Towards an interoperable framework for mixed real-time simulations of industrial embedded systems

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Introduction

• We present a simulation framework enabling the developer and tester of industrial embedded systems to use mixed real-time simulations during the development cycle of these systems

• This framework offers simulations in different abstraction levels, ranging from MiL to HiL

• But why we bothered to give such an effort??
Gains

- **Commercial reason**: time to market is reduced for a newly-designed industrial embedded system product

- **Economical reason**: the cost of a classic experimentation involving a fully real industrial embedded system’s plant is significantly higher than running a simulation, such as HiL – E.g. an unmanned aerial vehicles (UAVs) worths multi-million dollar, while running a HiL for such product, in the mid 90s, cost only $125,000!!¹

- **Applicability reason**: Doing some experimentations are not feasible in a real life, while doing them as a simulation can be easily performed by tuning relevant parameters to simulate the plant and environment

¹ http://www.embedded.com/
The sketch of our approach

• The general approach in our framework is to cut the entire embedded system into two parts

• One part is the system under test (SUT) – e.g. control software

• The other part is the controlled part (aka, plant) that could be fully simulated, fully real or consisting of a mix of real and simulated components

• On the boundary between these two parts, an interface exists that connects them. This interface is taken over by our framework
The overall architecture of our framework
Case study

• We are specializing our simulation framework for a case study in the healthcare domain, which considers an *Interventional X-Ray (IXR)* machine

• So far, we have integrated a simulation model of one of the components of the IXR machine, viz., a patient-table pressure sensor executed by Simulink
Future works

• We are currently setting experiments for the evaluation of this simulation framework

• We would like to enforce the automatically code generation of simulations – i.e., more automation

• Boosting interoperability among different simulation tools/models is one of the key objectives of our project

• We would like to investigate the real-time capabilities of a mixed real and simulated parts of an integrated system