Workshop On
LEGO Mindstorms with MATLAB and Simulink for Teaching Controls, Robotics and Mechatronics

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Workshop/Tutorial Abstract:

This workshop describes the built-in support for prototyping, testing, and running Simulink models on LEGO® MINDSTORMS® NXT. This platform aims to address the growing need for hands-on and project-based learning via a low-cost, easy to use hardware and software platform that builds on the widely used MATLAB & Simulink platform.

The Simulink built-in support for hardware enables students to access the hardware capabilities of the 32-bit LEGO NXT brick from within Simulink environment, and to automatically generate and cross-compile the necessary code for real time autonomous implementation. Faculty who attend will have a chance to work through lab modules with examples of embedded genetic algorithms, motor speed control and mobile inverted pendulum. They will have an opportunity to gain practical hands-on experience in building such high-level examples themselves, and by extension understand the potential for use in the classroom with undergraduate students.

Presenter(s):
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Hardware required: Lego Mindstorms NXT (10 units provided by MathWorks for this session) / PC Computers running MATLAB / Simulink R2012b

Expected Number of Attendees: 20 maximum

Session Outline:

Introduction and review of Simulink – 20 mins
- Building models in Simulink
- ODE solvers and simulation of dynamic systems
- Simulink for Model-Based Design of embedded or real-time applications
- Using MATLAB code in Simulink

Introduction to HW Support for Project Based Learning – 10 mins
- Advances in low-cost embedded hardware
- Rapid Prototyping and Automatic Code Generation tools
- Overview of the Simulink built-in support for LEGO® MINDSTORMS® NXT
- Demonstration of a few pre-built systems: “Segway bot”, Genetic algorithms and SpiderBot

Example lab module 1 – 45 min

- Example 1: Explore a pre-built Simulink example, generate code, download and execute on LEGO MINDSTORMS
- Example 2: Build a new example from scratch following the user's guide
- Example 3: Use sensors to develop an audio example from the user's guide

Key Concepts: System configuration and data types

Example lab module 2 – 45 min

- Using Sensors, Actuators and Feedback Control
- Example 1: Motor speed control
- Example 2: Line Following

Key Concepts: Implementing feedback control, configuring a model, working with data types

Wrap-up

Expected Background of Participants:

Basic knowledge of dynamic modeling and controls. Knowledge of MATLAB.