

Unexpected Situations in Service Robot Environment: Classification and Reasoning Using Naive Physics

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Abstract. Despite perfect functioning of its internal components, a robot can be unsuccessful in performing its tasks because of unforeseen situations. Mostly these situations arise from the interaction of a robot with its ever-changing environment. In this paper we refer to these unsuccessful operations as external unknown faults. We reason along the most frequent failures in typical scenarios which we observed during real-world demonstrations and competitions using our Care-O-bot III robot. These events take place in an apartment-like environment. We create four different - for now adhoc - fault classes, which refer to faults caused by a) disturbances, b) imperfect perception, c) inadequate planning or d) chaining of action sequences. These four fault classes can then be mapped to a handful of partly known, partly extended fault handling techniques. In addition to existing techniques we propose an approach that uses naive physics concepts to find information about these kinds of situations. Here the naive physics knowledge is represented by the physical properties of objects which are formalized in a logical framework. The proposed approach applies a qualitative version of physical laws to these properties to reason about the fault. By interpreting the results the robot finds the information about the situations which can cause the fault. We apply this approach to scenarios in which a robot performs manipulation tasks (pick and place). The results show that naive physics hold great promises for reasoning about unknown external faults in the field of robotics.

Keywords: faults in robotics, unexpected situations, naive physics

1 Introduction

Robots, operating in the open world, outside of lab conditions, may face situations where they are not able to perform their task successfully. These situations occur instantaneously, are sporadic in nature and are caused by interaction with the environment.

In the RoboCup@Home League the main focus is to enable a service robot to perform household chores. Clear or set the table, clean up the apartment, fetch and deliver objects: these are typical tasks for a service robot. To perform them in a desired manner in an uncertain environment, the robot needs the ability to handle unforeseen situations.