

## SimRob – Environment simulation for robots

The institute of electronics (IFE) builds a software framework consisting of realistic physical obeyed simulation models for faster robot development.



### Motivation

Robots of the future need to be more autonomous, which requires more powerful decision making algorithms in the form of artificial intelligence to be integrated. Intelligence is strongly linked to learning capacity. Research on reinforcement learning has shown that a large number of interaction iterations are required before the robot can perform even a simple task. If these iterations have to occur with a real, i.e. hardware robot, the learning time is prohibitive. An interesting approach to dealing with this problem is to simulate the robot and its environment on a computer during the first phase of learning. In a second step the trained algorithms are ported and executed on the real robot. In order to obtain good results with such a setup, the simulator must be fast (ideally real-time capable) and as realistic as possible, including dynamics and simulated sensors. The goal of the project is to develop such a simulator.

### Description

A virtual three-dimensional environment obeying physical laws will be created for the robot to interact with. The robot itself will be simulated therein as entity consisting of a physical shape as well as various sensors and actuators. Interactions between the simulated robot and the world occur according to a physical model. This model allows context-dependent sensor values to be generated in real-time which are passed on to the robot's decision making algorithms contained in the CSEM Robot Control Framework. Based on this simulated sensor data, the robot selects a set of actions to be taken and passes this information back to the simulation. Based on the commands issued by the Control Framework the state of the simulated robot actuators is updated and a new overall configuration of the simulated world derived. This in turn leads to new simulated sensor values being generated, thus completing one iteration of the simulation framework.

One important aspect of the system to be designed is the visualisation module. Using 3D computer graphics techniques, an intuitive representation of the world and the objects contained is displayed. This feature is particularly powerful during verification phases, when the control algorithms' behaviour in a given situation is inspected by a human operator.

### Results

Strengths of our simulation framework are the easy construction of arbitrary environments for the robot to interact with, including the creation of situations which would be expensive to set-up in the real world or the operation in potentially hazardous locations. The exact recreation of a given scenario (e.g. for metering AI learning progress) can be achieved with virtually no effort and in absolute precision as compared to a real-world experimental setting.

**Project**  
SimRob

**Project Partners**  
Centre Suisse d'Electronique et de  
Microtechnique (CSEM), CH-Alpnach  
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**Project Duration**  
24 months

**Project Budget**  
CHF 220'000

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