UNIVERSITÄT KLAGENFURT

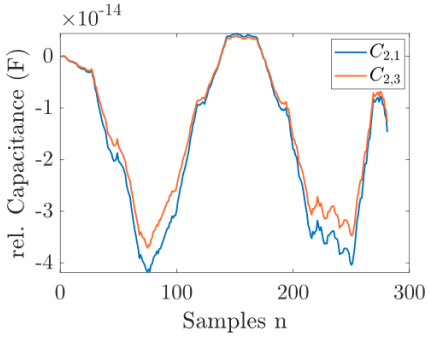
SAT
Institute of Smart System Technologies
Sensors and Actuators

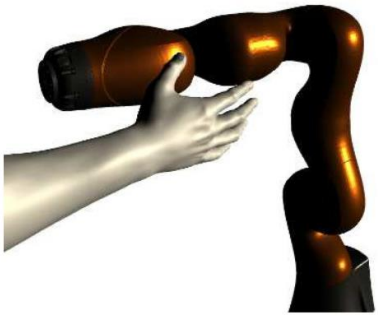
Master Thesis

Development of a real-time 3D capacitive sensor simulation environment

Motivation and Objective

In robotics, state-of-the-art control algorithms rely on machine learning techniques which require massive amount of training data. With the aid of simulation, training and implementation of such algorithms could further be enhanced. Hence, realistic sensor models in simulation are needed to account for such problems. Capacitive sensor technology is a potential candidate for proximity and tactile sensors in robotics. Simulation of such sensors are mostly performed using Finite-Element-Methods (FEM) tools which are rather slow and not designed for real-time application. Hence, a real-time 3D solution would be crucial for future sim-to-real approaches in robotics including tactile interaction and proximity servoing. Based on an existing 2D capacitance simulation framework implemented in Unity3D and MATLAB, the goal is to develop and implement a real-time 3D accelerated FEM solver embedded in a game engine environment. The proposed framework should then be validated using a real-world capacitance sensor embedded in a robotic scenario. Also, the proposed simulator embedded can optionally be embedded with a soft-body physics simulator to account for tactile modalities.





Milestones/Tasks

M1: Get familiar with capacitive sensors and in-house simulation frameworks
M2: Literature study on state-of-the-art FEM solvers
M3: Implementation and integration of a 3D FEM solver with (optional) GPU acceleration
M4: Optional: Implementation of the framework in a soft-body physics environment
M4: Validation with a real-world sensor for a given use case scenario

Requirements

- Knowledge in FEM and physics
- Knowledge in programming (Python, C++, CUDA)
- Self-driven motivation to learn new topics

Skills

Theory	[◆◆◆
Simulation	[◆◆◆◆
Practical	[◆

Period and Contacts

Time period:	6 months, beginning as soon as possible
Contact:	Christian Schöffmann (christian.stetco@aau.at)

We offer funding and publication possibilities!