

# Interdisciplinary search for field-like coherence and coordination principles in the case of social modeling<sup>1</sup>

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**Abstract.** This interdisciplinary research aims to distinguish field-like fundamental principles of self-organization and coordination in the case of social domain. Literature review in different scientific areas gives a deeper understanding about possible universal field-like interaction and coordination mechanisms in biological, mental and unconscious levels of human nature. Based on presented basic principles and assumptions we introduce pervasive information field (PIF) concept which serves as a simulation media for contextual information storage, dynamic distribution and organization in social complex networks. The concept presented also gives a prospective vision how humans and, maybe, even societies can be understood, analyzed and simulated not just as rational limited and separate entities but also as interconnected members acting coherently in an all-embracing holistic environment. The social modeling concept presented as joint time-frequency representation gives fundamental vision how social systems could be interpreted and simulated as oscillating processes immersed in the all-pervasive information field.

**Keywords:** Field-like coordination, oscillations based modeling, pervasive information field, social modeling

## 1. Introduction

Approaches related to field-like coordination and self-organization principles gain an increasing interest among many researches and application developers [1][2][15]. These novel approaches try to establish a new way of understanding and modelling complex and live systems covering not only technological scientific areas but social aspects as well.

Despite the fact that this paper draws attention to the principles of field-like interaction observed in a variety of domains, the main focus is related to social domain. If we accept that society reflects the totality of its individual members, i.e. human beings, a deeper look and search for universal principles across different levels of human nature is necessary. Therefore a search for field-like coordination principles in biological and mental levels of human nature is considered in this paper.

The paper draws attention to the underlying social processes related to the view of holistic systems. In the simplest sense, it introduces an idea of a multifaceted field-like media for pervasive information storage and communication, i.e. pervasive information field (PIF) concept. In fact, PIF can also be referred to a virtual oscillatory field employed as simulation media to enforce indirect and uncoupled (contextual) interactions among the society members. In this way, PIF serves as a basic cornerstone in the currently being developed oscillations based multi-agent system (OSIMAS) simulation paradigm. According to the OSIMAS paradigm, all social information processes can be simulated as self-organizing, dimensionless and field-like entities.

It is beyond the purview of this article to provide a comprehensive review of the surge of publications on the field-based coordination and communication paradigms. Nevertheless, in the following sections we are

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going to try to systemize the basic principles of this approach beginning from the biological and mental levels of human nature and finishing with the field like coordination principles in the areas related to subconscious or so called unconscious mind field theories.

## 2. Field-like coordination principles and coherence in different levels of human nature

In order to model and understand the behaviour of society it is necessary to look closer into the very nature of society members or humans. When talking about humans and analysing different aspects of their existence first of all let's try to distinguish the basic levels of human nature, see Fig.1.

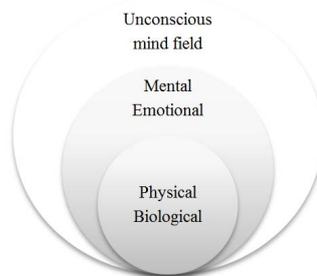


Fig. 1 Different levels of human nature

Given the Fig. 1 there could be distinguished three basic levels as physical or biological, mental or emotional and unconscious. Let's talk separately in more details about each level and let's search and overview the evidences and principles of coherence, interconnectedness and field-like coordination in each of these levels.

### 2.1. Field-Like Coordination in Physical or Biological Level of Human Nature

As most obvious and scientifically recognized is physical or biological aspect of humans, where biomedical models based on chemistry, genetics, physics etc. can be implemented. Let us briefly review this level searching for evidence of interconnectedness and field-like coordination.

In biology cells are considered to be the functional basic unit of life. Cell is understood as the smallest unit of life and can even operate individually, e.g. bacteria or other unicellular organisms. Not naming all the components of the cell and considering that microtubules in cytoskeleton are the structural elements of cells which act as tracks in transporting various products and also contribute to key processes during cell motility, including the regulation of focal adhesion turnover and the establishment and maintenance of cell orientation [3], a search for possible field-like coordination evidence in this part is of great importance. Microbiological research related to nerve cells tells that there is a great degree of coherence between the neighbouring microtubules. There is an agreement that a vibration in one microtubule tends to resonate in unison through its neighbours [4]. This phenomenon, sometimes called "superradiance" or "self-induced transparency", has been presented by K.H.Pribram, S.R. Hameroff, S. Hagan, M.Jibu and K. Yasue. "Superradiance" explains to us that microtubules create the global coherence of the waves in the body allowing the energy impulses to pulse coherently [5].

Other evidence related to possible coherence and interconnectivity between cells can be found in neurophysiology. Neurophysiologists agree that the brain operates as electrical impulses generated by ionic current flow within the neurons. Different frequencies of electrical impulses can be measured and analysed. A good evidence of such theory in practice is Electroencephalography (EEG), which is widely applied in contemporary medicine. The same principles related to electrical impulses, measured in other cell groups, like muscle or particular organ cells, are analysed during Electromyography (EMG) and Electrocardiography (ECG) procedures.

These medical practices and several theoretical examples related to biological aspect of human nature reveal the possibility of the existence of the field-based coordination mechanisms between the cells. Beginning from the information transmission in the scale of one cell, the basic unit of life, and continuing

with intercellular communication mechanisms, the human body can be understood or even treated as pervasive information field.

Considering the results from biological level of human nature, we moved to a mental level, trying to find field-like interaction and coherence principles at mental or emotional level of human nature as well.

## **2.2. Field-Like Coordination in a Mental and Emotional Level of Human Nature**

Besides the exploration of communication methods between cells, neuroscientists and neurobiologists are confronted with the question about consciousness and the mind in general- is coherence possible at this level as well? Despite the variety of research in the area [7-8], so far there is no general answer about the nature of consciousness. Nevertheless let us name and shortly overview the most dominant ones.

The conservative approach explains that consciousness must be located somewhere in the brain and created by electric impulses interacting between neurons. This approach is related to artificial intelligence, pattern recognition, neural networks and other areas linked to science of logic and computers, where the variety of true- false rules build the foundation for such a belief [9-10]. Despite the dominance of this approach, many scientists face the question of emerging subjective experience only from the interaction of nerve impulses. Is a machine able to implement a coherent behaviour by just making computations? In general the proponents of the conservative approach agree that the core problem of logic based approach of consciousness is related to explaining and defining the nature of subjectivity.

Searching for alternative approaches about consciousness and extending this overview let us talk about Holonomic Brain Theory. Holonomic Brain Theory, developed by a psychologist Karl Pribram in collaboration with a physicist David Bohm, is a model for human cognition that is based on neurological wave interference patterns and postulates that our brain can communicate with the body, other brains and even the World not using just images or chemical impulses, but in the language of wave interference, “a holographic or spectral domain” [11]. Karl Pribram theorized that perceptions, like visual senses, responded to a limited range of frequencies. He also noticed that other senses like smell, taste, hearing, etc. can be analysed also through frequencies [12]. Similar evidence about the limited band of frequencies and their role perceiving visual information were also discussed by other famous neuroscientists in their book “Spatial Vision” [13].

Other related theories, like "quantum-holographic theory" or “non-local mind theory”, trying to explain phenomena such as remote viewing, clairvoyance, intuition and etc. suggest that mental activity can be stored in holographic patterns in space [14]. The non-local effect then allows holographic patterns in space to communicate with each other in the same way as electromagnetic waves do. The same idea about a coherent mind field existence and wavelike communication has been broadly discussed by Lynne McTaggart in her book *The Field- ‘We perceive an object by resonating with it, getting in synch with it, being on its wavelength’* [6].

A conscious electromagnetic field (CEMI) theory, explored by J. McFadden, is one more attempt to explain the phenomena of consciousness as electromagnetic field [2]. This approach tries to explain how conscious mind integrates information distributed among billions of spatially separated neurons to generate the unity of conscious experience. According to CEMI theory, brain generates an electromagnetic (EM) field that influences brain function through EM field-sensitive voltage-gated ion channels in neuronal membranes. Information in neurons is therefore pooled, integrated and reflected back into neurons through the brain’s EM field and its influence on neuron firing patterns [2]. Considering CEMI theory, perhaps even our societies (macro world) no longer can be viewed as separate entities. Indeed, societies can be understood as global processes emerging from the coherent collective behaviours of the conscious mind fields of individual members.

## **2.3. Coherence and interconnectedness in unconscious mind field**

In psychoanalytical science the mental activity is often divided into conscious and unconscious processes. Conscious level mostly is determined as a mental activity where conscious thinking plays the main role of the process. Unconscious level of mental activity is determined as a predominant field in which only further processes of consciousness can emerge and operate [16][17]. Taking into account these issues and

considering the length limitations of this paper let's only name scientific theories related to the existence of so called unconscious mind field and its impact on us. As one of the most famous theories of the unconscious mind field are unified field theory [18][19], zero point field theory [20], nonduality approach [21] or the theory of social global consciousness field [22], where principles of interconnectedness, coherence or resonance applies. Beside the great diversity of scientific approaches related to unconscious mind field a similar understanding is shared also by such famous psychoanalysts like Sigmund Freud, Alfred Adler, Carl Rogers or Carl Gustav Jung who said that the essential the biggest and the smartest parts of the human's mental activity are formed by the unconscious system where only a very small part by the conscious one.

The above mentioned approaches, considering biological, mental and unconscious aspects of human nature, can put a foundation that humans and, maybe, even societies can be understood, analyzed and simulated not just as rational limited and separate entities but also as interconnected members acting coherently in an all-embracing holistic environment.

### 3. The Basic Principles and Assumptions of OSIMAS

In this section, we are going briefly to summarize the systemized universal principles of self-organization in live and other complex systems and integrate our findings into one coherent set of principles, which lays ground for the OSIMAS (oscillations based multi-agent system) or self-organized social system simulation paradigm. For the sake of clarity it is worthwhile mentioning that the proposed OSIMAS paradigm employs the conceptual trinity of models (see Fig. 2).

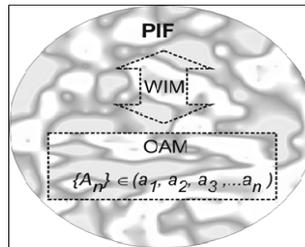


Fig. 2. Three major OSIMAS models: (i) all-embracing pervasive information field (PIF), (ii) oscillating agent model (OAM), which identifies each agent from a set  $\{A_n\}$  in the PIF and (iii) wave-like interaction mechanism (WIM), which realizes interactions between those agents

According to OSIMAS paradigm, pervasive information is distributed in frequencies, and frequencies – although expressing some global information – are locally perceived by agents (individuals), who are inseparable from the PIF. In this way, PIF simulates universal media, which contains all possible multifaceted self-organizing information present in the real system. Our paradigm is based on the view that this universal media can be represented via spectra of oscillations. Consequently, PIF is a grand total of all individual spectra. PIF model can be constructed following these principles:

- Social systems behave in a coherent way because they are integral holistic units, where each part is inseparable from all the rest.
- Such systems should not be fragmented to the independent parts, i.e. separate agents as such. Therefore, we should simulate agents as local processes of self-organized information in the global all-embracing multifaceted information field (PIF).
- In the PIF, dimensionless self-organizing information processes, i.e. agents can be modelled using such abstractions like sets of standing waves or, in other words, resonant frequencies. The agent has as many resonant frequencies as it has degrees of freedom. At resonant frequencies the agent stores energy, i.e. self-organized information. This information is used to enhance inner processes and outward behavioural patterns.
- Homeostatic agent can be represented in terms of the local energy spectral density (LESD) distribution, which describes how the inner energy (or its variance in time series) is distributed with frequency. Meanwhile, the system-wide distribution of LESD gives global energy spectral density (GESD) distribution, which uniquely describes the state of PIF for each moment.

- The main way for the agent to increase negentropy (negative entropy or information) is via adoption of some set of resonant frequencies, which may yield to the beneficial behavioral patterns in the dynamic environment. Homeostatic agents search how to sustain and increase self-organized information via the increase of inner negentropy. The adoption of the new resonant frequencies (information) changes agent's LESD and GESD distributions accordingly.
- Coordination and synchronization between the agents can be realized via coherent convergence, i.e. synchronization of oscillation phases. Large-scale integration or 'social binding' involves synchronous oscillations of local field potentials. Coherent convergence of resonant oscillations leads to the synchronization among self-organized information processes (agents).

Based on the proposed principles, the following question arises – how to visualize the entire PIF model in a single, yet comprehensive manner? In fact, joint time-frequency representation (JTFR) could provide a bridge between time and frequency representations, visualizing some spectral and temporal information simultaneously, see spectra illustration in Fig. 3.

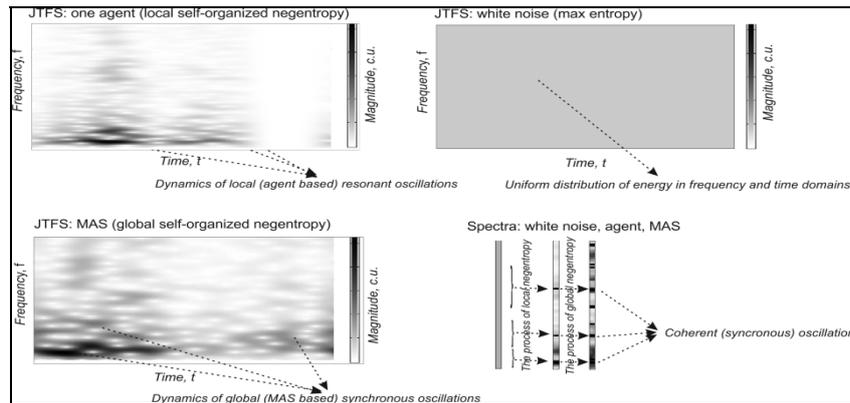


Fig. 3 Spectra diagrams used for illustration of the joint time-frequency power spectra (JTFR) approach as a mean for visualization and analysis of local agent-based and global PIF energy states containing distributions of multiple time-varying frequencies. In the top right diagram, white noise oscillations are uniformly distributed (with maximum entropy). In the top left diagram, LESD exhibits ordered structure of oscillations depending on agent's behavioral patterns and inner states. In the down left diagram, GEST exhibits overall superposition of LESD, i.e. PIF representation.

JTFR depicts how information-energy states (represented by frequency distributions) change over time. JTFRs are useful for the representation and analysis of dynamic LESD and GEST containing multiple time-varying frequencies. JTFR lets depict how information-energy states (represented by frequency distributions) change over time. JTFRs are useful for the representation and analysis of dynamic LESD and GEST containing multiple time-varying frequencies.

In the frames of such phase and frequency approach it is quite natural, that synchronization processes in various systems of different nature will have close similarities and can be studied by using common field-based tools.

#### 4. Conclusions and Discussion

The paper gives an overview of interdisciplinary principles of field-like coherence and coordination. Approaches listed in this paper considering biological and mental aspects of human nature altogether with scientific trends in psychological and subconscious domain can put a foundation that humans and, maybe, even societies can be understood, analyzed and simulated as pervasive information field (PIF) concept, which employs principles of field-like coordination.

The presented fundamental principles, assumptions and JTFR visualization can be as a novel way in understanding and simulating self-organized complex social systems. Societies can be understood as global processes emerging from the collective coherent behavior of conscious and subconscious mind-fields of individual society members. OSIMAS paradigm suggests the conceptual trinity of models: PIF (pervasive information field or, in other words, virtual oscillatory field), OAM (oscillating agent model) and WIM

(wave-like interaction mechanism) which gives a vision how social systems could be simulated as oscillating processes acting in behavioral synchrony.

Like all pioneering approaches, this study needs a thorough further investigation. This work, however, gives some clear outlines and their explanatory sources for the further investigation exploring the OSIMAS paradigm and PIF model in particular.

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