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Roadmap for Exploitation for Industry, Outreach and Communication Campaigns

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Content

1. Introduction and structure of the document

This document is meant to give long-term suggestions and visions oriented towards sustainability. It focuses on specific outcomes from ERL competitions that could be in perspective relevant for the Industry as well as it describes some guidelines to improve the success of the competitions.

As mentioned in Sect. 2.3, it is clear that both Academia and Industry in equal measure, benefit from this kind of competition and this fact has to be considered a strong starting point to keep on looking beyond the status quo described in Sect. 2.7.

2. Topics for industry resulting from ERL tournaments

2.1 Relevant outcomes from ERL that could be transferred to industry

The ERL extended the concept previously developed in RoCKIn of benchmarking through competitions. The introduced scoring mechanisms provide a step forward towards more systematic and objective performance evaluation of robot tasks and functionalities. Benchmarking concepts, though not yet fully put in practice, bring an extra dimension relevant for design and verification of robot systems, as they enable studying the impact of composing different sets of functionalities into a task plan. Benchmarking can ultimately lead to being able to estimate the performance of a robot system by picking functionalities from a repository of software modules which are not only systematically composable, but also have an associated expected performance level.

The user's stories of both ERL Service Robots and ERL Industrial Robots are rooted in realistic situations - a robot system helping humans in their daily chores, helping an old lady keeping her life quality, and handling a medium-sized factory to improve its production process to meet the increasing demands of its customers. Therefore, the progresses made during the competitions in the development of functionalities and their integration into task plans affects many different relevant aspects useful in future industrial products. To name but a few:

1. object detection, recognition and localization
2. object grasping
3. navigation in dynamic environments cluttered with obstacles and taking into account the presence of humans
4. natural interaction with humans
5. speech-based dialogue with humans
6. mobile manipulation
7. networked robot systems involving mobile robots, cameras and other devices (lights, blinds, machines)

2.2 Interesting topics for industry resulting from ERL tournaments – company's point of view

1. Invest more in Local Tournaments (LT) instead of Major Tournaments (MT)

The ERL is composed of multiple Local Tournaments, held in different research labs across Europe, with certified test beds, and a few competitions as part of Major Tournaments, such as RoboCup.

MT have the advantage of being visible to the public and should be seen as dissemination tool. In regards to the actual value to industry their influence is rather little. It is of much more importance to be able to observe the students/teams closer in the LTs. E.g. where at MTs teams just move on to the next test if something fails, in a LT you can observe the problem solving skills of a team or a single person depending on the problem they face.

2. Foster exchange between teams

Though at most competitions teams tend to help each other out if there are hardware problems, this is practically still impossible on a software level. Even if most teams use ROS as a middleware to drive their robots, which offers a standardized interface, the systems are most often so tightly integrated that a simple exchange of e.g. the navigation module would break the complete system. Finding a solution to this problem would be a big benefit for industry.

3. Encourage teams to invest more in the benchmarking part

From an industrial point of view it is good to see that teams start to value the scientific over the benchmarking part over the competition part. This is also only true for the LT (see point 1). If they get the time and space to actually fix their systems properly the result and quality of performance is much better than seeing them struggling and "hacking away" to find a quick and dirty solution to a problem just because their timeslot is up soon.

4. Get rid of a strict ruleset

Different to an industrial use case with very specific requirements and an often customer driven application in a defined environment, where often enough requirements do change over time, rules in a competition don't add a lot of value to the solution of a problem. Rules should rather be seen as guidelines from which you shouldn't deviate too much, but in the end the final decision about a good execution of a test should be taken by the Technical Committee (TC) or the referees (which could very well represent a customer in a real scenario). Otherwise teams tend to search for and find loopholes in the rules to get an advantage over their competitors and endless discussions around that are just a waste of time. In reality quality is mostly measured by customer experience and small deviations are expected and allowed as long as the use case is solved (not concerning safety critical parts of an application of course).

5. Increase KUKAs visibility in the research community

The KUKA youBot having been the de-facto standard hardware platform in the ERL-Industrial Robots (IR) showed that the product is very suitable for research in robotics. The fact that the participating teams are all interested in a successor to the youBot shows that there is no other hardware platform on the market that is suitable for their research needs. However, there is the need of an alternative standard platform for ERL-IR since the manufacturing of the KUKA youBot has been discontinued.

The visibility gained through the ERL proved beneficial in a way that more research groups became interested in industrial robotics research and KUKA was able to widen its network in the academic research community.

2.3 Goals for industry and academia

Scientific competitions should not rely uniquely in re-engineering well-known solutions so as to adapt them to a particular problem and win the challenge. They need challenges that push the state of the art in given domains, including better and generalizable solutions for systems engineering. Companies are being increasingly pushed to compete in a global market where innovation adds substantial value over competitors. Therefore, novel challenges posed by robot competitions are perfectly compatible between the acedemic goals of research progress and the industry goals of innovation to add value to their products.

2.4 Additional support that can be offered by industry

Industry wants to see its products being used and tested in realistic and challenging environments. Simultaneously, it looks at students involved in competitions as highly skilled future employees.

Thus, robotics companies should be interested to support robot competitions in at least three ways:

1. providing novel challenging ideas for application scenarios, tasks and functionalities
2. providing grants to teams that can be used, e.g., to pay to research engineers and lab technicians to provide (hardware and software) engineering support to the team development, enabling the involved students to focus on innovative concepts that relate to their theses and other academic work
3. providing platforms (e.g. mobile robots, manipulators) to be used by the teams in the competitions

2.5 The role of the students within the competition

Students involved in robot competition acquire very relevant skills for potential future jobs in the robotics industry, namely:

1. learning teamwork, i.e., how to distribute tasks by team members and how to coordinate its execution; dealing with different member skills and work pace
2. learning to work under pressure to solve complex problems
3. learning to integrate multi-disciplinary knowledge and different subsystems into a complete system

2.6 The skills of students as relevant advantage of such competitions from the company's point of view

The skills learned and the hands-on experience students gather through competitions is very valuable on a job application. Personal contact to representatives of industry, opens up possibilities for participants to apply for internships or to write their final thesis major robotics companies because hands-on experience significantly increases the success rate of applicants. It can be observed that students with a background in robotics competitions, either the ERL or others, are in general more resilient and committed to their assigned task. Their work, be it their final assignment from university or work done during an internship, is often of higher quality than the work of those who do not have this experience. During their time in the company they need less support from their supporting employee. Often they are able to work better on their own and in teams.

2.7 Looking beyond

The leagues are equally promising and cannot be compared directly to each other since they target very different applications. For instance, in the ERL-IR competition challenges arise not through the environment as compared to ERL-SR or ERL-ER. The environment is much more uniform, but the objects the robots have to manipulate are often harder to detect and grasp than objects in the other leagues. In ERL-ER for example the environment itself makes it very challenging to detect an object in the first place, where it would most likely not be a big problem if you'd try to find and pick up the same object in the ERL-IR testbed. Same thing the other way round. It's most likely impossible to find most of the objects of ERL-IR in the ERL-ER environment. If you try to compare ERL-SR and ERL-IR, which are a little bit more compatible to one another, you will find that there's only a very small part of manipulating the environment in ERL-SR, but rather the interaction with a human stands out as the most challenging factor, something that is completely absent in ERL-IR at the moment. Another crucial difference between ERL-ER and ERL-IR/SR is that in ERL-ER different teams with different expertise (land, sea and air robots) have to work together. This is an approach that should also be explored more in the other leagues since it introduces another level of complexity very relevant for industry, e.g. human-human communication skills.