On Making Robots Proactive

av

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Abstract


The question addressed in this thesis is: Can we make robots proactive? Proactivity is understood as self-initiated, anticipatory action. This entails the ability to generate own goals and pursue them. Our work is based on the assumption that proactivity makes robots more acceptable in human-inhabited environments. Proactive behavior is opposed to reactive behavior which is merely responding to external events and explicit requests (by the user). We approach the question of how to make robots proactive by first identifying the necessary cognitive capabilities, how they relate and interact. We find that to enable proactive behavior one needs to bridge the gap between context, planning, acting and goal reasoning. We then propose a model of opportunity which formalizes and relates these cognitive capabilities in order to create proactivity. In order to make the model of opportunity computational we introduce a framework called equilibrium maintenance. We show formally and empirically that the framework can make robots act in a proactive way. We can make guarantees about the behavior of a robot acting based on equilibrium maintenance: we prove that given certain assumptions a system employing our framework is kept within desirable states. Equilibrium maintenance is instantiated in different scenarios, both theoretically and in practice by deploying it in a number of systems including both robots and humans. More specifically, we conduct experimental runs in simulation in the domain of robotic disaster management and we implement the framework on a real robot in a domestic environment. The latter is done by integration in different levels, from conceptual examples to closing the loop with a full robotic system. Empirical results confirm that equilibrium maintenance creates proactive behavior and leads to preferable outcomes.

Keywords: Proactive robots, Goal Reasoning, Knowledge representation and reasoning, Fuzzy logic.

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