Wednesday, July 20, 2011

On Wednesday evening, starting in the late afternoon, there will be a welcome reception

Thursday, July 21, until Saturday, July 23, 2011

Summit sessions during the day

Lab tour of TU Berlin robotics labs

Sunday, July 24, 2011

On Sunday, there will be an optional tour of art galleries of the city, including lunch, ending at 3pm

General Idea of the Program

The scientific program of the Berlin Summit on Robotics is concerned with three to five topics. These topics will be determined prior to the meeting by the participants. They will cover the range of scientific vision for robotics research to educational issues in robotics. These themes will form interactive and interwoven discussion threads. These threads evolve and can change their emphasis or initiate other threads in response to the discussions at the meeting. Participants will be asked to recapitulate and summarize interesting developments of the day and prepare provocative statements to initiate the discussions on the following day.

The program also includes *Speakers' Corner presentations*. These are short visionary or provocative or risky statements regarding ideas, topics, views, approaches that would normally not be presented at a conference or workshop.

The themes are:

1. "Keep on Going" versus "Paradigm Shift": Robotics as the real AI? (Burgard, Brock)
2. Robotics curricula: bridging the communication gap by building a minimum common background (Sukhatme, Roumeliotis)
3. Are we even in the (manipulation/perception) game? (Kumar, Mason, Davison)
4. The role of learning in robotics (Lozano-Perez, Toussaint)
5. Perception-Action-Learning (Schaal)

Daily Schedule

9:00 – 10:45

Workshop

10:45 – 11:15

Speakers’ Corner Presentation

1 1:15 – 13:00

Workshop

13:00 – 14:00

Lunch

14:00 – 15:30

Workshop

15:30 – 16:00

Speaker’s Corner Presentation

15:30 – 17:00

Workshop

“Keep on Going” versus “Paradigm Shift”: Robotics as the real AI?

Is the field of robotics on the right track to build robots with human-like capabilities in dexterity and cognition? On the one hand, one could argue that with great advances in methods, mechanisms, algorithms, computation, and sensing, robotic has made great strides towards this goal. On the other hand, Moravec’s paradox still seems to hold. In the words of Steven Pinker:

"The main lesson of thirty-five years of AI research is that the hard problems are easy and the easy problems are hard. The mental abilities of a four-year-old that we take for granted – recognizing a face, lifting a pencil, walking across a room, answering a question – in fact solve some of the hardest engineering problems ever conceived.... As the new generation of intelligent devices appears, it will be the stock analysts and petrochemical engineers and parole board members who are in danger of being replaced by machines. The gardeners, receptionists, and cooks are secure in their jobs for decades to come." From: The Language Instinct

But is this true any longer? We have seen many robots perform complex tasks in kitchens—so are cooks still secure in their job? And if yes, for how long will they be?

This theme at the Berlin Summit will be concerned with the question if robotics is on the right path or if a paradigm shift is needed to develop truly dexterous and “smart” robots.

According to Kuhn’s book “The Structure of Scientific Revolutions”, paradigm shifts in science occur when anomalies are encountered that cannot be resolved within the current world view. Is Moravec’s paradox such an anomaly to which the robotics community has to respond? Or are recent advances in robotics an indication that Moravec’s paradox has been overcome?

Should we keep on doing the same things—or do we have to look for a paradigm shift? One view could be that we are generally on the right path but need to integrate more closely with related disciplines, such as AI, to be successful. The other view could be that yes, such integration is necessary, but can only be successful if the robotics community adopts a different approach to problem solving.

The discussion will be structured as a debate between Wolfram (keep on going) and Oliver (paradigm shift). Both will present their initial arguments, (20 minutes each) followed by a mutual rebuttal (10 minutes each). Hopefully before the rebuttals are over, we will be in an animated debate with everybody. After a discussion block, two new people will be asked to represent the two views in the beginning of the next discussion block, probably on the next day. This leaves them some time for discussion and preparation of new arguments.

Following the discussion Wolfram and Oliver (and anybody else who wants to join) will author an editorial on this topic to be published in TRO or IJRR.

Robotics curricula: bridging the communication gap by building a minimum common background

Technical societies are often identified by the common background of their members usually acquired through undergraduate and graduate training.

Members of some fields, despite the differences in the curricula of different programs among schools across the world, exhibit a degree of common background. As an example, it is safe to assume that the vast majority of the members of the IEEE Controls society have taken courses in control, and a random attendee at the CDC can correctly tell you what a Lyapunov function is.

This is not obvious for robotics where it is difficult to determine the defining core of our community in terms of common technical background. Various factors contribute to this but most importantly the inherent diversity of the discipline of the field means that robotics programs are housed in many different departments (e.g., computer science, electrical, mechanical, aerospace engineering, etc); probably a unique characteristic of our discipline.

While this pluralism enriches our society, it sometimes also hinders communication since people with different training often fail to understand and appreciate different viewpoints on the same subject, thus missing the opportunities that result from synthesis of different ideas. One often sees this e.g., at program committee meetings in the arguments between area chairs from different areas within robotics.

This theme at the Berlin Summit will be concerned with the question of whether a common core for robotics is possible to envisage, desirable to implement, and achievable in reality.

The discussion will be structured as follows. Stergios and Gaurav will take the position that the answer to these three questions is yes and will give an outline and rationale of a proposed curricular structure. By this we mean a list of areas and topics and list of dependencies among them. We do necessarily propose to make lists of classes.

The assumption is that the summit attendees will disagree (or at least some of them will disagree) leading to a discussion and concrete revisions to the initial structure proposed.

If, at the conclusion of the debate, the understanding is that the answers to these questions is yes (at least to a reasonable degree), we will be left with a suggested curriculum. At that point we will be done with the easy part, and we'll be left with the somewhat harder problem of convincing the remaining 5000 odd academic roboticists on robotics-worldwide that they should adoput our recommendations at their institutions.

Following the discussion, Stergios and Gaurav (and anybody else who wants to join) will author an article on this topic to be submitted to the Robotics and Automation Magazine.

Perception-Action-Learning

It appears that the largely monolithic approaches to perception, control, and learning have reached their limits and a more integrated approach is needed. Interestingly, if you check out ICCV statistics, you will find hardly any papers on perception for manipulation. Active vision, i.e., perception that includes moving sensors, seemingly has been dead for many years, despite it was quite popular in the 1990ies. Similarly, how many robotics researchers actually work with real perception systems, and how many papers can be found where people address control strategies to improve the quality of perception? Again, there is not too much out there. Learning adds another component to these problems. There is a community that cares about learning for control, although the number of people working on machine learning for complex robots is rather small. Obviously, machine learning is part of computer vision, but I haven't seen too much work where people try to devise strategies how perception systems learn competency in a bottom-up approach, e.g., the idea of "autonomous perception systems". And perception also includes tactile perception and acoustic perception, which are rarely addressed in robotics research. Naturally, sensor fusion becomes important in multi-modal perception, a topic that researches in mobile robotics and state estimation have looked at, but that hasn't found wide spread attention in robotics systems, particularly when fusing vision, haptics, and audition.

In contrast, the importance of perception-action cycles has been emphasized in psychology for a long time. Multi-modal and cross-modal perception is an upcoming topic in cognitive science. Thus, a bigger question for robotics becomes how to start a more comprehensive approach to perception-action-learning systems, an approach that emphasizes the need to address all these topics in an integrated way rather than treating them as independent research topics.

Potential Structure of Discussion

1. Identify what perceptual components are important for robotics and potentially not receiving enough research so far.

1. Identify how perception could benefit from active movement.
1. vision (moving cameras)
2. haptics (moving touch sensors)
3. audition (moving microphones?)
4. manipulation (move objects)

5. Identify what control components are missing for active perception.
1. Control/manipulation/exploration strategies (maybe optimal) to gain information
2. Is optimal exploration really useful or would some heuristics do the job?

3. Identify what machine learning can provide, and what is missing.
1. Learning state machines? Manipulation graphs?
2. Active learning for active perception

3. Principled ways of generate perception-action-learning systems

1. How can we bootstrap autonomous learning perception?
2. Learning can we bootstrap autonomous learning of manipulation?

3. Speculation: Associative memory for perception-action-learning.
4. It appears that the human brain acts as a massive cross-modal symbolic and non-symbolic associative memory. Observing information in one modality automatically completes (predicts) sensation in other modalities. Objects are associated with appropriate manipulation acts. Manipulation acts predict sensory consequences. Associations can be on continuous and/or discrete time scales. Would it be useful to develop methodologies to autonomously learn such associative memories?

Deliverables

The above discussion will be summarized as a technical report. If there is enough substance, a position paper could be published in an appropriate journal.

9:00 – 10:45