

New A.I. and the Morphological Turn

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Abstract

During the last 20 years, research in New A.I. has been providing existence proofs for a major theoretical shift in cognitive science: one which denies the deeply engrained belief that cognition is *something done by the brain*. A significant part of the work done in evolutionary robotics conceives the cognitive system as constituted by dynamically coupled sub-systems which include body morphodynamics, environmental dynamics and internal neural dynamics. For example, leg movement coordination in insect-robots (Beer, 1995) doesn't rely on a coordinating centre, and critically depend on the local interaction between leg and environment. It is very hard, if not impossible, to attribute a particular functional property to one of the subsystems.

I propose that this shift is a component of a broader *morphological turn* that is clearly detectable from the second half of the 20th century onwards, in different areas of research. Apparently unrelated examples of its manifestations include early investigations in A.I., e.g., the studies on morphogenesis and its relation with 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.

I will present a general framework for this morphological turn, by developing the theoretical implications of the three examples given above. Then I will elaborate on the consequences that can be extracted for cognitive science from morphodynamically inspired robotics, where cognitive behaviour is a result of the opportunistic exploitation of all intrinsic and extrinsic physical properties available. In particular I will be aiming at the larger scope of morphodynamical properties, which includes the body's morphological characteristics (body shape, sensor locations, etc.), along side with the morphological characteristics of the world "as perceived by the agent".

Gestalt theory in psychology of perception and Jakob von Uexküll's functional circle hypothesis, in biology/ethology, provide two general frameworks for the understanding of active perception as a morphologically-based ability. Partially based on these two approaches I delineate an all-encompassing picture of a morphodynamical treatment of cognition.