

Preface

While robot platforms have played a role in artificial intelligence and robotics education for over 30 years, the cost and size of these platforms have limited their reach. Recently, low-cost robot platforms have emerged, extending hands-on educational benefits to a diverse audience. Examples of the flurry of activity in this area include competitions and exhibitions at all levels, the availability of on-line curricula and textbooks, journal special issues, and recent AAAI workshops on robotics and education.

We believe that these low-cost platforms have matured sufficiently to become a standard tool for teaching artificial intelligence and robotics to advanced undergraduate and beginning graduate students. Furthermore, the accessibility of these low-cost platforms introduces the exciting prospect of incorporating robotic agents into non-traditional venues such as museums, science centers, and do-it-yourself websites. Such educational opportunities will help to inspire the next generation of artificial intelligence and robotics scientists and engineers.

Hands-on interaction with physical agents excites students and provides insights that are difficult to achieve with paper-and-pencil exercises or even simulator programming. Unfortunately, it is time-consuming to build and manage a course that includes hands-on robotics. Existing texts and curricular material stress the use of robots in general undergraduate engineering and computer science, as well as K-12 education. Courses focusing on AI topics, however, tend to push low-cost robotic systems up to—and sometimes past—their limits.

The purpose of this symposium is to disseminate the experience and vision of early adapters by gathering instructional material in a form that can be directly used to build artificial intelligence curricula with hands-on robotics exercises. This symposium brings together artificial intelligence educators and robot education practitioners, including curriculum creators and low-cost platform designers. Their contributions span six major categories, corresponding to the sessions of the symposium:

- Curricular Themes
- Laboratory Exercises
- Hardware/Software
- Assessing Approaches to AI/Robotics Education
- Beyond the Traditional CS Student
- Invited Papers/Discussions

Curricular Themes sets the stage for the symposium by highlighting papers from contributors who have thought carefully about the role of robotics within an AI curriculum. These educators have developed and tested educational themes that motivate and tie together the fields of AI and robotics for an advanced undergraduate audience. Their papers provide guidance to instructors for framing their labs and lectures within these fields' broader academic context.

Laboratory Exercises presents classroom exercises for teaching specific topics in artificial intelligence and robotics. The first of two sessions focuses on a variety of approaches for teaching localization. The second session considers the successes and challenges of teaching advanced AI with low-cost robot platforms.

Example topics include developing neural-network-based controllers for the Handy Board platform, a spatial path-planner for the Lego RCX, and Monte Carlo Localization on the Evolution ER1. All of the step-by-step exercises in these sessions provide raw material for new course designers and educators seeking to include robotics into existing offerings. Because the contributions consider a variety of different low-cost platforms, these sessions highlight the impact of available sensing and processing power within a robotics-based AI curriculum.

The tradeoffs of using different platforms are considered more explicitly in the *Hardware/Software* sessions. Papers explore novel platforms, sensors, and components currently supporting undergraduate AI robotics, with detailed information to help potential adopters choose among the growing number of available options. For instance, contributions include a series of labs based on the use of low-cost hobby servomotors, robotics courses based on the Sony AIBO, and software substrates that help students investigate and develop algorithms, rather than worry about the peculiarities of robotic and imaging hardware. Because each system is presented in the context of its classroom use, these resources will inform laboratory designers in choosing appropriate platforms and integrating them into their courses.

Assessing Approaches to AI/Robotics Education provides the insights of educators who have carefully evaluated the effects of robotics-based curricula on student learning. Contributions include exemplars of metrics and evaluation strategies for assessing such courses and for tracking students' changing attitudes and increasing sophistication with robotic systems. With these examples, educators have a template for measuring the success of low-cost robot platforms in their courses. A second session theme is the role of robot competitions within AI and robotics courses. Robot competitions are popular and successful ways to excite students about robotics, but they also constitute only one of many ways in which courses involving robots have been organized. Contributors examine and assess the benefits—and drawbacks—of this popular organizing principle.

Beyond the Traditional CS Student presents experiences and lessons from robotics adopters whose target audiences are outside the advanced undergraduate/graduate focus of computer science and engineering departments. The diverse set of examples range from using robotics to teach computer science to non-majors, projects that tightly couple art and robotics, and engaging undergraduates in the teaching of secondary students through a series of robot-building projects. This session also examines how Web-based educational venues can make robotics widely accessible outside of the university altogether—and how low-cost platforms can help bridge elementary/secondary educational efforts with undergraduate and research work in AI robotics.

As with each of the symposium's sessions, these contributions offer a foundation of experiences and experiments in making AI/robotics accessible and relevant to a broad audience. Both the successes and difficulties presented provide guidance to new educators and educators taking a new look at their curricula. Inexpensive platforms that sense and act in the world provide a promising resource. Our challenge is to leverage that resource to broaden the engagement of students at all levels with with artificial intelligence and robotics.

Much of the activity of the symposium is in the form of live and/or video demonstrations of step-by-step lab exercises, robot projects, panel discussions, and informal presentations and discussions. Reports, media, and links from these activities (as well as future contributions) are available at <http://www.cs.hmc.edu/roboteducation>.

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