

Context

The work of the team DEFROST at Inria is focused on numerical methods to simulate and control soft robots. These robots are compliant by design and achieve their actuation or locomotion goals by deformation. The main tool we use is the simulation framework SOFA (C++, Python), that is also being developed by the team. One important aspect of control of soft robots is the ability to include external forces due to contacts with the environment. Therefore, recently the team has pushed in this research direction, developing methods and also sensors to provide soft robots with the sense of touch.

Short description

In the lab we have developed a novel tactile sensor pad made out of silicone that works by measuring the changes of volumes of cavities embedded in the pad. With the help of SOFA we have implemented a numerical method to estimate to magnitude of a force acting on it. However, to this end we need a prior position estimate that is provided by a machine learning algorithm. The topic of this internship is to improve the existing method by developing an (iterative) optimization scheme that can find the force location and magnitude on the pad based only on the volume changes observed, i.e. without relying on a previously trained model.

The activities during the internship will comprise a learning/training phase with SOFA, the actual design and implementation of the optimization method and an evaluation to verify the method on different sensor designs. The idea is to show that the method can work without making strong assumptions on the shape of the pad or the cavities inside it. The practical part will also involve handling the hardware and the sensors used (Arduino), but is not the main focus.

Profile

- Programming: Familiarity with C++ is highly desirable, familiarity with Python is a plus
- Numerical simulation: Some familiarity with physics-based simulation and basic concepts of optimization
- Motivation: Interest to learn and contribute to the research on Soft Robotics using SOFA!

Schedule (total time 4 to 6 months)

- A period of approx. 4 weeks in which the student will be trained in the use of SOFA and in getting familiar with the existing body of work
- Discussion and conception of the optimization scheme (one or two variants)
- Implementation of the optimization scheme
- Experimental evaluation on different sensor designs
- Tuning of the code to be able to run the methods at interactive update rates for demo purposes

Contact

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