

Evolutionary robotics and the morphological turn: an epistemological perspective

Fernando Almeida e Costa

Centre for Computational Neuroscience and Robotics, University of Sussex
F.AlmeidaCosta@sussex.ac.uk

What are the philosophical and epistemological implications of work in evolutionary robotics (ER) dealing with the evolution of morphologies and morphogenesis? So far, its theoretical consequences for cognitive science have not been fully fleshed out. Also, investigation in morphologically-based ER has not shown its affiliation in the long tradition of a *morphological thought*. Understanding theoretical implications and the phylum of thought of some line of research may be of great importance not only to the historians of science but to the future development of the research itself. I propose that the shift towards morphodynamics belongs to an old phylum of cognitive and biological thought, both naturalist and structuralist in nature, and is a component of a broader *morphological turn*. Examples of its manifestations include early investigations in A.I., e.g. the studies on morphogenesis and cognitive structures by Alan Turing, the semiophysics firstly proposed by René Thom, or the morphological, non logico-combinatorial structuralism of Claude Lévi-Strauss in cultural anthropology. More recently, work in ER addressed not only the morphodynamics of an agent's body and environment but also the morphological properties of its "perceived world" (Almeida e Costa et al, 2008, Alife XI, these proceedings). By highlighting what is common to these apparently unrelated lines of research, light is shed on the entire framework of the morphological turn. Structuralism is normally seen as the continental current of thought that developed in the 60's and 70's and had its major tenets on linguistics or literary criticism, while being of a logico-combinatorial, algebraic and static nature. But there is another phylum of structuralist thought: one that can be traced back to the works of D'Arcy Thompson and even to Goethe. This other phylum thinks of structures as dynamical forms in development. It is a naturalist and non-formalist (in the sense of formal logic) approach that considers forms as morphodynamically self-organised wholes. The concept of "transformation" and its mathematical treatment is central to this perspective. Morphodynamically inspired robotics exploits all intrinsic and extrinsic physical properties available. This entails the denial that the "cognitive" properties are to be found at an algorithmic level that dominates the physical properties. Cognitive activity relies crucially on the agent's morphodynamics, actually implying the minimization of control at the algorithmic level. The functionalist principle of the irreducibility of the cognitive level to the physical medium is put aside. Thus, the *morphological turn* opens up the possibility of a non reductionist physics of meaning. The success of modern science, i.e. the physical mechanism that emerged in the XVII century was only possible due to the abandon of the dynamics of forms: the Aristotelian physics of qualities. This implied the impossibility of connecting the new "objectivity" with the qualities of the world as it is perceived. It is often pointed out that the recent embodied approach to cognition refuses the Cartesian mind-body dualism. It should be noted that it also refuses the divide between physics and qualitative form. On a supplementary note, this perspective is totally consistent with high-level and low-level cognitive abilities forming a continuum. The hypothesis of an evolutionary path leading from the emergence of particular human morphologies (feet and hands), hence the ability to walk, to the emergence of language, put forward by palaeontologist André Leroi-Gourhan, in the same structuralist vein afore mentioned, is entirely consistent with this orientation.