A Mobile Robotics Course for Undergraduate Students in Computer Science

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Abstract

A first generation of mobile robots able to cope with the high uncertainty of natural environments is starting to emerge. As a consequence, there is an increasing need for theoretical and practical courses that can formally teach the state of the art of the technology. This paper describes our experience teaching a mobile robotics course as part of our computer science curriculum for undergraduate students. The course has a strong experimental part, where the goal is to provide the students with a set of hand-on experiences using real mobile robots. In particular, we show how using a simple differential drive mobile platform and a low cost visual sensor, it is possible to teach the topics that are currently most relevant to the area of mobile robot programming for autonomous navigation. The course starts by illustrating low level control routines, such as locomotion, and simple behaviors, such as obstacle avoidance and target tracking in non-structured environments. Then, as the course moves to higher level tasks such as localization and mapping, the real world becomes too complex and a more structured world is needed. A structured world, called MazeWorld is then presented where we are able to illustrate high level topics using limited perception capabilities. In addition to the main parts of the class, we also describe the perception algorithms that we developed to achieve autonomous navigation in non-structured environments and in MazeWorld. Our experience indicates that the course is highly motivating for the students. They are able to reinforce several topics from the computer science curriculum and they learn the basis for advanced coursework, research, and the development of applications in robotics and related fields, such as, artificial intelligence and computer perception.

Keywords

Mobile computing, Mobile robots, Educational robots, Computer science, Navigation, Uncertainty, Education, Costs, Robot programming, Level control.