

# Deployment of Standalone Modelica Models to the RPI+Arduino

Leonardo Laguna Ruiz  
Wolfram MathCore

---

---

## Contents

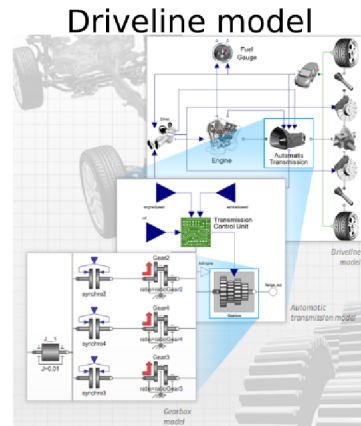
---

- Introduction
- Interact with simulation models
- Run standalone models

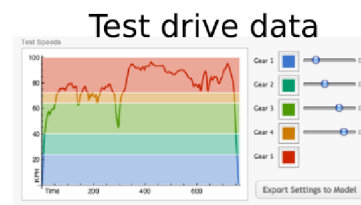
## Modelica as a Simulation Language

### Traditional workflow:

- Create the model.
- Define test scenarios.
- Simulate scenarios.
- Improve the model or the controller.



Scenarios must be realistic



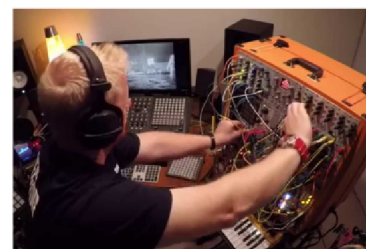
## Modelica as a System Design Language

### Rapid prototyping:

- Simulators are rapid prototyping platforms.
- Simplify the creation and testing of models.

### Interactive models:

- Simplify creating scenarios.
- Provide more realistic input data.
- Test corner cases.



## Arduino

---

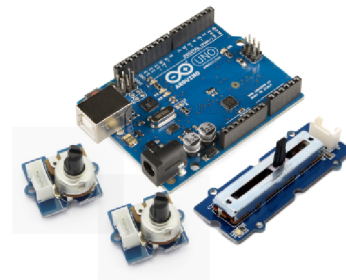
### Inputs to models

- Every model requires custom inputs.
- Input data should be close to real data.
- It's hard to make a user interface that fits all cases.



### Arduino

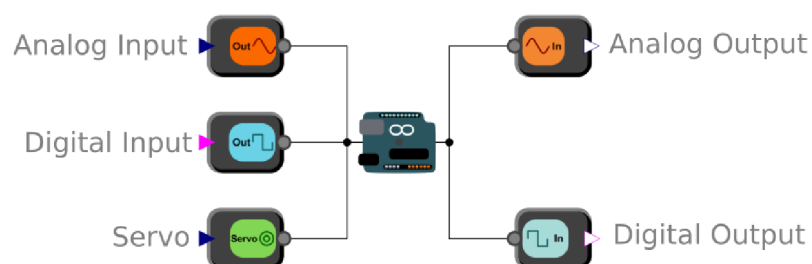
- Can connect to almost anything.
- Many sensors and actuators available.
- Extensive documentation.



## ModelPlug Library

---

Easy way of connecting simulation models to the real world.



Uses Arduino as data acquisition board:

- Reads sensors.
- Use actuators.

## Board Compatibility

---

### Arduino derivatives

- Official boards.
- Arduino clones.
- Boards using the same IDE.



### Custom boards

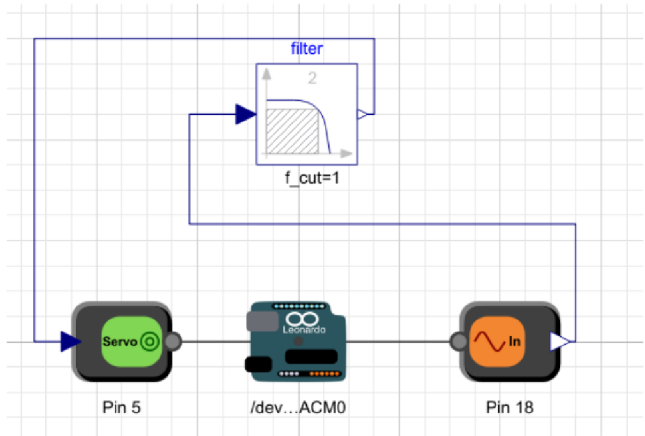
Uses Firmata protocol:

- Open-source protocol.
- Supported by many boards.
- Easy to implement for your own board.

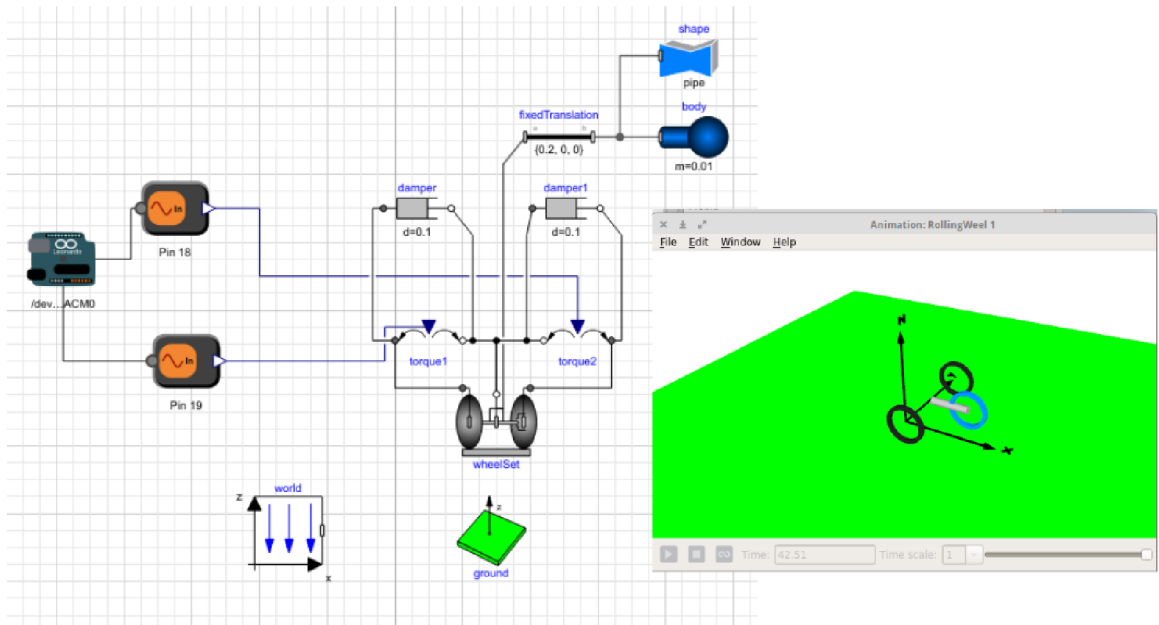


Firmata - <https://github.com/firmata/protocol>

Demo: Basic I/O

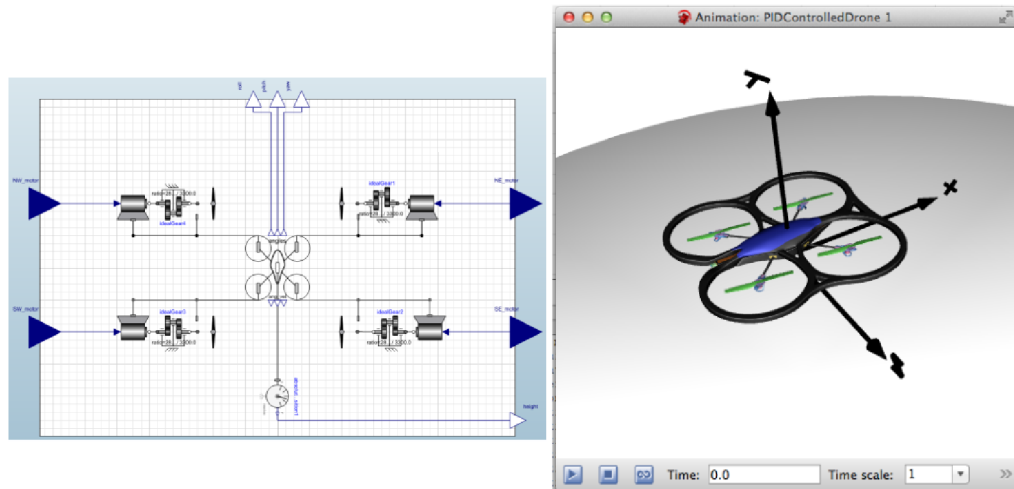


Demo: Inputs to Simulation Models



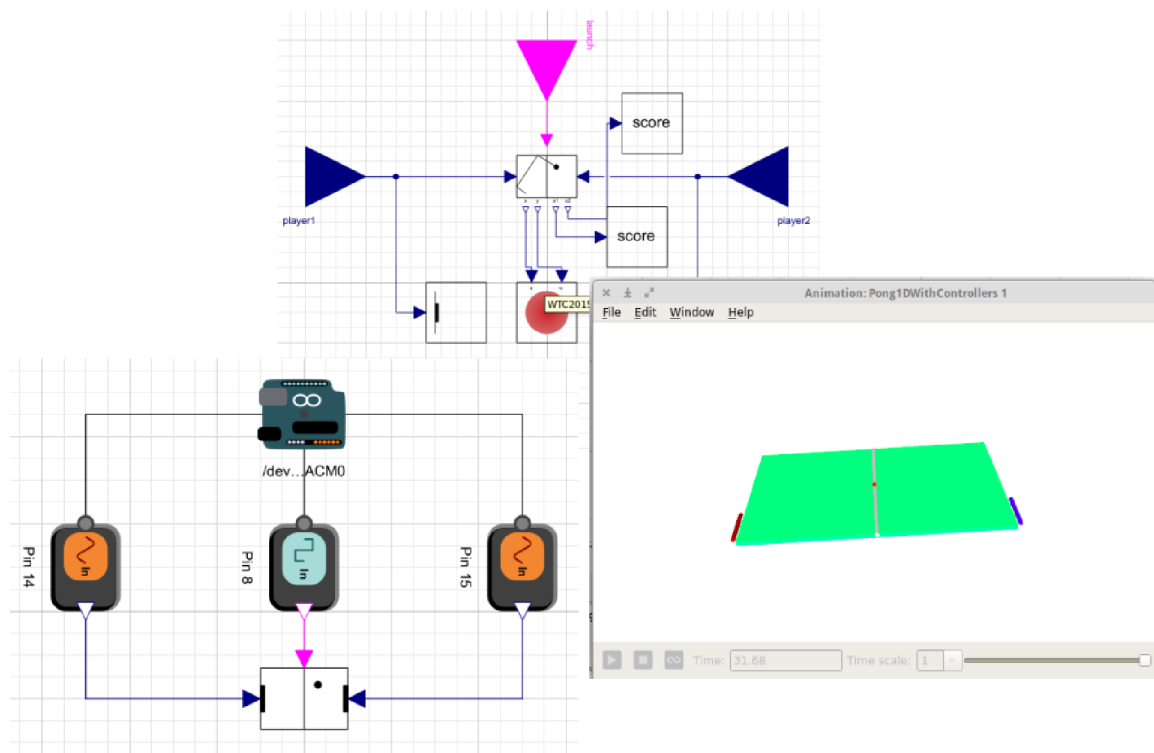
Video

## Demo: Inputs to Simulation Models



Video

## Demo: Other Educational Models



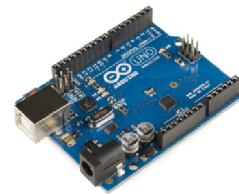
[Video](#)

## Scope of ModelPlug

---

### ModelPlug limits:

- Board transfer speed.
- Model complexity.
- OS timer accuracy.



115200 Bauds

ModelPlug requires a computer attached.



12 MBits

---

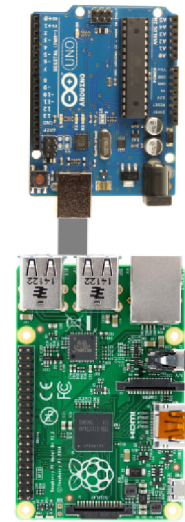
## Running Models in the RPi

## Characteristics:

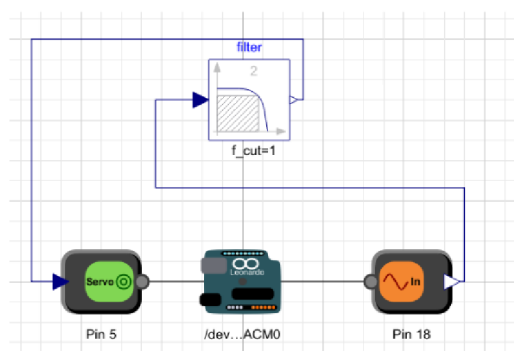
- Linux computer.
- 900MHz quad-core, 1GB RAM.
- Includes C++ compiler.

## Idea:

- Send simulations to the RPi.
- The RPi compiles and runs the models.
- Arduino provides the I/O.



## Demo: Deploying Simple Models

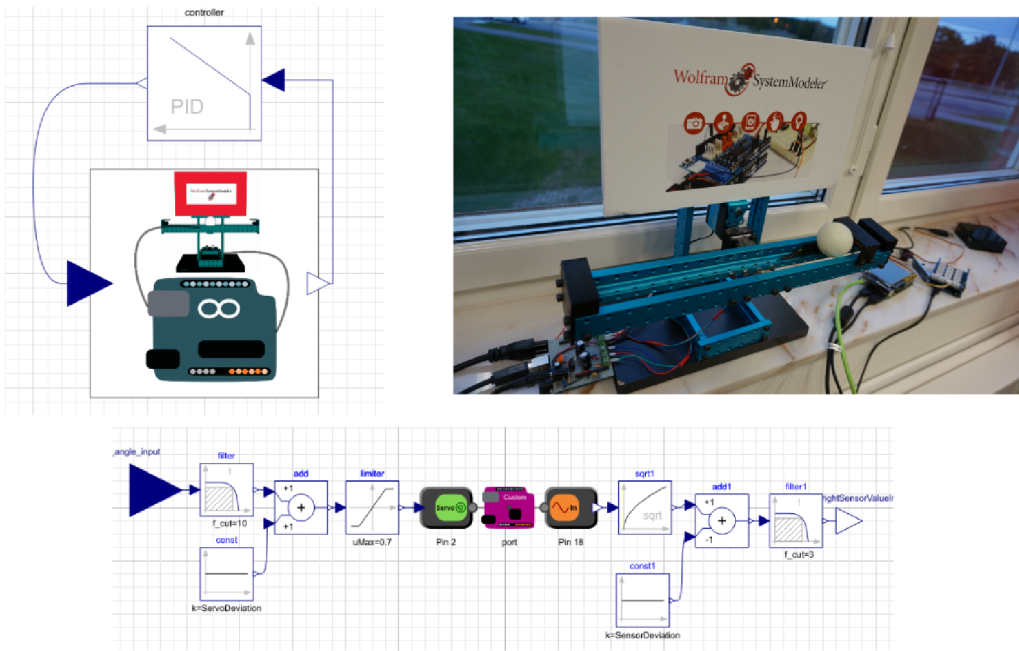




Video

Demo: Balancing Robot

Real-time control using a Modelica model



Video

Video A

Video B

Conclusion

## ModelPlug+RPI allows:

- Interaction with simulation models.
- Creation of more realistic test scenarios.
- Connection with many sensors.
- Fast prototyping of systems.
- Use of Modelica components.

## Applications:

- Hardware-in-the-Loop (HIL) simulations.
- Model-in-the-Loop (MIL) simulations.

**Thank you for listening!**

leonardo@wolfram.com



leonardo@wolfram.com