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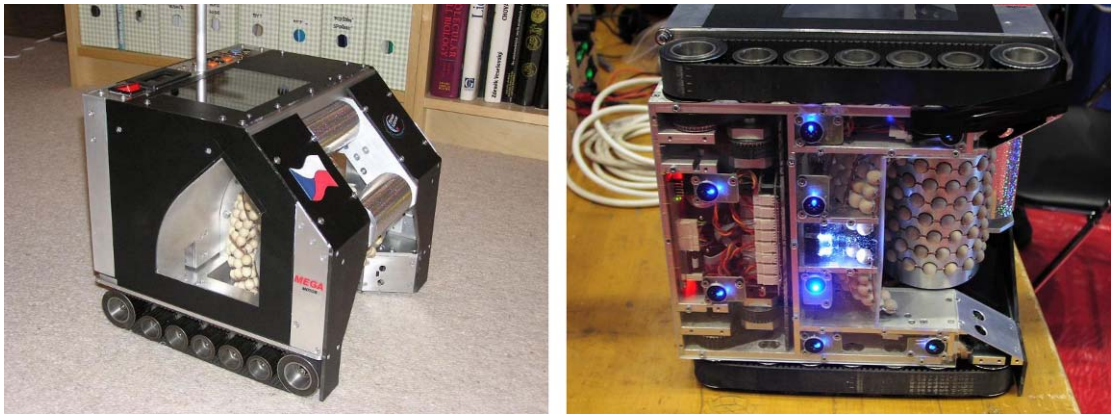
Abstract:
We are a group of researches from academia and industry formed around Charles University in Prague and robotika.cz. Our focus ranges from low-level hardware via sensor processing to high-level modelling and control. To promote robotics among general public and to attract young people to join the field we organize robotic competitions (Robotour, Czech national cup of Eurobot). In the last ten years, we also actively took part in several other competitions. At robotika.cz, we publish advices and experiences for beginners and intermediate level roboticians.

Detailed research information:

Research

- Low-level hardware



Robot Ester

For some of our research we have designed several specialized robotic platforms. Robot Ester, on the figure above, is an example of such a robot. Thanks to its modular architecture it has been successfully modified for several different robotic tasks and it is also used in our lectures and for demonstration purposes.

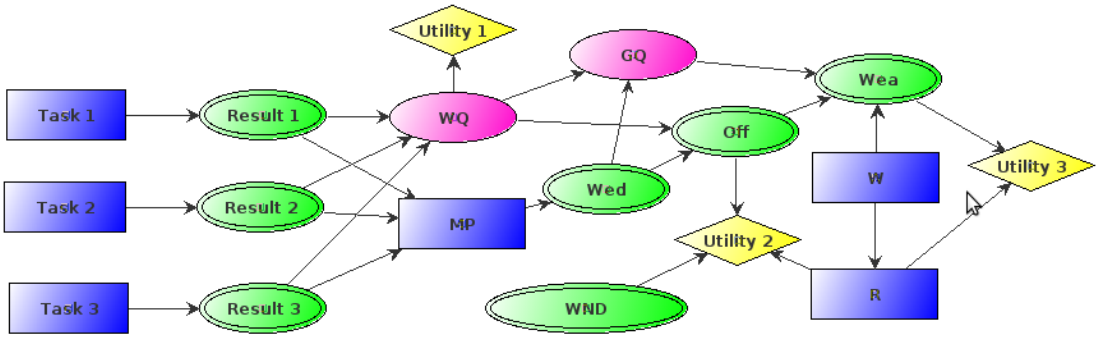
- Sensor processing

A typical park road on the left, our automatic on-line adaptive recognition in the centre and for comparison a hand-tuned colour segmentation of the input image on the right.

Our work covers several different subtopics of sensor processing. In the localization and in the SLAM domain, we are especially interested in particle filters (for example, we have proposed and demonstrated successful combination of the Monte-Carlo localization and genetic algorithms). As the images above illustrate, we are also interested in computer vision. We believe that cameras are an easily available sensor with wide areas of use. On the other hand, cameras are very often extremely sensitive to the environment (such as illumination and shadows) and thus require advanced handling. We have also shown how neural networks can be used to process raw and noisy sensor data.

Currently, we are also working in areas where robotics overlaps with other domains where real-world robotic methods might be used virtually, for example in web data processing.

- Planning



A probabilistic graphical model for decisioning under uncertainty

On top of our probabilistic sensing models, we build advanced planning and decision algorithms. As an example, the figure above shows a graphical probabilistic model, which we can use to describe a task and compute the optimal sequence of decisions automatically.

Robotic competitions we organize

- Robotour - robotika.cz outdoor delivery challenge

Robotour

Robotour (http://robotour.cz) is an international outdoor robotic challenge we organize since 2006. The task of the robots is to travel a prescribed cca 1 km long complex path in a park. The robots must fully autonomously deal with the sensor and hardware problems (inaccurate map, GPS occlusion, shadows, partially unstructured roads, ...). About fifteen mostly university teams participate regularly.

- Czech national cup of Eurobot and Eurobot Starter

Eurobot: Coconut rugby

We also organize a Czech national cup of the international Eurobot competition (http://www.eurobot.cz, http://www.eurobot.org). The rules of this competition differ from year to year in order to make an entry of newcomers easier. During the Roboday other robotic competitions are organized along with the Eurobot national cup. Most notably, the Eurobot Starter with simplified rules for the high-school students is held to attract pre-university students (see http://www.eurobot.cz).

Robotic competitions we take/took part on

Not only we organize robotic competitions, we also strongly encourage our students to take part on some. We believe a robotic competition is a great opportunity for students to learn to work on a specific task in a team under a deadline. Among others, our students competed at:

- First international contest for autonomous cleaning robots, 2002, Lausanne, Switzerland: 1st place for the Short Circuits team
- Eurobot 2004, La-Ferté Bernard, France: 4st place and the Teams' prize for the Sirael team
- Puck Collect at Robotchallenge 2009, Vienna, Austria: 2nd place for the Eduro team
- and other.