

Embodiment, morphological computation, and robot body schemas

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Traditionally, in robotics, artificial intelligence, and neuroscience, there has been a focus on the study of the control or the neural system itself, and on symbolic or connectionist representations. Over the last decade or so there has been an increasing interest in the notion of embodiment in all disciplines dealing with intelligent behavior, including psychology, philosophy, and linguistics. In this talk, I explore the far-reaching and often surprising implications of this concept. First, I will show that surprisingly complex behaviors can be produced with little control and representation. Often, morphology and materials can take over some of the functions normally attributed to control, a phenomenon called “morphological computation”. Second, I will show how robots acquire their own body representations (body schema), what forms these can take and what functions they serve. Such representations can also provide the link to machine cognition as emergent from the interaction of brain, body, and environment, or more generally from the relation between physical and information (neural, control) processes. It can be shown that through the embodied interaction with the environment, in particular through sensory-motor coordination, information structure is induced in the sensory data, thus facilitating categorization, perception and learning. A number of case studies are presented to illustrate the concepts introduced.

Short Bio

Rolf Pfeifer received his master's degree in physics and mathematics and his Ph.D. in computer science from the Swiss Federal Institute of Technology (ETH) in Zurich, Switzerland. He spent three years as a post-doctoral fellow at Carnegie-Mellon University and at Yale University in the US. Since 1987 he has been a professor of computer science at the Department of Informatics, University of Zurich, and director of the Artificial Intelligence Laboratory. Having worked as a visiting professor and research fellow at the Free University of Brussels, the MIT Artificial Intelligence Laboratory in Cambridge, Mass., the Neurosciences Institute (NSI) in San Diego, the Beijing Open Laboratory for Cognitive Science, and the Sony Computer Science Laboratory in Paris, he was elected "21st Century COE Professor, Information Science and Technology" at the University of Tokyo. In 2009 he was also a visiting professor at the Suola Superiore Sant'Anna in Pisa, at Shanghai Jiao Tong University in China, and he was appointed "Fellow of the School of Engineering" at the University of Tokyo. His research interests are in the areas of embodiment, biorobotics, artificial evolution and morphogenesis, modular robotics, self-assembly and educational technology. He is the author of the book "Understanding

Intelligence", MIT Press, 1999 (with C. Scheier) and "How the body shapes the way we think: a new view of intelligence," 2007 (with Josh Bongard) MIT Press (popular science style). Next project: "The ShanghAI Lectures 1.1 (building on Shanghai 1.0 in 2009)", a global mixed-reality lecture series on natural and artificial intelligence, broadcast this time from the University of Zurich in Switzerland in cooperation with universities from around the globe (fall term 2010, starting Thursday, 30 September 2010).

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