Summer job and master's thesis within robotic ultrasound imaging

Background

Automation of tasks using robots has not been widely adopted within the healthcare sector. One of the reasons is that current robot systems are still not very good at handling moving objects and soft materials. This makes it challenging to interact with body parts and organs that are moving and changing shape, both because the patient does not necessarily lie completely still, but also because of breathing motion and pulsation and because the body is manipulated as part of the procedure.

In the project Robotics for Moving Objects (ROMO), SINTEF and NTNU develops methods that will enable robots to handle moving objects. This includes methods both for detection and prediction of the objects' motion and for controlling the robot based on such predictions. In particular, we are trying to combine new machine learning methods such as reinforcement learning with more traditional methods for tracking and robot control. One of the use cases we are focusing on in ROMO is automation of ultrasound examinations of the abdominal aortic artery. The goal is to create a system that can localize the artery and image it while taking the patient's movements into account. The project is carried out by a multidisciplinary group with backgrounds in both robotics, machine learning, ultrasound imaging and image processing.

Tasks

Summer job:

- Create a virtual clinical environment for simulating the dynamics of robot control and interaction with moving objects in MuJoCo. The simulator will include a robot arm holding an ultrasound probe in various realistic settings.
- Integrating this simulated environment with a machine learning and control framework in Python. Open AI – baselines is a suitable framework to start with.

Master's project and thesis:

- Explore boundary conditions and optimization criterions for robots in a simulated clinical environment.
- Identifying a suitable machine learning (reinforcement learning) method/methods to control the robot in the simulated environment to dynamically compensate for the motion and changing shape of the object. Train and evaluate the robotic manipulation task in the simulated environment using identified machine learning methods.
- Test the developed methods in a lab.

Qualifications

It is necessary with a basic knowledge of Python, robot control, machine learning and kinematics. Experience with C++, basic 3D modelling, reinforcement learning is an advantage.

We primarily seek candidates who are starting their fifth year of study this fall and who wants to do both a summer job and the master's project and thesis in connection with the ROMO project. The candidate will get access to lab and office facilities at SINTEFs group for medical technology and take part in an innovative and exciting research project. We believe that the skills acquired through this project, with its balance of practical and theoretical work of demanded expertise, will make the candidate well prepared for work within both research and industry.

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