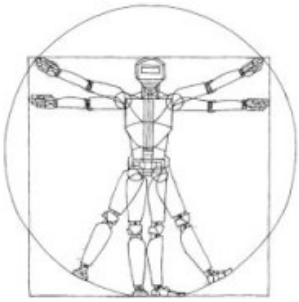

ROBOTICS
SCIENCE AND SYSTEMS

Teaching With Robots

Robotics: Science and Systems 2008 Workshop
ETH, Zürich, Switzerland
28 June 2008

Organizers

Chris Rogers – Tufts University, USA - crogers@tufts.edu
Pedro Lima – Instituto Superior Técnico, Portugal - pal@isr.ist.utl.pt
Roland Siegwart – Swiss Federal Institute of Technology, Switzerland - rsiegwart@ethz.ch
Illah Nourbakhsh – Carnegie Mellon University, USA - illah@cs.cmu.edu
Aaron Dollar - MIT, USA - adollar@media.mit.edu

Goal

The three main goals of the workshop will be to (1) promote hands-on learning at the college level through robotics, (2) identify potential collaborators for increasing the robotics content of the college classroom, and (3) examine the effectiveness of competition-based learning (RoboCup, DARPA challenge, etc).

Description

Over the past 10 years, a number of low-cost, highly capable robotic platforms have come on the market and have introduced students to math, science, and engineering at all grade levels. Our goal with this workshop is to identify innovative ideas where the hands-on, project-based nature of these platforms have successfully improved student learning at the university level. We propose to identify this in two ways: presentations in the morning and a hands-on discussion in the afternoon. The morning will be comprised of 10 min talks, with the first 1.5 hours being presentations from faculty on successes and failures in the college classroom and the second 1.5 hours being presentations on successes and failures in the college robotic competition world. In the afternoon we will offer a 2.5 hour session of building and programming, where attendees will get a chance to build robots while talking amongst each other.

The workshop will be of interest to all researchers and educators in Robotics who support Robotics education through hands-on experimental work in classes and competitions. The advantages and pitfalls of such approaches will be presented for several case studies and discussed for the general case.

Schedule

8:30 – 9:00	Welcome and goals
9:00-10:30	5 presentations (10 minutes each + discussion) on classroom robotics
10:30–10:45	Break, informal discussion
10:45-12:15	5 presentations (10 minutes each + discussion) on after-school robotics
12:15-1:30	Lunch
1:30-3:00	A chance to test out some of the different robotic toolsets

SESSION 1

STOMP - Teaching through Outreach

by Chris Rogers, Tufts University

Eight years ago, Tufts started a program called STOMP (Student Teacher Outreach Mentorship Program) where we paid students to help out pre-college teachers to bring robotics into the classroom as a way of teaching math, science, and engineering. The program has turned out to be a major force within the school of engineering (about 7% of all undergraduates participate) and has been especially popular with female engineers. In this talk, I will present the effect STOMP has had on the undergraduates' education and survey the six other STOMP programs at other universities across the U.S.

Teaching Robotics the Braitenberg Way

by Dr. Dylan Evans, University College Cork, Ireland.

When running workshops in building robots, we can specify the target behaviors of the robots we ask students to build in a variety of different ways. A common way is to specify these behaviors in physical terms ("the robot must approach light sources"). An alternative way is to follow the strategy Valentino Braitenberg employs in his influential book, Vehicles (1984). The behaviour of each of the robots he describes is characterised in psychological terms. One robot is said to "love" light sources, while another robot is said to "hate" light sources, and so on. I developed a robotics taster course for psychologists in which all tasks were specified exclusively in psychological terms. The result is that cognitive robotics becomes the default way of thinking about robots, rather than an interesting "extra" tacked on to a primarily engineering-based approach.

RoboticsCourseWare.org - An Open Repository for Robotics Pedagogical Materials

by Aaron Dollar, MIT

On February 15, 2008, we formally launched RoboticsCourseWare.org, a repository for university-level robotics pedagogical materials, with initial content from four courses. The site was developed in collaboration with Daniela Rus (MIT) and Paolo Fiorini (University of Verona) during the latter part of 2007 with funding from the IEEE Robotics and Automation Society's 'New Initiatives' program. We created the site for the primary purpose of providing a resource to faculty to facilitate the creation of new robotics courses and the improvement of existing ones. The repository is a free and open educational resource for faculty, students, and hobbyists throughout the world. By providing easy access to teaching materials, we hope to facilitate the introduction of robotics courses everywhere from large institutions with established robotics programs to small colleges, ultimately transforming robotics into a core component of computer science and engineering academic programs.

Using LEGO Bricks to teach Controls and Robotics
by Robert White, Tufts University

We have started to use the LEGO Mindstorms toolset to teach both introductory controls and robotics. The idea is to start students off with a hands-on problem as a way for them to understand the need for simulation as well as to verify their modeling and simulation skills. The talk will show some classical controls problems using the Mindstorms toolkit.

SmartRob – Project Based Learning with Robots
by Roland Siegwart, ETH Zürich

Engineering is the art of creating new products and systems through creativity, physical modeling, analysis, synthesis, prototyping and fundamental experimental evaluation. For doing so, an engineer requires excellent basic knowledge in a broad field of science and technology. However, soft skills like systems engineering, product design methodologies, creativity or teamwork are of equally high importance for the design of innovative products and systems. In order to develop these soft skills in parallel to the classical engineering topics, I established during the last 15 years various project based coursed for undergraduate and graduate engineering students. Robotics, which is also my home discipline, showed to be an excellent field for such project based education. I will present our experience with the "smartRob" student competition that we were running for more than 15 years at ETH Zurich and later at EPFL Lausanne. Further I will report on our experience of the last two years in using LEGO robots for hands-on education in product design in the first year of the bachelor program. This second course involves 300 students that are split into around 75 teams.

SESSION 2

RoboCup Junior - Rationale, Competitions, and Experiences

by Gerhard K. Kraetzschmar, Bonn-Rhein-Sieg University of Applied Sciences, Germany

RoboCupJunior has developed into one of the most successful robotics events for young people. The talk presents the rationale behind the RoboCupJunior initiative, outlines the ideas and learning goals of its competitions, and summarizes the experiences accumulated in many years of RoboCupJunior competitions.

The Portuguese Robotics Open - Putting Robotics on the Map

by Pedro U. Lima, Institute for Systems and Robotics, Instituto Superior Técnico, Portugal

The Portuguese Robotics Open has been taking place since 2001, and has reached impressive numbers of participants for the size of the country (700 from high schools, 100 from Universities) in recent editions. The talk will describe its traditional structure, with special emphasis on the original Autonomous Driving competition, and the impact the event brought to the visibility of Robotics education and research in Portugal.

Community Robotics and Technology Empowerment

by Illah R. Nourbakhsh, Carnegie Mellon University

The CREATE lab has embarked on a series of public projects to try and understand how significant scaling may be feasible using robotics for technology empowerment and community-building. Our work is now hybridizing the Global Connection efforts together with our more traditional Telepresence Robot Kit and CMUcam educational tools, and we are carrying out experiments locally in Pittsburgh and internationally in collaboration with UNESCO. I will describe the current status of our community products, describing both our target communities spanning the cognitive pipeline, and the new technologies we have been releasing.

The E-Puck Experience

by Michael Bonani, EPFL

In the MOBOTS team, we have a long history of creating miniature mobile robots for education and edutainment. Building upon our experience with the Khepera robot, we continue to develop miniature mobile robots that exploit the latest technologies. The e-puck robot results from this process and sets new standards in terms of desktop robotics. Thanks to the inclusion of a large number of sensors and actuators, this small open source robot is fit for a wide range of experiments. We will present some of them, focussing on college students level works. Traditionally, such small robots require complex low-level programming of their microcontrollers. To simplify this task, we have developed the ASEBA framework. Based on a tiny virtual machine running on the microcontroller of the robot, this framework enables access to the features of the robot from a high level script and allows to seamlessly program, debug, and monitor its behaviors. This approach drastically improves the accessibility to robotics technology and has been applied with success in a major public event. Finally we will shortly illustrate some other ongoing robotic education projects.

RoboCup Nanogram Competition: Rethinking robots on a very small scale
By Dominic Frutiger, ETH

Since its inception in 1997, the RoboCup soccer competitions have become a premiere vehicle for driving and showcasing advances in mobile robotics research and agent co-operation. The tournament provides an international venue for students and academics to focus research efforts. The competition creates a constrained task environment to develop and test complete robots covering a full range of challenges in the field of robotics and artificial intelligence. Soccer was chosen as a suitable competition activity because it includes many of the key aspects of robotics and artificial intelligence and has social appeal around the globe. In 2007 a demonstration tournament for microrobotic agents was launched. The competition was the ideal challenge that motivated us to develop a successful micro-robotic platform based on a novel type of resonant magnetic actuator in a surprisingly short amount of time. We think that the well defined and competitive environment is one of the most suitable approaches for advancing robotics at all scales - even in emerging fields such as micro-robotics.