MEMS-HILSIM – Hardware-in-the-loop simulation

A simulation tool for micro electromechnical system ...

Motivation

Advances in micro technology extended the scope of simulation from mono structure systems (e.g. exclusively electronic) into more complex micro electromechanical systems (MEMS), which contain electronic circuitry, micro-machined mechanical parts and sensors of various types (electronic, mechanical, chemical, etc.). Highly realistic simulation of these complex systems can only be achieved via hardware-in-the-loop simulators. A typical hardware-in-the-loop simulation (HILS) system includes a powerful computing engine, which can be implemented either on very high speed processors, or on custom designed FPGAs and/or ASICs with specific hardware modules that mimic the operation of custom blocks, such as sensors, signal generators, etc. Currently available HILS systems suffer from a lack of real-time operation capability for certain MEMS applications. Most MEMS operate in the MHz or higher ranges. None of the existing HILS systems can address requirements of real-time MEMS simulation in these high ranges. This gap can only be closed by the introduction of a powerful MEMS HILS system.

Description

Within the scope of this project, a HILS module library for MEMS will be created. The project will be executed in the following steps:

- Target MEMS applications will be chosen.
- Design and block requirements for the selected systems will be identified.
- The top level system architecture will be outlined. In this top level design, each and every module that forms the MEMS HILS system will be identified.
- Mathematical model of each module will be created and verified by software simulation.
- An implementation method for each module will be chosen according to design, computational simplicity, and efficiency requirements.
- Each module will be implemented with its corresponding method.
- The implemented modules will be collected inside a module library, which will then be used to implement a basic MEMS HILS system for demonstration.

Results

The created MEMS-HILSIM module library will eventually lead to a complete MEMS HILSIM system. There will be follow-up projects, where integration of library modules will be realized in order to form the complete MEMS-HILSIM system, and actual MEMS will be simulated using the developed simulation environment.

Project
MEMS-HILSIM

Project Partners
Politecnico di Torino (LIM), Italy
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Project Duration
12 (+24) months

Project Budget
CHF 95'000

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