Anticipatory Agents, Scenarios Approach in Decision-Making and some Quantum -Mechanical Analogies.

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Abstract
New applications of proposed multi-agent's models of neuronet type with intellectual agents for economics and social problems are described. Some unexpected analogies with some topics from quantum physics are proposed. The selection procedures in proposed models remembers the measurement process of quantum state. Also the analogies with concept from quantum mechanics - namely with many- world interpretation of quantum mechanics is discussed. In such interpretation at each moment of time the system with observer is exposed to branching. We may suppose that such analogies aren't accidental. Another important property of proposed models consists in analogies to the description of quantum process on microlevel to the so -called causal nets in quantum gravity. Multivaluedness of solutions in our models allows connecting of its properties to the gauge theory.
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1 Introduction

It was demonstrated earlier in author's papers (Makarenko, 1998; 2001) that investigation of the large socio- economical systems requires the new models. Firstly we briefly remember the general frames of our concept. One of the milestones is the associative memory property in models and presumably in original systems. Further we had concerned as the extending of frames as the applications. New aspects are essential, especially mentality accounting. It was found that anticipating property accounting had followed to absolutely new properties of proposed new models (one of the main is multivaluedness). All this allows considering on the strict background many properties of society (Makarenko, 2001). Also the new properties have followed to new deep research problems.
In the present report we will describe some new aspects and problems. The main goal of the report is to attract attention to some focal points of approach which may extend the

understanding of proposed models and may be of nature. So for this goal we take here the verbal level of description. The quantitative understanding of such problems will require the strict formalization and mathematical investigations. But just the posing problems and preliminary discussions may be useful before formalization.

2. Milestones of author's models of society (Makarenko, 1998, 2001)

For the sake of discussed issues understanding we remind some considerations from previous works. Following considerations are leading. Firstly, some global structures (formations or civilisations in alternative approaches) in society dynamics exist. The society as the rule operate in the frame of such structures. Secondly, alternation in individual state frequently is determined by the influence of some society environment. Environmental influence can be described by mean field approach. Namely there are many interrelations between the elements of social systems (and not only in social but also in natural systems). The idea of interrelations of all things in the World have existed in philosophy and theology (without concretisation of such influences). One source of interrelation idea is humanity sciences: sociology, psychology, politology. Famous recent sociological theories have as milestone idea of social influence of different type: social interaction by T.Parsons, D. Easton, E.Durkheim, social fields by K.Levine. Influence of surrounding environment on individual presents in psychology of small groups of peoples (with some scales for measuring influence between individual); implicitly in social psychology by G.Lebon, K.G.Young, G.Tard, S.Moskovicy; in collective consciousness ideas by E.Durkhaim.

There are many sub processes in such systems - political, social, and cultural. The whole model may be very complex and expensive because it must contain a lot of processes details description. But even global principles shed some light on dynamic of transition processes in large social systems. For example, the society can go from one global structure to another by two ways: by evolution or by revolution. Revolution can be described by the fast rupture of bonds between elements and is unpredictable. Evolutionary way is long and demands patience. The change of social formation may be considered as the change of the 'patterns' in such models. In such cases some features of structures stay invariant and some features should to change. Remarks that the nonsimmetric bonds cause the chaotic oscillations overlapped on the cyclic processes. The description of competition of Lotka- Volterra types may be considered as the consequences of global model. Also we can consider the models for the sub processes in the global system processes. As the lower level of description we may take for examples industry or separate sub-regions. All branch of industry may be considered as union of producers, consumers and mediators.

Many interrelations between elements should be considered. These relations have the same properties as the relations in global model: the bonds had originated evolutionary; all industry branches are rather stable, and analogies of holography property exist (the similarity of production type). In such case the 'patterns' of systems with associative

memory corresponds to the branches of industry. If there are some concurrent sub-branches (as in the transport for example), than for each sub-branches there are corresponding concurrent 'sub-patterns'. Similarly the separate subpatterns corresponding to separate goods production are formed by bonds between the producers, consumers and mediators. These bonds may be implicit or explicit by market, transport and communication interrelations. On such level of description and modelling the life cycle is the manner of functioning of corresponding 'pattern' in complex net structure. It worth to remark that with the descent on hierarchy scales the volume of bonds in 'patterns' decrease. The plasticity of bonds increases and characteristic inertia time (or rebuilding time of bonds) diminishes. The same building principle for models is applicable to the large organisations and institutions.

3. Some key issues of the general frame

In preceding section we have posed some very short sketch of main ideas. The detailed description may be found in previous papers by author (Makarenko, 2001, 2003). But further analysis of approach background had followed to necessity of some new aspects considerations. So here we propose the discussion on some general features of approach which may be connected to other fields of activities in science. This aspects concern the description types in models, the possible varieties in solutions and of choice between possible alternatives in the solutions.

3.1 'Patterns' as possible description of environment and elements

'Patterns' are the one of the components in our models. The 'pattern' is the collection of elements and bonds between them at given moment of time. As was pointed out in (Makarenko, 2001) such description is useful as for environment as for the mental structures of individuals (or agents in the models). In such case the description remembers the relational network in programming. But now it may be proposed some prospect for investigation relations with different kinds of systems description.
Firstly, it is known since John von Neumann that in another field of science (quantum mechanics) 'geometrical' or 'events' description may be transformed in pure 'logical' or sometimes 'linguistic' description (Meskiv, 1987). So the 'patterns' may be transformed to 'logical' description.
Second type of description may be finding in data mining. One example is the language of map in geography (Lutiy, 1980). In such approach the designer of map extracts the elements and connections between elements of the maps. Then he represents the description by special language. The problems of language extraction is intrinsic to the considering the patterns and images (Giammarresi, Restivo, 1992). Recently also new relations between neural networks and geometrical and categorical description had been proposed (Pfalzgraf, 2001).
Thirdly the description of 'pattern' types may be exploited for hierarchical levels of the nature. Some useful abstract considerations had been described at the papers by Atkin&Bastin and Kulakov Yu. Yu. Another example of familiar construction may be

found in micro level description of quantum gravity (Zimmerman, 2000). The core of this approach consists in considering the so called causal networks (Markopoulou&Smolin, 1997). The events are nodes and causal connections are bonds. That is in such case physical phenomena are initial and its properties follows to the properties of causal networks. Conversely in case of hierarchical network description in our models we may supposed that the networks and their dynamical laws in models follow to some intrinsic (physical law remembering) laws. Moreover, may be the original phenomena under modelling (for example large socio- economical systems) also has such laws, including quantum- mechanical description.
One presumable consequence concerns to the problem of consciousness. From many recent investigations some general properties of consciousness had been extracted: multiple possibilities of behaviour and choice of unique variant (Stapp, 1998; Marcer, 2001; Perus, 2001). So for many levels in hierarchy (may be for all) the problem of specific type of consciousness intrinsic for given level in hierarchy may be posed. Remark that recent approach (definition (?)) of consciousness may be represented in rather general form. Categorical frame is one of useful approach (especially topos theory, (Johnbston, 1977; Zimmerman, 2000)). Particular models may be transformed to such forms. Finally remark that described approaches are prospect for mental world of agent's description.

3.2 Multivaluedness in models

To make the choice it is necessary to have the set of possibilities (that is many variants or possible trajectories of the system). First and the most important source of multivaluedness is anticipatory property as had been considered in (Dubois, 1998), see also discussion in (Makarenko, 2001) and some possible applications in scenario approach (Makarenko, 2003). Nonlinear processes are another source of multiplicity possibilities, especially in physics. Bifurcation theory is the background in this case and dissipative structures are the examples of its realisation. Another less evident source of multivaluedness may be found in the calculus of variations (generalised curves since Young and possible applications in turbulence (Young, 1967)). New type of asymptotically multivalued solutions had been founded in the theory of difference equations (Sharkovsky et al, 1986). Many solutions are intrinsic to incomplete problems and to control theory. Also just some linear problems allow multiplicity as it had been described in (Stapp, 1998).

3.3. Procedures of choice

Choice is important component in our approach in case of anticipation accounting. Presumable multiplicity follows to the necessity of unique variant choice. One recipe is to use the theory of catastrophes, or implicit choice in numerical computations of solutions (Dubois, 1998). In considering the systems which includes the humans the problems of choice also are very important. In such case we may speak not about the simple choice but on the decision- making. Such shift of viewpoint follows to necessity

of new decision- making investigations. Decision- making incorporates the investigation of decision – maker. The personal rules for decisions are the result of individual development through social environment (including institutions) and of given individuals brain peculiarities. So just in the case of formal coincidence of choice rule with the rule of the catastrophe theory the background in the first case may be more complicated. The rules of decision- making are intrinsic to particular individual. The rules are in some since the 'fingerprint' of given individual. Remark that it may be interesting to consider the accidental choice in the theory of dissipative structures as some specific decision rule.

The investigations of such kind of problems are as complex and important as the investigation of whole problem of artificial intelligence. Just the problem of choice with fixed preferences is important and takes place in many disciplines. First example is the theory of rational choice in economics (Arrow, 1959). Second is the theory of preferences, orders and order functions (Sholomov, 1989). And third is description in mathematical psychology (Krylov, 2000). Also important is the theory of multi- criteria optimisation. Such developments of decision theory may be incorporated into the author's models of social systems.

Another aspect of decision theory is formal background for the theory of choice. Some ideas about relations of optimal control and symmetry are present in optimal control theory. The choice event is connected with the spontaneously broken symmetry idea in the quantum field theory (Ryder, 1985). In such theory small initial disturbances breaks the initial symmetry. This leads to choice of unique asymmetric solution with complex structure. For exploiting this idea in the models of social systems it will be necessary to develop the symmetry theory of models with internal world representation by given individual. This will lead to the models of society of the gauge theories type or to continuum theory with internal structures.

The possibilities of choice also allows posing the problems of scenarios and risk evaluation in organisational systems and large socio- technical objects (Makarenko, 2003). The application of new methodology will allow to reconsiders the problems of risk evaluation in large- scale systems with many different parts: natural, technical, biological, social and individuals. In this approach the variety of scenarios is intrinsic property of systems. The risk may be evaluated by counting probabilities of trajectories of the system. This is prospective namely for accounting human factor in decision making. Proposed approach to mentality accounting may help in considering planning, decision-making and different scenarios of sustainable processes. Closely connected issues are considering the role of personality in the history; possible and impossible ways of historical process, virtual history and possible scenarios of socio- ecological processes. Recently some such aspects are described qualitatively on the base of bifurcation and catastrophe theories. But till now the important problem is next: what does it mean 'decision' and what does it is the conditions for definition of 'decision-making'. The solution of problem may require exploiting of ideas on non- classical logic and multiplicity of semantic worlds; investigation of perception and knowledge of decision- maker; reflexivity and non-completeness of Turing automata.

4. Possible applications of some ideas

Here we will consider some examples of phenomena where ideas above may be reasonable.

Real neuron is the first object for future considerations. Now the behaviour of the cell collections is under intensive investigation. One of the examples is microtubules by (Hammerof&Penrose, 1996) and one of the main problems of neurophysiology is the behaviour of brain as the collection of large number of neurons (Eccles, 1992). But just single real neuron is complex object. Now a lot of models had been proposed for neuron description: ordinary differential equations., distributed models, integro- differential equations. Parabolic equations are used usually as the models of distributed neurons (Hodgkin- Huxley). But such parabolic equations had been derived from hyperbolic equations of electromagnetism of second order at time (Dubois, 2001). Remark that original hyperbolic system is more accurate and allows more effects in the solutions. One interesting class of effects is intrinsic for signal propagation. As usually in electromagnetic systems the retarded solutions are considered. But another possibility is to choose advanced solutions (see for references (Dubois, 2001)). If we were to consider advanced solutions in neuron equations then neurons were automatically received anticipatory property with many neurophysiologic consequences.

As the example of ideas application we here describe the new models of stock market. These models allow illustrating to the ideas on description, choice and multiplicity. First model earlier had been described at (Levkov et al, 1998). For the simplicity we consider here only the idealized market of one security. The trade consists from discrete steps, at which the actual transactions take place. Within each step we identify the substeps, which describe the dynamic bidding and asking or decision-making processes for every individual. The market consists of N homogeneous participants (in future developments the homogeneous assumption obviously should be removed). With every trader we associate the state variable $s_i \in S = \{0,\pm1,\pm2,...,\pm M_i\}$, where s_i represents the number of shares that trader i is planning to buy (if $s_i>0$) or to sell (if $s_i<0$), and M_i is the maximum allowed trading volume, which represents the number of shares trader i able to buy. With every pair of traders I and j we associate the variable $c_{ij} \in \mathbf{R}$ - the integral value of reputation that trader j has from the point of view of trader i. As one of the basic characteristics of the system we introduce the concept of a vector field of influence where influence means the integral influence of opinions of all other participants on i^{th} trader. The ratio $\frac{s_j}{M_j}$ represents the trading intentions of participant j at the current step. It shows the number of shares trader j is planning to buy or sell as a percentage of what his actual buying or selling power is. The product $c_{ij} \times \frac{s_j}{M_j}$ is the information about intentions of trader j filtered through the matrix of reputation.

Obviously, the best strategy for rational individual will be to adjust his own initial intentions to the filtered information about others. It is done by correlating the trading

decision of individual i with the corresponding value of the field of influence f_i. Thus, we may formulate the evolution equation describing the trading dynamics: The initial conditions for this dynamic equation are the intentions of each individual to buy or sell at the beginning of the trading step. Recently we had proposed some development of these models. We have took into account the internal structure of trader and anticipatory aspects as implementation of ideas above. With our graduated students A.Fursa and V.Solia we already have received some interesting numerical results. For example we had received interpretations of solutions in terms of panics, grows and stagnation of market. In such example the state of stock market is described by 'patterns' of market and 'patterns' of internal representation, the anticipation of agents may lead to multiplicity and different scenarios, and choices correspond to decision- making by agents.

Conclusions

Thus in proposed report we have discussed some issues (different descriptions, multiplicity and choice of trajectories) in our approach which relate to quantum mechanics or was inspired by quantum mechanics ideas We may suppose that this issues may be also useful in some cases for quantum mechanics understanding. Moreover we may try to consider some of proposed issues as the background for system analysis of large hierarchical systems. One of the main further conclusions is that neuronal networks are relevant description and models for some scales of nature. Because of great flexibility and generality this approach may be the one of the tool for unification of all natural scales. Another prospect propositions are that the large social systems with anticipatory property may have some quantum mechanical analogies and moreover some kind of collective consciousness. We feel that such properties may be intrinsic to systems with humans. It is also interesting that proposed approach may be useful in considering applications.

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