PHD POSITION: LEARNING TO GRASP UNKNOWN OBJECTS

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As part of the newly funded H2020 European project SoftManBot, ISIR is looking for a PhD candidate in robot learning.

1. Topic

Grasping an unknown object remains a challenge in robotics. Using machine learning techniques to learn grasping behaviors is an interesting option to avoid having to manually program the appropriate action and adapt it to new objects. It is particularly useful when the 3D model of the object is unknown.

Several approaches are possible, from learning from demonstrations (human or robotic) to learning by trial and error. The advantage of learning by trial and error is that it opens the way to the autonomous exploitation of gripper features and it removes the need for a human to bootstrap the system.

It raises a challenge: how to efficiently explore grasping behaviors? As possible robot movements are many and most of them will fail to produce any relevant grasping or interaction with the object, grasping constitutes a sparse reward problem. It can be solved by constraining possible movements to only relevant ones or by including a priori knowledge about how to grasp the objects in order bias the sampling process.

A successful exploration is likely to require a large number of trials, which have a significant cost on a real robot and prevents systematic explorations. A solution consists in exploring in simulation, where the samples have a lower cost, and then transfer these solutions to the real world. This approach creates a reality gap issue: a behavior learned in simulation may not transfer well to the real world if it exploits some discrepancies between simulation and reality. This is a specific case of a more general problem: the generalization problem that occurs when efficient learned behaviors do not perform as well in conditions not explored during the training period.

The goal of this thesis is to propose methods to efficiently explore grasping behaviors while limiting the number of samples to try on the real robot [Mon16]. The proposed approach will rely on an exploration in simulation and will deal with the reality gap issue by combining several approaches, may it be domain randomization [TBD+18, JWK+18]...
or adaptation [BIW+18], transferability or local adaptation and repertoire-based control [KCD19]. Demonstrations can be included to accelerate the search process by biasing the set of behaviors the search starts from.

2. Context

The position is located at Sorbonne Université’s Pierre et Marie Curie campus, at the heart of Paris, France. The successful candidate will join ISIR as a member of the AMAC (Architectures and Models for Learning and Cognition) team. They will be expected to collaborate with other participants to the SoftManBot project at ISIR, and to contribute to the project’s deliverables. The PhD will be supervised by Stéphane Doncieux and Alexandre Coninx and start in Fall 2019.

3. Candidate profile

Candidates need to hold an MSc in Robotics or an MSc in a related field and experience in real or simulated robotics. Good programming skills with C++ and/or Python, a strong interest for robot learning, and good communication and teamwork skills are required. English is required but no knowledge of French is needed. Other desirable traits include:

• Skills in statistical learning or evolutionary algorithms;
• Knowledge of robot simulators such as DART or Bullet;
• Knowledge of the ROS framework;
• Prior experience with robot grasping or object manipulation.

4. How to apply

Please contact Alexandre Coninx (alexandre.coninx@sorbonne-universite.fr) with a CV, cover letter and at least two references we can contact about your work.

References


