Robotics Projects 2026-27

Contents

Explaining robotic planning decision points along execution

Supervisor: Gerard Canal

Areas: Artificial Intelligence, Robotics

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Project Description

Explanation of robotic behaviours has been proved to be very important to improve the understanding of the users of such robots, which improves their trust in the robotic system.

However, explanations in robotics are tricky as they need to be given at the correct moment and based on what happened in the execution. In robotic-based planning, an interesting explanation is that of decision points, where the robot could have taken a different action with a different outcome.

This project focuses on the explanation of such decision points at execution time, integrating information om the current events and past events that may help explain the decision to a user. For this, we will look into explainability in the space of plans where, knowing the committed plan and what has happened in the execution, we compare with the other alternatives that the robot had at a certain decision point. This will evolve towards generating explanations along the execution of plans, as well as determining when some decisions may not be obvious to the user, thus warranting explanations.

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Goal-based explanations for autonomous systems and robots

Supervisor: Gerard Canal

Areas: Artificial Intelligence, Robotics

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Project Description

Autonomous systems such as robots may become another appliance found in our homes and workplaces. In order to have such systems helping humans to perform their tasks, they must be as autonomous as possible, to prevent becoming a nuisance instead of an aid.

Autonomy will require the systems or robots to set up their own agenda (in line with the tasks they are meant to do), defining the next goals to achieve and discarding those who can't be completed. However, this may create misunderstandings with the users around the system, who may expect something different from the robot.

Therefore, it is important that these autonomous systems are able to explain why they achieved one task and not another, or why some new (unexpected) task was achieved that was not scheduled. Other sources of misunderstandings may come from action failures and replanning, where the robot finds a new plan to complete an on-going task. In this case, the new plan may be different to the original one, thus changing the behavior that the robot was performing.

This project will explore how to generate goal-based explanations for robots in assistive/home-based scenarios, extracted from goal-reasoning techniques. It will also look at plan repair to enforce cohesion after a replanning to ideally increase the trust and understanding of the users about the system. Those explanations should also contemplate unforeseen circumstances, therefore explaining things based on "excuses" that the robot may give to the user. Finally, we will investigate how to obtain and provide those explanations at execution time, so explaining on-the-go. The methods developed shall be integrated into a robotic system, in an assistive/service robot scenario.

In addition to the available support by the CDT, the candidates will have the opportunity of contributing to the REXAR (UK) and COHERENT (international) research projects, while collaborating with and being supported by a network of researchers in aligned areas. These projects focus on reasoning for autonomous robots in assistive scenarios, dealing with explanations at different levels of the robotics system, and reasoning about goals and plans.

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Adaptation and effective communication in collaborative physically Assistive Tasks

Supervisor: Gerard Canal

Areas: Artificial Intelligence, Robotics

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Project Description

Physical robotic Assistance can often be modelled as a collaborative task in which the goal of both the user and the robot is to complete an assistive task together. However, assistive settings have a lot of particularities that differentiate them from traditional Human-Robot Collaboration tasks.

For it to be effective, the assistance should be seamless, natural, and without a required effort on the user's side. This means that these robots must be able to communicate with the user in a very natural and intuitive way, but also in an adaptive manner.

In this project, we will investigate the development of techniques for the online adaptation of the robot to the human, as well as anticipation of user needs, and seamless communication in the context of assistive tasks such as robotic feeding and dressing.

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Foundation Models for Model-based Reinforcement Learning in Robotics

Supervisor: Matteo Leonetti

Areas: Machine learning / Deep learning, Robotics, Artificial Intelligence

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Project Description

Learning and effectively using world models is a currently unmet challenge in autonomous robotics. We will look into leveraging recent foundation models to build representation hierarchies, speed up policy search, and learn the world model itself.