TEACHING A COURSE ON MODELING AND SIMULATION FOR CYBER-PHYSICAL SYSTEMS USING MODELICA AND FMI TECHNOLOGIES WITH HANDS-ON-LABORATORIES

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The Modelica standard provides rich language features enabling the development of complex Cyber-Physical System models. Meanwhile the success in the adoption of the FMI standard allows engineers to share models between tools, facilitating collaborative design. Despite these, and many other advantages, Modelica and the FMI have limited adoption in the academic community, especially in North America (NA). This poses both a challenge for the NA industry seeking talented students with the right skills set, and at the same time for universities to train students with such valuable knowledge. This presentation gives an overview of the efforts of the author in developing, piloting and integrating into the curriculum a new course on modeling and simulation (M&S) for CPS based on Modelica and FMI technologies.

The main goal of this presentation is to provide the basis for the introduction of a Modelica and FMI-based course on M&S for CPS suitable for the North American-style course curriculum, using the presenter's experience as an example.
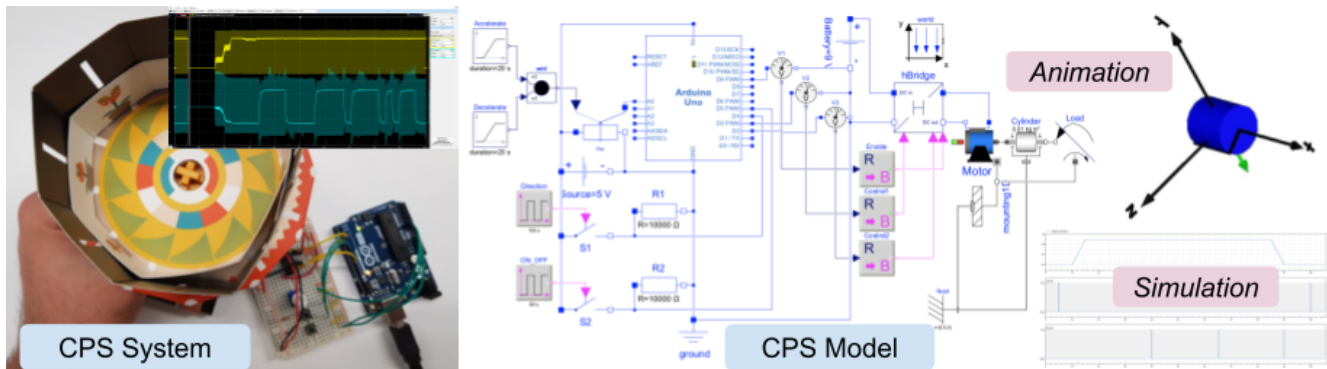
FIGURE 1. Example Hands-on-Laboratory Assignment using the Modelica Arduino Library and Dymola (Zoetrope Project)

The presentation will cover the different teaching and learning activities carried out in the course. In addition to lectures and homeworks, the students carry out two hands-on labs which make use of the Arduino Starter Kit (ASK) and the Modelica Arduino Library. The first consists of building projects from the ASK both the physical prototype and model, and comparing measurements to simulations. The second aims on interacting with models via hardware-in-the-loop simulation using three experiments, learning to interface real-world IO with real-time simulation. For their final assessment, the students carry out a project where they have to apply the knowledge and skills gained from the course. The presentation will provide a few examples of interesting projects carried out by the students.

Another goal of this presentation is also to obtain feedback from industry and academia towards developing a sort of template that can be shared and replicated in other NA institutions with the goal of students use Modelica and the FMI for CPS design and analysis, and more importantly, to expand the existing Modelica community in North America.