The Rise Of Robots - Machines Sharing The Environment With Natural Creatures

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Abstract: Robots are rapidly evolving from factory "workhorses" that are physically bound to their work-cell to machines evolving in our environment and interacting with natural creatures. This development makes systems obviously much more complex and raises important new questions that are meanwhile addressed by a very interdisciplinary research community. The fundamental questions linked with the development of such robots and systems span from locomotion and control, to natural interaction and social intelligent up to functional / semantic representations.

In this talk various projects of the speaker's research group will be presented and discussed. It starts with tiny and simple robots building mixed societies with cockroaches. Based on simple interaction rules and behaviors, the robots are able to significantly influence the collective decision making process of the mixed society in the test environment. However, these promising results can unfortunately not be simply scaled up to more complex environments and interactions. The fundamental problem lies in the fact, that collective intelligent is essentially limited by the competences and performance of the individuals of the society. Future robots able to integrate in human society and offer useful services require first of all the perception and representation capacities that can cope with complex settings. Furthermore, their design has to be optimally adapted to the environment and given tasks. These two issues have driven our research in mobile robotics towards novel designs of wheeled and flying robots and functional-based environment representations, which we consider as fundamental for higher cognitive functions. We suggest in a first step a hierarchical probabilistic representation of space that is based on significant features and objects arranged in a relative map. In our most recent projects with the European Commission and the European Space Agency (ESA) we try in interdisciplinary teams to further enhance the design of robots for challenging environments and to apply the Bayesian approach for solving complex cognitive tasks. Our research and future directions are strongly influenced by the long-term robot experience we made at the Swiss National Exhibition in 2002 and the more recent work on planetary exploration rovers and intelligent cars.

Keywords: Mobile robot design, mobile robot cognition, real world navigation.