proceedings

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Proceeding Paper

Overview: Neosentience, Biomimetics, and Insight Engine 2.0 †

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Abstract: The goal is to create a model for an autonomous robotic system via transdisciplinary information processes and information exchanges. Neosentience is a new approach to AI that is informed by the functionality of the human body through biomimetics and bio-abstraction. The long-term goal of this model is to potentially enable Neosentience to arise via the system's functionality. Transdisciplinary research is explored through the use of a unique intelligent database, search engine, a natural language API, a dynamic set of visualization modes, and a series of independent AI collaborators (what we call Micropeers)—The Insight Engine 2.0 (I_E) working in conjunction with differing researchers from multiple disciplinary domains.

Keywords: neosentience; articficial intelligence; biomimetics; The Insight Engine 2.0; extended approach

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1. Introduction

The human body/brain/mind/environment is perhaps one of the most complex living systems. This text will discuss a new set of computational approaches and related research methodologies to work toward defining a model of Neosentientience production, eventually articulating a new form of artificial sentience. It will employ a new transdisciplinary Search Engine and Visualization System—The Insight Engine 2.0.

2. Definition of Neosentience

Pragmatic benchmarks are used to define Neosentient robotic entities (as opposed to the Turing Test): the system can exhibit well defined functionalities: It learns; it intelligently navigates; it interacts via natural language; it generates simulations of behavior; it metaphorically "thinks" about potential behaviors before acting in physical space; it is creative in some manner; it comes to have a deep situated knowledge of context through multimodal sensing; and it displays mirror competence. Seaman and Rössler have initially entitled this robotic entity *The Benevolence Engine*. Synthetic emotions would also become operative within the system. The System would be benevolent in nature. The concept of Neosentience (coined by Seaman) was articulated in the book *Neosentience/The Benevolence Engine* by Seaman and Rössler [1]. The development of a model for neosentenience is explored through the employment of biomimetics and bio-abstraction, primarily Seaman's interest. Rössler is interested in a top-down approach he calls the brain equation which is discussed in the Neosentience text at length [1].

3. The Neosentient Model Environment

The Neosentience book provides hundreds of micro-chapters and background on the history, potentials and uniqueness of Neosentient research. Seaman has been working on a system to enable transdisciplinary research to develop this model of Neosentience. Central is development of an extended intelligence system, which seeks to help provide insights into the authorship of a higher-order intelligent system. Initially a transdisciplinary search

engine and intelligent database designed to research Neosentience was set up for testing as a closed system—The Insight Engine 1.0, where participants were invited to contribute papers and textually annotated media objects. We are now working toward a new open system, with additional AI aspects enfolded, to assist research with the processes this system enables. The goal is to arrive at a model for an intelligent autonomous learning robotic system via transdisciplinary information processes and information exchanges. The long-term focus of this research is to develop a model for an ultra-complex system, one that seeks to abstract human sentience via biomimetics and bio-abstraction. The ultimate goal of this model is to potentially enable Neosentience to arise via a robotic system's functionality. We call this transdisciplinary database and intelligent visualization system designed to function in a relevant manner for differing transdisciplinary researchers The Insight Engine 2.0. We are developing the intelligent database and visualization system, such that the Insight Engine 2.0 can help researchers work toward the creation of a higher-order intelligent system, functioning in the service of defining a model for The Neosentient entity. Research related to this goal is accomplished through the use of an intelligent transdisciplinary database, search engine, a natural language Application Programming Interface (API), a dynamic set of visualization modes, and a series of independent human collaborators, as well as computational collaborators that we call Micropeers—The Insight Engine 2.0 (I_E).

I am working currently with a team of researchers primarily from Duke University to define and articulate this new system. The System development team for the Insight Engine 2.0 consists of Professor Bill Seaman, PhD, Computational Media, Arts and Cultures, Duke University, primary investigator; John Herr, Duke's Office of Information Technology; Dev Seth, Computer Science student, Duke University; Hojung (Ashley) Kwon, Computer Science student, Duke University; Quran Karriem, Duke Computational Media, Arts and Cultures PhD researcher; Kelsey Brod, PhD researcher, Computational Media Arts and Cultures, Duke; and Mingyong Cheng, PhD researcher, UCSD.

A transdisciplinary database and unique set of visualization modes enable researchers from differing disciplines and advanced exploratory research domains to peruse data which may not normally be found in the papers and books related to a specific disciplinary domain. New knowledge and insight potentially arises via the intelligent juxtaposition of one or more domains. No single discipline of science, the humanities and/or the arts can tackle such a difficult information-related problem set. A special transdisciplinary team of teams will potentially arise out of the use of the Insight Engine 2.0. I will discuss the Insight Engine 2.0 more fully later in this text.

4. An Ultracomplex Bio-Machine

The body is an ultra-complex biomachine, with a complexity greater than all 'human-made' systems. Robert Rosen early on saw the limitations of the machine metaphor in relation to biological research. In a book published in 1999, *Essays on Life Itself*, Rosen points to a particular form of limit: "I have attempted to introduce, and to motivate, a concept of complexity. A system is called complex if it has a nonsimulable model. The science of such complex systems is very different from the science we have become used to over the past three centuries. Above all, complex systems cannot be completely characterized in terms of any reductionistic scheme based on simple systems. Since the science is different, so too are technologies based on it, as well as any craft pertaining to the systems with which that science deals" [2]. Perhaps we can devise an ultra-complex simulable model given the potentials of new computational systems and the development of new conceptual approaches. Additionally, we can work toward building a system to explore complex mathematics and logic that enable new forms of modeling ultra-complex systems, enabling the development of new methodologies and ultra-sophisticated technologies to explore and map entailment structures. This is one of the richest goals of this project. Rosen, in the 1999 text suggests: "It is too early to tell how such ideas will develop in the future. My purpose here has been to introduce some of the flavors of the concept of complexity, how it pertains to

basic biological issues, and how it may force a complete reevaluation, not only of our science, but of our concepts of art and of craft as well. Indeed, it may turn out, as it has before, that the pursuit of craft may provide the best kind of probe to guide our science itself" [2].

This project seeks in part to provide a technological platform to aid in the research of such future ideas related to unpacking complexity, defining new forms of mathematics, and articulating methodologies to best map the entailment structures that enable sentience to arise, and to futher explore the development of new forms of code to reflect the functionality of the entailment structures.

5. Entailment Structures

The full entailment (the study of relevant structures at operation in the body) and the later potential emulation of the body's functionality, especially related to what I have called the creation of an ultra-complex network of simulable models in response to Rosen's ideas presented above, has to my knowledge not been achieved. This is due in part to the distributed, highly complex nature of the mind/brain (as it falls in relation to the operation of the body), where a small event in one part of the brain might not be picked up in terms of the resolution of a technological scan or other contemporary technological methodology, yet it might shift elements of thought and lived interaction. This inability to define entailment structures in the brain precisely is also potentially due to data processing strategies. A paper from 2020 states: "studies have shown that measurement of laminar functional magnetic resonance imaging (fMRI) responses can be biased by the image acquisition and data processing strategies" [3]. What new technologies will have to be developed in order to undertake such scanning tasks that successfully encompass the biological functionality of the entire body? Interestingly, there exists a paradox central to our problem set—researchers must come to know the human body better to elucidate its functional abstraction, explored in the articulation of a new form of combinatoric N-dimensional bio-algorithic system (and/or other new computational approach arising out of the research). Ward and Stapleton state: " . . . when we say that cognition depends on 'our activity', or upon 'bearing relations to an environment', the phrases within the quotation marks can be cashed out in many different ways." In terms of the enactive paradigm Ward and Stapleton suggest that: "To be a cognizer, in the sense which interests the enactivist, is to manifest an appropriate degree of attunement to the objects, features, threats and opportunities present in the immediate environment." Ward and Stapleton continue: "The features of the environment to which the system is attuned are not inert and independent of the system, but dependent upon, and specified at least partly in terms of, the system's activity and capacities" [4]. It is the interfunctionality of all of the systems in the body leading to Sentience production that we seek to research and better understand in the service of defining a model for Neosentience production.

6. The Insight Engine 2.0—Focusing on a Model for the Production of Neosentience

The pragmatic goal is to make the Insight Engine 2.0 function in such a way as to "point" to potential new research data across disciplinary boundaries by using advanced information processing, computational linguistics, a natural language API, and additional forms of AI acting as Micropeers—AI collaborators (as mentioned above)—to enable intelligent bridging of research questions, and the development of new informational paradigms through bisociation, after Arthur Koestler [5] and poly-association (Seaman's coin). The Insight Engine information system is being designed to support researchers, to empower them to access relevant transdisciplinary information from the database, to contribute to the higher order goal over time of articulating a functional Neosentient Model as an 'extended' approach to knowledge production, accessible via the internet. Such a model is informed from many intellectual perspectives and transdisciplinary conversations facilitated by the I_E system including a list-serve (still to be set up), and future information-oriented gatherings and relevant links. I often call this a multi-perspective approach to knowledge production, and in this case to Neosentience production.

The Insight Engine embodies a series of intelligent processing structures, visualization systems, the dynamic mapping of relationalities related to the corpus of key words, papers, books, media objects, research areas, abstracts, diagrams, etc. initially driven by texts and textual annotations. We are also in the process of researching new forms of visual pattern recognition, and sonic recognition systems for sonic text translation to typed form, which will later potentially be integrated, as well as dynamic sonification methodologies. Alternately we are interested in exploring new forms of making data "felt" through haptic interfaces, and employing physics engines metaphorically defining new conceptual potentials for the Unity Game Engine, that are different from more historical visualization environments i.e., the game engine adds potential new forms of interaction and computational functionality like giving 'gravity' to ideas that might attract each other in a self-organizing manner.

These approaches will potentially extend the search engine capability to explore specific kinds of data and in turn help outline the articulation of a very new variety of Bio-algorithic system—informed by the bio-functionality of the human body. Biological structures are to be abstracted and then re-articulated through biomimetics, and/or bio-abstraction in the Neosentient model. This model, exploring methods to define an operative approach to the arising of neosentience, seeks to illuminate how a dynamic ultra-complex system of systems must function in an interactive manner within a variety of environments, building new knowledge up somewhat like humans do, through pattern-flows of multi-modal sense pertubations (embodied computation), as well as incorporating a layering of other potential learning and knowledge-based systems. Meta-levels of self-observation and the development of language (both natural and code languages) to articulate such contextual learning is central for the future embodiment of the system, as well as the set of pragmatic benchmarks that define the Neosentient entity as described above.

7. A New Combinatorial N-Dimensional Bio-Algorithm

We seek to answer some difficult questions via the Insight Engine 2.0: (a) What is the correct ontology that bridges psychological concepts with real-world neurological entities? (b) What are the neural correlates which map onto this ontology? (c) How, in the distributed brain, do disparate sensing systems integrate information? (sensor fusion), and how does embodied interaction with the environment play into thought processes? Knowing at least approximate answers to these questions is crucial to building sentience modules, since synthetic modules will each be uniquely implemented. They will be functionally equivalent versions of the biological modules [in conversation with Dev Seth] that they emulate.

Cognitive Behavior is approached through a series of information-oriented processes. Central is to define all of the entailment structures that inform the emergent arising of sentience in the human. Our scanning technologies currently have limitations related to biological scale and time-based data acquisition. This suggests one area of new technological development. Researchers would seek to explore many different mappings of sub-systems abstracted from operations in the body, and form them into a continuously self-organizing, switching and shunting network of ultra-complex bio-mechanisms. The many different mappings (and also black box articulations given the limitations of current technology) would inform the construction of a bottom-up model related to achieving the functionality of an autonomous Neosentient robotic system. This would happen over time, by first chipping away at each sub-system's functionality and their relationality to other systems in the human. Here clues are taken from the Embodied, Embedded, Enactive and Extended paradigm [4]. These approaches are interrelated. Unlike historical approaches exploring the brain and its functionality as the center of AI research, this holistic approach becomes an active methodology for understanding how the body, focusing on multi-modal sensing systems working in conjunction with the brain/mind, and differing kinds of memory, form an ultracomplex dynamic system informing sentience production in an embodied, enactive manner, enabling in the long run, the creation of a model for neosentience production. We ask, at what level of complexity will our self-aware neosentient techno-species begin

to have a deep self-knowledge, always learning and applying new knowledge into the functioning of the intelligent neosentient system. Again, pragmatic benchmarks are used to define Neosentient robotic entities (as opposed to the Turing Test) discussed above.

8. Conclusions

We have given ourselves a very difficult and interesting task. We have discussed the body as an ultracomplex intelligent environment that depends on language, both natural language and code-based language working in conjunction with that natural language, to help us articulate, research and solve a set of deeply complex transdisciplinary problem sets. This also includes articulating meta-levels of self-understanding. We are treating the body as a holistic ultra-complex system. We are devising an elaborate set of human/computational systems to work together with a diverse body of researchers to bring new forms of emergent insight to light related to the topic of human sentience production and in particular the biological functionality at operation in the body that enables sentience to arise as an emergent property of human biofunctionality. In particular we seek to employ the holistic, non-reductive concepts of *enacted, embodied, embedded, affective and extended* approaches to cognition research. We seek to employ biomimetics and bio-abstraction to, in the long run, define a model for a Neosentient entity.

Institutional Review Board Statement: Informed consent will be obtained from all subjects involved in the study.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Conflicts of Interest: The author declares no conflict of interest.

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