ending at the present time. Also, a comparison with the chronology of events of the Standard Model is performed [18].
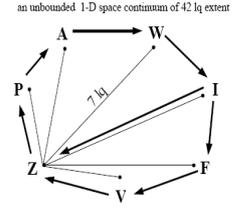
Table 1.A chronology of events according the Standard Model

Time [sec]	Event	Characteristic
10^{-43}	Super force	Planck's time
10^{-43}-10^{-35}	Grand unification of the forces. The GUT period	$\varnothing=10^{-33}cm$; $T=10^{32}$ K;
10^{-35}-10^{-32}	Inflation of the Universe (Guut)	$T=10^{28}$ K;
10^{-35}-10^{-12}	The birth of quarks	$T=10^{25}$ K; dimension of orange
10^{-12}-10^{-6}	The birth of leptons	$T=10^{15}$ K;
10^{-6}-10^{-4}	The phase of the hadrons	$T=10^{13}$ K;
0.0001-1	The phase of the leptons	$T=10^{10}$ K;

1-3	Formation of the first atomic nuclei	$T=10^6\ K$;
3 min.-300 000 years	The Universe becomes transparent	$T=10\ K$;
300 000 years and after	The formation of the first atoms	

Table 2.A chronology of events according to proposed model

Time [sec]	Event	Formula	Example
1tp+1tq	Present time for A	F(2)+1	A→W•→I•
10^{-41}	No matter, energy, space	from the graphic	A→W•→I•
$4.11744005 \times 10^{-40}$	1-D space	F(3)	A→W•→I•→F• or A → W• → I• ↓ Z• 1 lq
$3.86597019 \times 10^{-38}$	2-D space early start of the inflation according to GUT	F(4)	
$6.16910503 \times 10^{-37}$		F(5)	A → W• → I• M → R• ↖ ↗ X• → V•
$4.45132565 \times 10^{-35}$	π/2Ntq, rapidly huge number of baby universes, start of inflation according to information theory, a little difference with GUT	F(8)	2, 3, 4 cross over arrow arranegements
$1.306106402 \times 10^{-32}$	all baby universes are less in number but much larger, dimension of universe. Extracted from the graphic		

1.440480×10^{-32}	at least one circle arrangement Compared with GUT fits with one monopole manifested as agent conscious in the circle	extracted from the graphic	an unbounded 1-D space continuum of 42 lq extent
$1.81163303 \times 10^{-32}$	Appearance of first circle and 1-D experience. Compared with GUT, near to X boson. Extracted from the graphic		
$2.20064574 \times 10^{-32}$	Appearance of first circle cross-over with 2 arrows, experience for 2-D unbounded space, appearance of photon. Compared with GUT, time for W± boson		
$2.38015083 \times 10^{-32}$	Appearance of first circle with 3 cross over arrows and experience for 3-D unbounded space, 2-D movement, fermions possessed their properties. Compared with GUT, time for Zº boson sphere.		
$2.51211856 \times 10^{-32}$sec	End of inflation, according to Gutt, 10-15 cm.	(πN/2)	
1.294246×10^{-31}	K is around 12.70623721 and n is 1.382583 x 10^{23}. The size of the Universe is (Kn)³lq.	(2Kn/π)	
$2.27365807 \times 10^{-7}$	Time of born of quarks, different from the Standard Model, but the size is the same	(2Kn)²/π	
$5.04788200 \times 10^{27}$cm	Identical value with the Standard Model for the size	(Kn)³ 2n lq	
$0.99423331 \times 10^{17}$	Prediction of the age of Universe	((2Kn)³/π)	

tq-Planck's time
lq-Planck's length

IV. EXAMPLE OF SOME TYPES OF RELATIONS GIVEN ON SIMPLE ARRANGEMENT

A. Scope of the example 1

The scope of this example is four agents, their information states and arrangement that represents consciousness of bounded one-dimensional space. Each agent, that has direct relation to other agent (relation of category 1), and has equivalence of attributes Existence, Unity and Act with

corresponding attributes to the pointed agent (relations of category 4)[1].

B. Schema of the example 1

On figure 4, different states on agent A are presented:
- one state of direct knowledge of A to B
- one state of direct knowledge of B to C
- one state of direct knowledge of B to D
- four states that exists because of
  - the attribute Unity on B and
  - the equivalence on three attributes of B with three corresponding attributes of agent C
- four states that exists because of
  - the attribute Unity on B and
  - the equivalence on three attributes of B with three corresponding attributes of agent D
- four states that exists because of
  - the attribute Unity on A and
  - the equivalence on three attributes of A with three corresponding attributes of agent B

In total, we present 16 states that show how relations between agents on Figure 4 can be arranged to achieve conscious of 1-D bounded space.
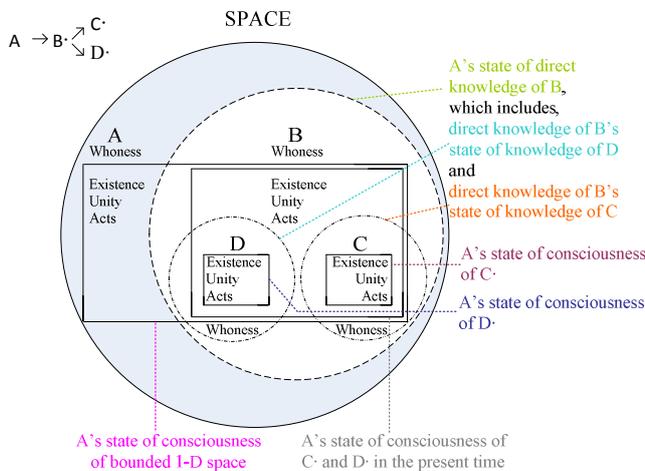

Figure 4.1-D space arrangement presented by attributes of relations between agents

C. Scope of the example 2

The scope of this example is one agent, its information states and simple arrangement that represents consciousness of Self. The agent has direct knowledge to itself (relation of category 1) and has equivalence of Existence, Unity, Act and Whoness with corresponding attributes to itself (relations of category 4)[1].

D. Schema of example 2

On figure 5, following states on agent A are presented:
- one state of direct knowledge of A to A
- five states that exists because of
  - the attribute Unity on A and
  - the equivalence on four attributes of A with four corresponding attributes of agent A.

In total, we present 6 states on Figure 5 on arrangement that presents conscious of Self.
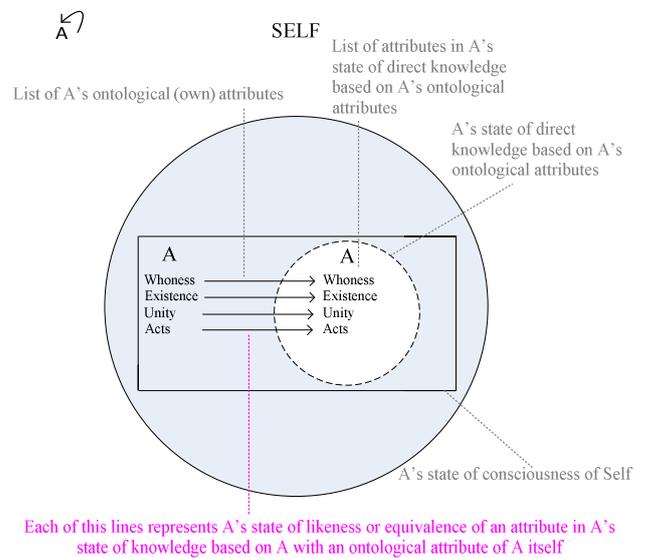

Figure 5.Arrangement of consciousness of Self

A consciousness for Self, as one element of consciousness, is associated with the attribute Whoness or who is that agent. Self-referenced nature of the model can be proved when the calculation of the total number of agents N is replaced with the Euler's equations. In this theory, given as a hypothesis, one of the ways of calculation of number of agents in the model is involving π and e. According to the proposed formula, we can obtain the following self referenced form:

$$10^{e^{\pi}} = N$$

$$e^{\pi} = \log N$$

$$e^{i\pi} = -1$$

$$\log N^{i} = -1$$

$$\log N^{\sqrt{-1}} = -1$$

$$\log N = \sqrt[\sqrt{-1}]{-1}$$

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[1] Relations of category 2 and 3 are not included

This self-referenced form can have different shapes. Starting from $logN^i = -1$ and $i = \sqrt{-1}$, we have $logN^{\sqrt{-1}} = -1$. So, we can obtain $logN^{\frac{1}{2}\sqrt{-1}} = \sqrt{-1}$. On the left side of the equation, a replacement of one part, which is equal to the right side of equation, can be done and we can obtain:

$$logN^{\frac{1}{2}(logN)^{\frac{1}{2}\sqrt{-1}}} = \sqrt{-1}$$

The previous replacement can lead to the following self-referenced form:

$$logN^{\frac{1}{2}(logN)^{\frac{1}{2}(logN)^{\frac{1}{2}(logN)^{\frac{1}{2}\cdots}}}} = i$$

Or, otherwise presented we got:

$$\sqrt{logN^{\sqrt{-1}}} = \sqrt{-1}$$

$$\sqrt{logN^{\sqrt{(logN)^{\sqrt{-1}}}}} = \sqrt{-1}$$

$$\sqrt{logN^{\sqrt{logN^{\sqrt{logN^{\sqrt{logN\cdots}}}}}}} = i$$

V. EXTENDING THE MODEL ARRANGEMENTS FROM GRAPH TO GROUP THEORY (MATRICES)

One of the known presentation of graph theory is mapping its' states in matrices. Implementation of this model as a presentation and prove for identity element of the matrix was given by B. Percinkova. The identity element is matrix with all elements 1. Direct knowledge between two agents is presented with element 1, and missing of the relation or direct knowledge in the structure is presented with element 0. To put two arrangements or baby universes in the matrix presentation is done in the 1-st and 4-th quadrant of the matrix. To make a connection between this two baby universes, there have to be only one 1 in the 2-nd and only one 1 in the 3-td quadrant. So, we can get a closed circle structure as it is of our interest. The complementary matrix of this are states that are potential to become a direct knowledge.

Figure 6.Baby universes G1 and G2 that will be connected adding 1 in empty quadrant of the matrix

$$G1 = \begin{array}{c} \\ A \\ B \\ C \end{array} \begin{array}{ccc} A & B & C \\ \left[\begin{array}{ccc} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{array} \right] \end{array} \qquad G2 = \begin{array}{c} \\ D \\ E \\ F \end{array} \begin{array}{ccc} D & E & F \\ \left[\begin{array}{ccc} 0 & 1 & 0 \\ 0 & 0 & 1 \\ 1 & 0 & 0 \end{array} \right] \end{array}$$

	A	B	C	D	E	F
A	0	1	0	1	0	0
B	0	0	1	0	0	0
C	1	0	0	0	0	0
D	0	0	0	0	1	0
E	0	1	0	0	0	1
F	0	0	0	1	0	0

The arrangement G1 has direct knowledge or relation with arrangement G2, or with other words, G1 is consciousness for Self through G2.

Using matrixes makes easier our visual presentation of states of knowledge and clear presentation of baby universe in one area of the matrix or whole arrangement watching the whole matrix. Moving on the diagonals of the matrixes, we get closed circle structures as it was case in the graph presentation through Hamiltonians.

Suggested by B. Percinkova, baby universe can become a basic element in defined structures and replace the agent. This is another extension of the model showing its fractal nature.

VI. QUALIFICATION OF THE ATTRIBUTES OF THE AGENTS

In this part, an example of qualification of attributes of the agents is given using the Zadeh's fuzzy granulated logic [10][11]. The main objective is to develop software approach for the proposed model of conscious of self and conscious of the physical. The qualification of the attributes of the agents is necessary to define likeness or equivalence of their relations in the model (relation 4). To define these properties we can use the concept of colors.

The concept of colors is a fuzzy concept that is actually associated with the degree of membership. Fuzzy concept is specified by graduation or by granular value.

Because of the uncertainty to determine the fuzzy set as common understandable for all, it is recommended to implement fuzzy sets of type 2. All membership functions of type 2 can be "aggregated" and then we can do mathematics for those fuzzy sets.

As it is suggested, [11], a tool for drawing the type 2 fuzzy sets is used and that is a spray can with different pattern and it is done by hand. Those values will be marked with leading *.

Lets S be the subject which is marked as a collection $P = (p\_1, \ldots p\_n)$ and every of this value is mapped in the interval [0,1]. For every p_i, S mark m_i in the interval [0,1] which presents the degree in which p_i match the S perception. Because the perception is imprecise, S is partly defined membership function for some color in a form of collection of sorted pairs. The first element of the sorted pair is the pattern of the color and the second one is the degree of fuzzy membership. Because we are working with colors, the

membership function of a color is determined by mapping the p_i with the spectral density of p_i.

Next step is layering of membership function S or more specifically, collection of pairs which is the definition of membership function is ascending ordering of m_i. The final step is granulating of the membership function as a collection of ordered pairs, in which the first element is granular (or fuzzy set) of the pattern in color and the second element is label or value of granulate. Rough granulation can enclose 3 granulates assigned as high, medium and low.

Following is an example of granulate High:

$$\text{High}=(p_3,t_H(1))+(p_5,t_H(1))+(p_7,t_H(1))+(p_9,t_H(1))+(p_6,t_H(0.9))+(p_{10},t_H(0.9))+(p_2,t_H(0.8))+$$
$$(p_8,t_H(0.8))+(p_4,t_H(0.7))+(p_1,t_H(0.6))$$

On similar way, granulates Medium and Low can be presented. Granulated fuzzy sets are of type 2.

It has to be marked that term $t_H (0.9)$ is actually $t_H (*0.9)$. It is suggested to implement the precise/imprecise principle that $t_H(*0.9)$ expand it in $*t_H(0.9)$, and $*$ is reading as approximately equivalent.

The final result is granulated, subjective, based on perception expression for membership function for chosen color. This membership function forms the subjective definition of that color.

VII. CONCLUSION

The presented model is a framework in which we can develop consciousness and physicality. The theory presented here is a great potential for future work on new physical phenomena. Also, the application of the model can be extended in other scientific disciplines and it opens new frontiers especially in artificial intelligence. Below are given some extensions and future ways for development [1].

Step further for development of the model is connection with theory of chaos. Working with recursion present in the model, it can be expecting chaotic performance of the system. Working on the development of recursions in the model we expect to find constant or so-called hidden knowledge in non linear systems representing the determined chaos. Furthermore, the introduction of a baby universe as a basic element that can replace the agent provides a clean connection with the theory of chaos and needs development in this direction.

Next direction for development is finding the biggest Hamiltonian using matrices. Working with matrices and the connection with circle structures should be lead on developing a topology. We need clear definition of cross over the circle which becomes a new circle and also, a distinction when dealing with matrices is required. Accordingly, we need clear definition of bifurcations presented via matrix.

Next direction for work is on connecting the coupling-constant that represents the forces of attraction or rejection in the circle structure, with π, although with existence of the circle or spherical structures, π is already included.

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