

MathWorks Announces Built-in Simulink Support for Arduino, BeagleBoard, and LEGO MINDSTORMS NXT

With one click, engineers run Simulink control system and signal processing algorithms in hardware

<http://www.mathworks.com/company/newsroom/MathWorks-Announces-Built-in-Simulink-Support-for-Arduino-BeagleBoard-and-LEGO-MINDSTORMS-NXT.html>



Simulink built-in support for prototyping, testing, and running models on low-cost target hardware, including Arduino®, LEGO®MINDSTORMS® NXT, and BeagleBoard.

NATICK, Mass. - (18 Apr 2012)

MathWorks today announced that Simulink models can now run directly on Arduino, BeagleBoard, and LEGO MINDSTORMS NXT platforms. These popular, low-cost devices are widely used in academia for hands-on teaching of robotics, mechatronics, audio signal processing, computer vision, and other engineering applications. Simulink models can run standalone on these hardware platforms or in tandem with a connected PC.

“Simulink built-in support for hardware is a big boost to project-based learning,” said Dr. Farid Golnaraghi, professor and director of Mechatronic Systems Engineering at Simon Fraser University. “Our engineering students who learn control theory by creating and running models in Simulink can now easily test and tune their algorithms on hardware, without knowing embedded systems.”

“Multifunction microprocessor boards are a tremendous learning resource,” said Tom Gaudette, principal academic evangelist at MathWorks. “Adding targeted support was a logical step, given the widespread use of Model-Based Design with Simulink in engineering schools and industry. With Simulink and a low-cost Arduino, BeagleBoard, or LEGO MINDSTORMS NXT robot, a student can learn industry best practices for DSP, robotics, and mechatronics design.”

Simulink provides built-in support for the following platforms:

- Arduino Uno and Mega 2560 microcontroller boards for robotics, mechatronics, and hardware-connectivity tasks
- BeagleBoard-xM single-board computers for audio, video, and digital signal processing
- LEGO MINDSTORMS NXT robotics platform for robotics applications

Simulink built-in support for hardware is available in MathWorks Release 2012a, including MATLAB and Simulink Student Version. Visit

www.mathworks.com/products/simulink/simulink-targets for additional information.

About MathWorks

MathWorks is the leading developer of mathematical computing software. MATLAB, the language of technical computing, is a programming environment for algorithm development, data analysis, visualization, and numeric computation. Simulink is a graphical environment for simulation and Model-Based Design for multidomain dynamic and embedded systems.

Engineers and scientists worldwide rely on these product families to accelerate the pace of discovery, innovation, and development in automotive, aerospace, electronics, financial services, biotech-pharmaceutical, and other industries. MathWorks products are also fundamental teaching and research tools in the world's universities and learning institutions. Founded in 1984, MathWorks employs more than 2400 people in 15 countries, with headquarters in Natick, Massachusetts, USA. For additional information, visit www.mathworks.com.

Dr. Farid Golnaraghi on STEM, Arduino and open source software

10 December 2012 – <http://www.driveforinnovation.com/dr-farid-golnaraghi-on-stem-arduino-and-open-source-software/>

iGEN: How do you expect Simulink/Arduino capabilities to change how you and your students use these new tools?

Dr. Farid Golnaraghi: I expect a major change in the way we teach the topic of Control Systems and Mechatronic type courses. In my next edition of my textbook titled “Automatic Control Systems,” to be published by John Wiley in 2013, I have integrated the LEGO-Simulink/Arduino capabilities with the vision that students can learn the concept through practical and inexpensive experiments at home without a need to go to labs at their respective universities. This will save schools money and resources and provide the students with the opportunity to learn the subject at their own pace and comfort level.

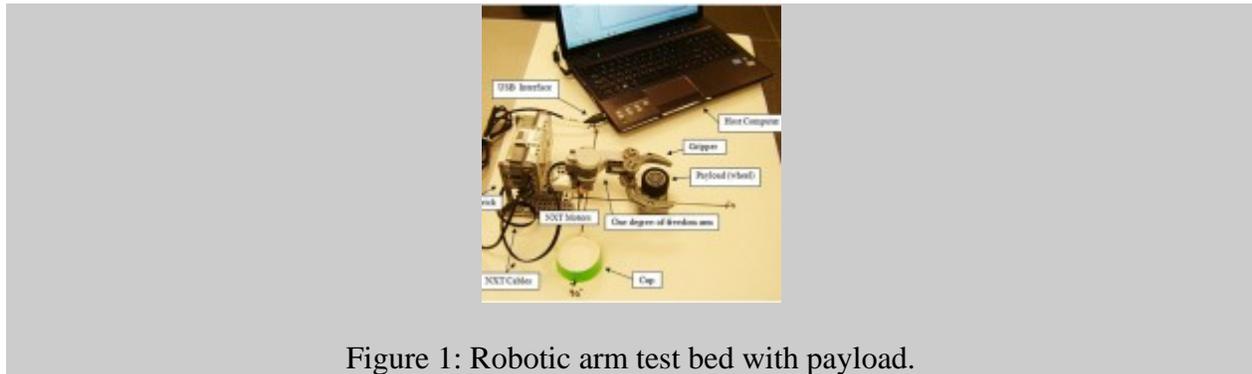


Figure 1: Robotic arm test bed with payload.

iGEN: Do you think middle-school students and teachers could make use of the new capabilities, and if so, how?

Golnaraghi: Yes. We currently teach middle school students these topics in various Summer Camps at Simon Fraser University’s Surrey Campus in British Columbia, Canada.

iGEN: Please describe a few of your students’ hands-on robotics projects and how they incorporated Simulink and the Arduino platform?

Golnaraghi: At the Mechatronic System Engineering Program at Simon Fraser University in Vancouver, Lego, MATLAB and SIMULINK are extensively used as instructional tools to help students better appreciate how to design mechatronic systems.

In one of our third year design projects, the primary goal is to help students gain experience in applying their control knowledge to a practical problem. The project is for teams of three students and is graded on a competitive basis. An in-house software utilizing the GUI components of MATLAB and SIMULINK – the SIMLab and LEGO Lab software – has been developed to provide enough flexibility to test various scenarios.

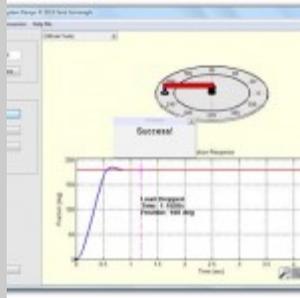


Figure 2: Position response of the one link pick and place robot in SIMLab.

Description of the Project

Consider the test system in Fig. 1. The system is composed of a dc motor. We connect a rigid beam to the motor shaft to create a simple robotic system conducting a pick-and-place operation. A gripper is attached to the end of the arm and is able to grip a payload and drop it into a cup at a specified angular position. The system interfaces with the host computer using a USB connection, while the host computer logs encoder data using a Bluetooth connection.

Objective

The objective is to drop the payload into a hole or cup as fast as possible.

Design Criteria

The arm is required to move in only one direction from the initial position. The hole location may be anywhere within an angular range of -90° to $+90^\circ$ from the initial position. The arm may not overshoot the desired position by more than 5° . A tolerance of $\pm 3\%$ is acceptable (settling time). These criteria may easily be altered to create a new scenario.

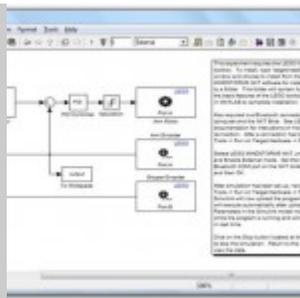


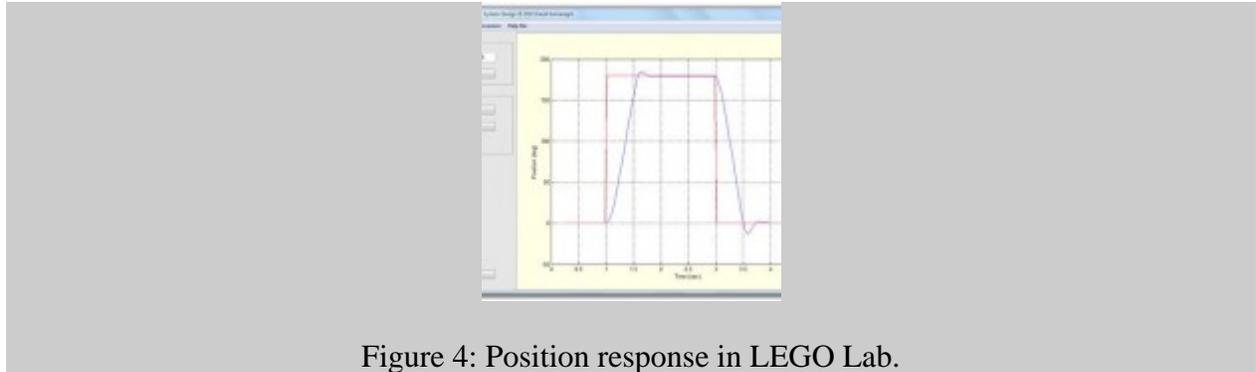
Figure 3 LEGO Lab Simulink model.

The objective may be met by looking at the settling time as a key design criterion. Students can make the design challenge more interesting by introducing other design constraints, such as the percent overshoot and rise time.

In SIMLab, students can also introduce a disturbance torque to alter the final value properties of the system. The LEGO Lab system contains nonlinear effects that make the controller design more challenging. Students have to experimentally confirm the system model parameters first.

Students create the test bed shown in Fig. 1 and try the experiment in LEGO Lab, comparing the results with SIMLab.

Instructional videos are available on YouTube. (See *Interfacing LEGO Mindstorms NXT using MATLAB Simulink: Part 1 & Part 2.*)



The SIMLab model response is animated. This feature makes the simulation more realistic. In SIMLab, it is possible to change the dimensions of the experiment setup. Choose ‘Modify Load Drop Setup’ from the SIMLab Tools menu to adjust the height of the drop and the length of the arm and change their controller design accordingly. A SIMLab time response of the system is shown in Fig. 2.

Upon opening the experiment in LEGO Lab, the Simulink model in Fig. 3 will appear. The drop angle and drop position time can be edited by double clicking on the Arm/Gripper Control block. A LEGO Lab time response of the system is shown in Fig. 4.