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An unconventional design for a nanophotonic cognitive automaton brain – A semantic evolutionary approach

Tational Cognitive robotics is concerned with endowing a robot with so-called *intelligent behavior* by providing the robot with an information processing architecture that will allow it to learn and reason about how to behave in response to complex goals in unpredictable environments. It is argued here that the capability of transforming just raw data into information is of the essence for realizing such cognitive capabilities, e.g. for the long sought-after autonomous robots, and that a highly miniaturized integration of sensing and information processing systems is needed for implementing cognition, together with a hardware/software (structure/function) condition throughout a chain of hierarchical dynamical stages of increasing abstraction, i.e. compression of degrees of freedom, in the state space of the automaton. Moreover, the usual recursive mathematics-based computing procedures, due to their essential syntactic nature, are not the best tool for making raw data into meaning and information. Accordingly, an approach aiming at designing a semantic evolutionary sensing – information processing (IP) machine is proposed, and it is shown that the recently developed field of Generalized Quantum Holography (GQH), stemming from geometric quantization of any holographic processes through the Heisenberg Group (G), supplies the nanophotonic tools for designing and assembling a complex set of nanophotonic associative memory modules (AMM) as the automaton brain. IP through GQH concerns the encoding and decoding of holographic interference patterns, not of mere binary digital logical (syntactic) information. GQH thus defines on the G's manifold an IP paradigm where information as experimental knowledge is processed; i.e., IP concerns both syntax and semantics. Such a nanophotonic AMM brain is shown fit for parallel massive simultaneous processing of information from data of complex structure for pattern recognition, classification, optimization, prediction, control and decision making. GQH, being a quantum-based machine, in addition to Turing computation may simulate any form of algorithm, physical process, morphology or dynamics. It is topological computation on the nilmanifold of the Heisenberg Lie group G, so that its action is defined in terms of Lie transformations.

Biography

Dr. S. Santoli co-founded in 1997 the **INT** – **International Nanobiological Testbed Ltd.,** London. He sits on the Advisory Boards of the journals *Nanobiology, JBIS* – *Journal of the British Interplanetary Society, Journal of Aerospace Engineering, Scientific Inquiry, and Intnl. Journal of Computing Anticipatory Systems*. The **International Institute for Advanced Studies** conferred on him in 2007 an honorary degree for his innovative work in Nanoscience. In 2010 he was appointed member of the Editorial Board of the Series on Systems Evaluation, Prediction, and Decision Making (CRC Press). His present interests are in BioNanotechnology, automata theory and intelligent systems.