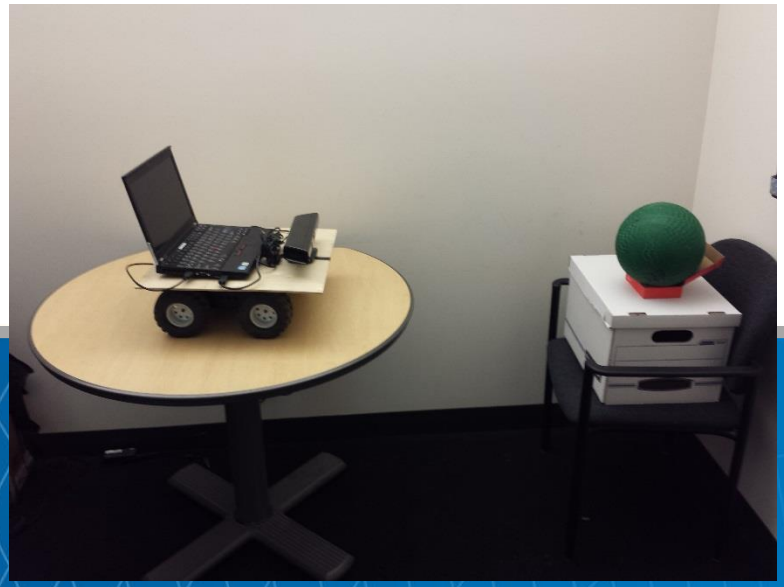
Controlling a Robotic System with MATLAB and Simulink using a Desktop Computer

By Sergio Biagioni



Agenda

- MathWorks Support for Student Competitions
- Advantage of MATLAB and Simulink for Robotics
- Demo: Ball Tracking with MATLAB and Simulink
- How to deploy MATLAB and Simulink to a Desktop Computer

MathWorks Support of Student Competitions

MathWorks supports student competition teams by providing them with software and training. Student competitions inspire the next generation of innovators to put their classroom knowledge to practical use, solving real-world problems with software and hardware used by professional engineers.

Robotics Student Competitions

- AUVSI Foundation
  - RoboBoat
  - RoboSub
  - RobotX
  - IGVC

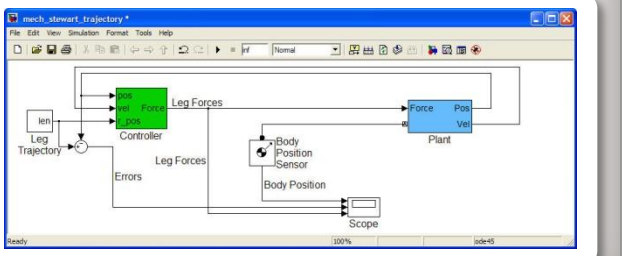
- RoboCup

Why use MATLAB and Simulink to deploy algorithms in competitions?

- Tools used by industry
- One design environment to design algorithms, model a vehicle and deploy algorithms to hardware.
- Model-Based Design

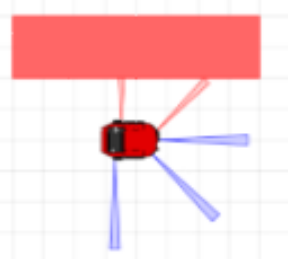
Model-Based Design: Introduction

DESIGN

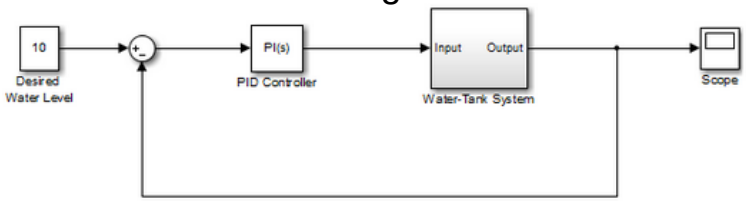


Model-Based Design uses block diagrams and simulations to mathematically model the system behavior.

Sensor Models



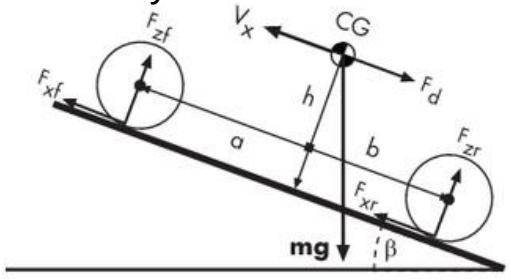
Control Algorithms



Embedded Software

```
Command Window
>> codegen matlabAlgorithm
```

Dynamic Models



Model-Based Design: Mobile Robot Examples

Sim.I.am

Mobile Robot Simulation with MATLAB

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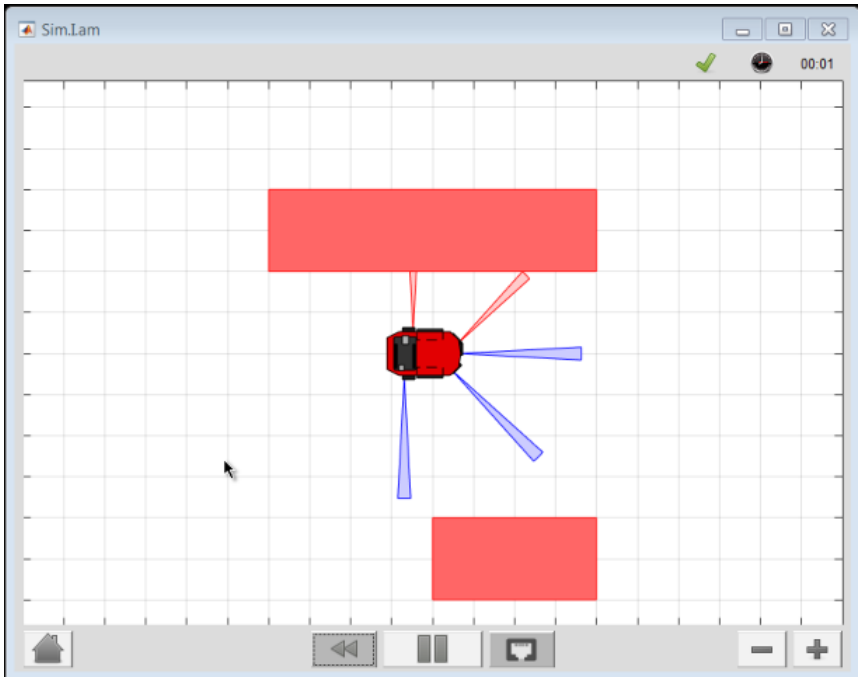

Mobile Robot Simulation for Collision Avoidance with Simulink

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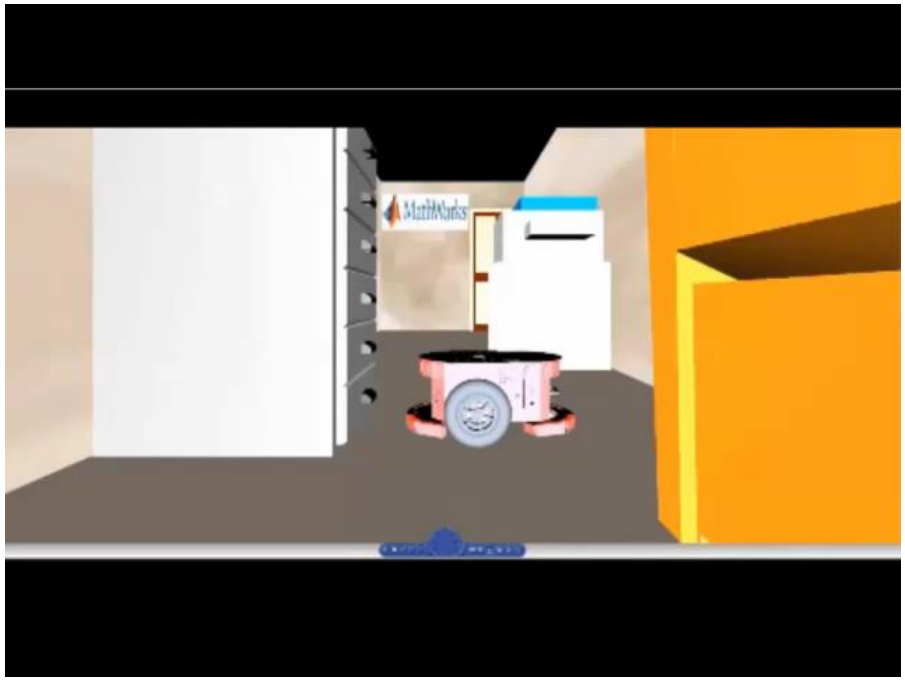
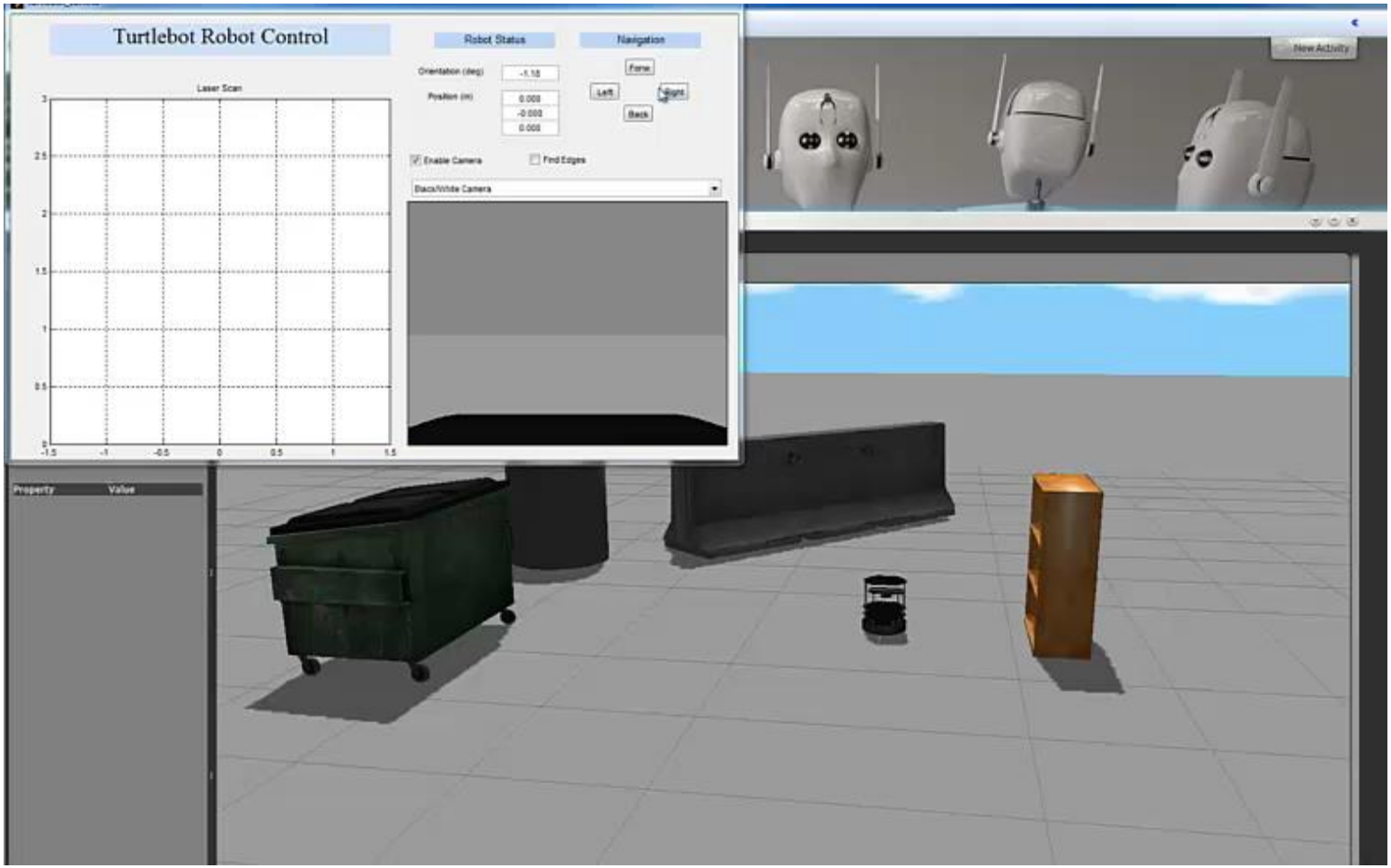
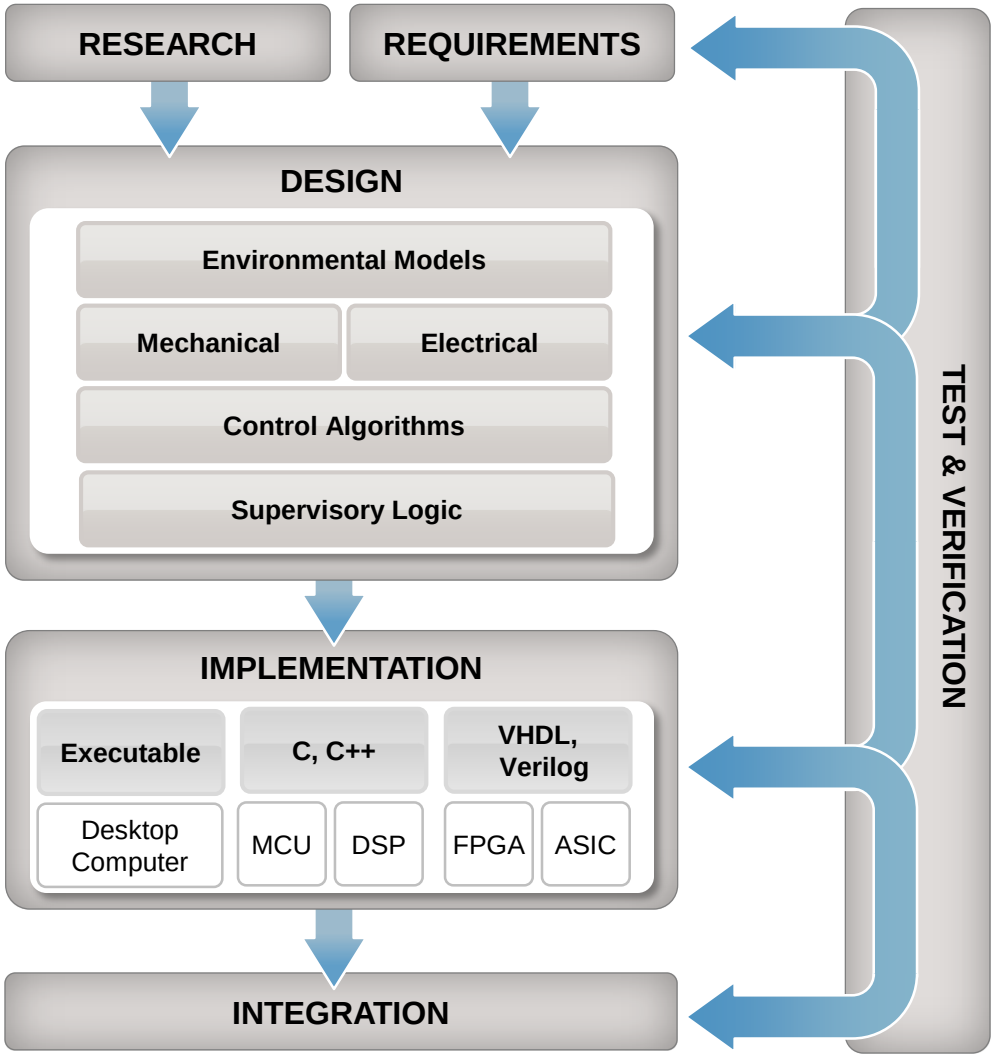


Model-Based Design: Mobile Robot Examples



Model-Based Design for Competitions

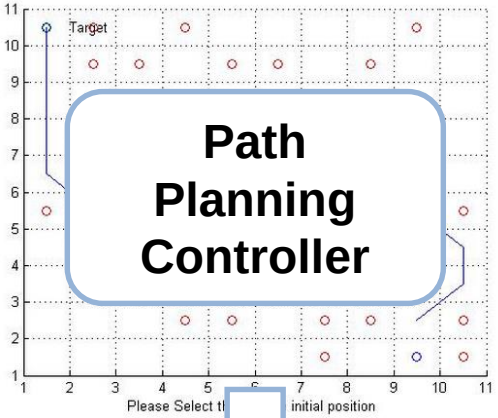


Start the design process early.
- Design without hardware
- Design without testing facilities

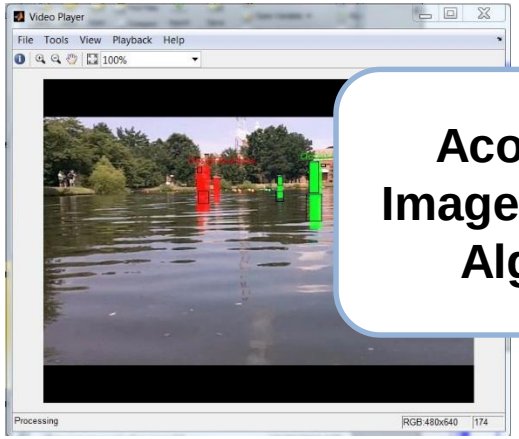
Automatically generate code from the simulation model for implementing directly on targets:

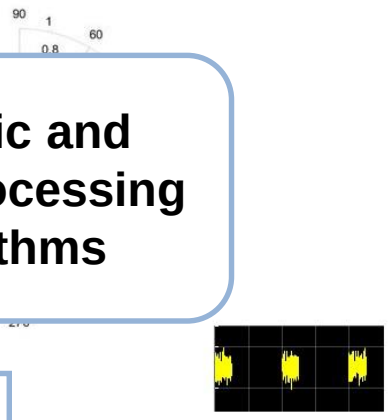
- **Desktop Computer**
- Microcontrollers
- FPGA's

Model Based Design in Competitions



Path Planning Controller





Acoustic and Image Processing Algorithms

MATLAB Executable

Desktop Computer

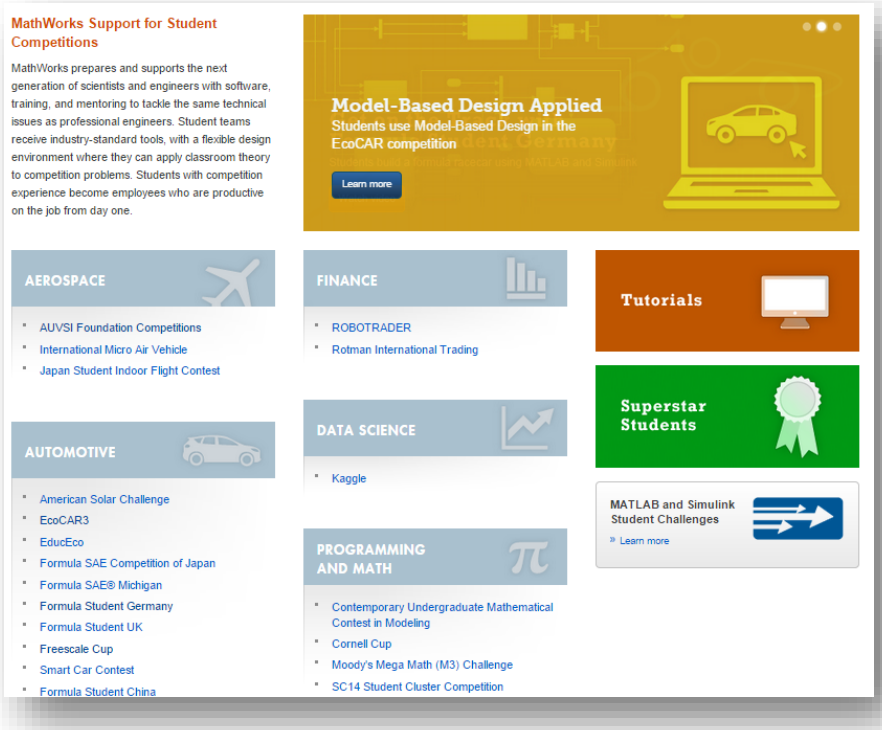
MATLAB ROS Node

Desktop Computer

Resources for MathWorks Support

- MathWorks Supported Student Competitions
- If your competition is not on the list of supported competitions, and you would like software support, send email to:

  academicsupport@mathworks.com

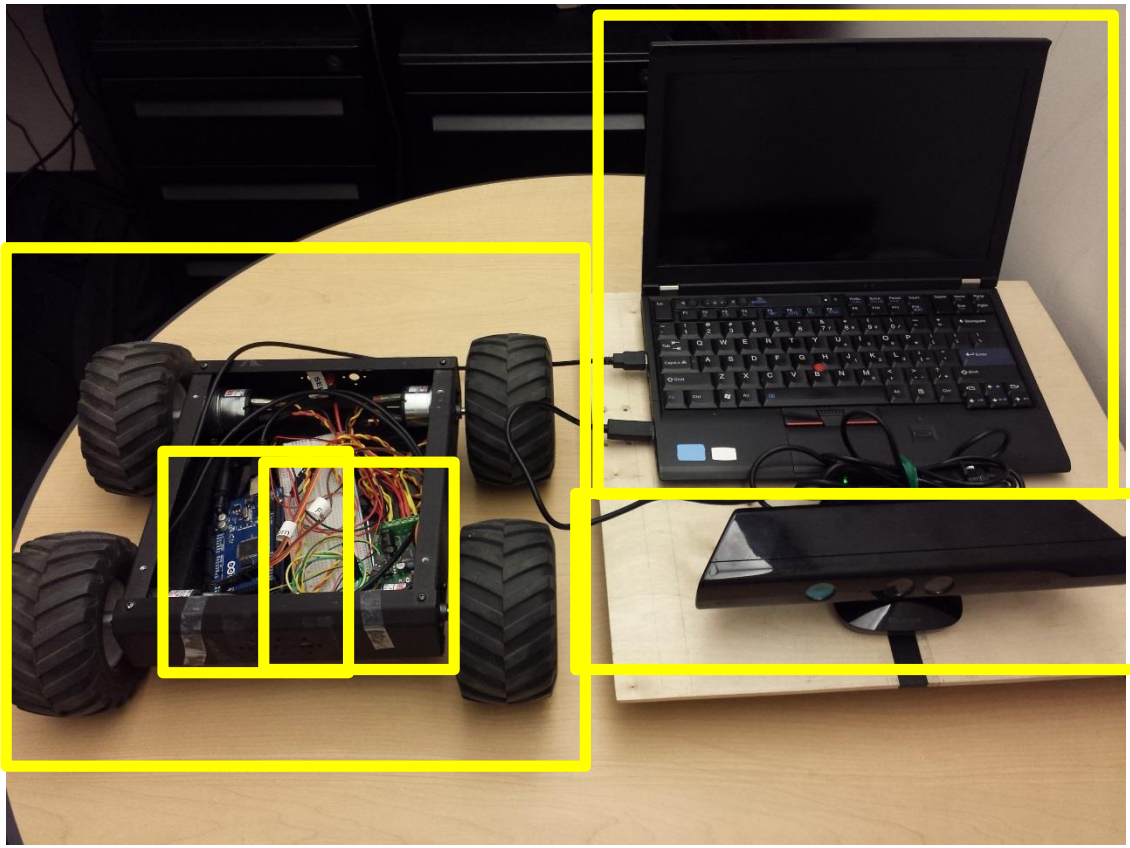


http://www.mathworks.com/academia/student-competitions/

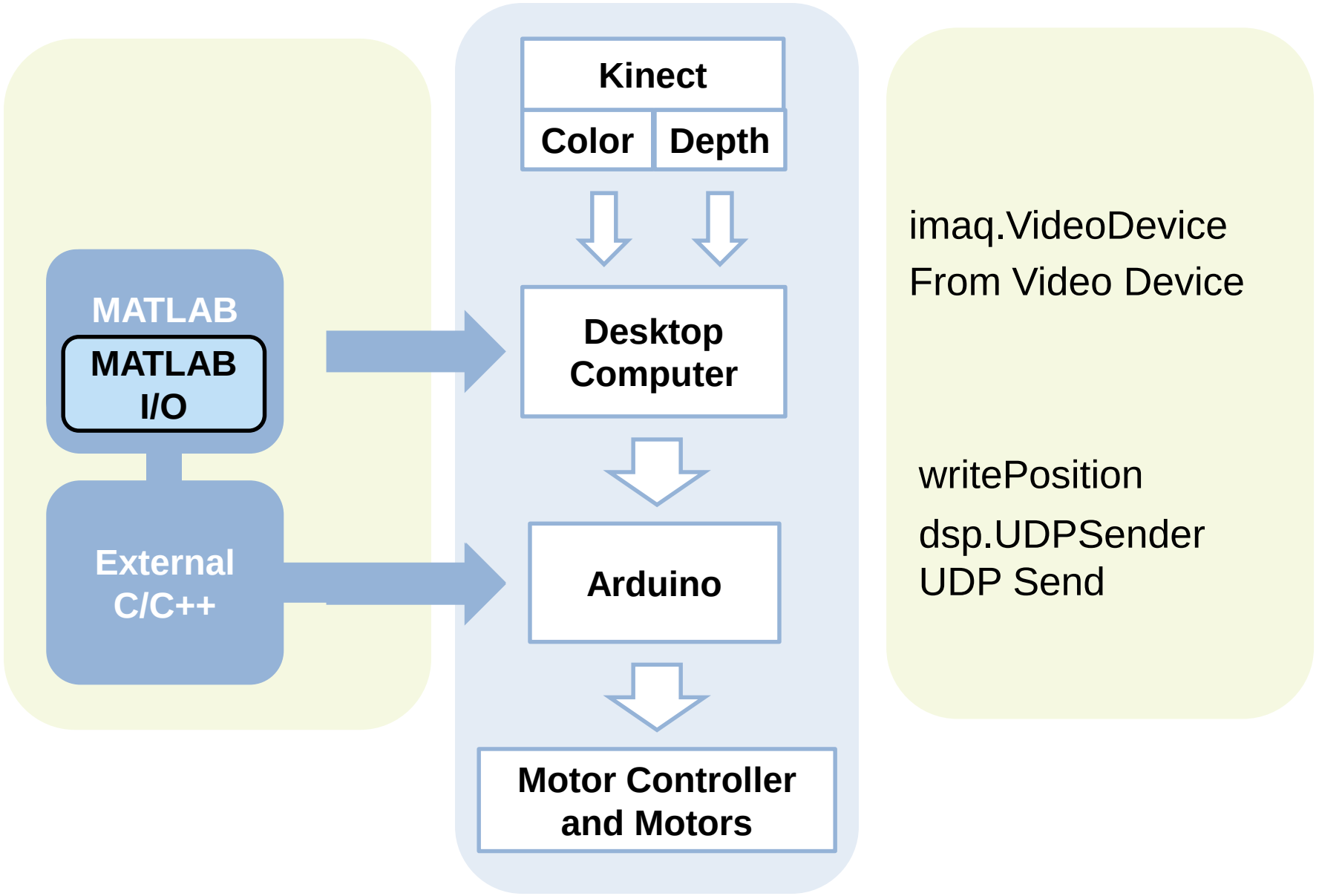
Demo: Ball Tracking with MATLAB and Simulink

Hardware Layout

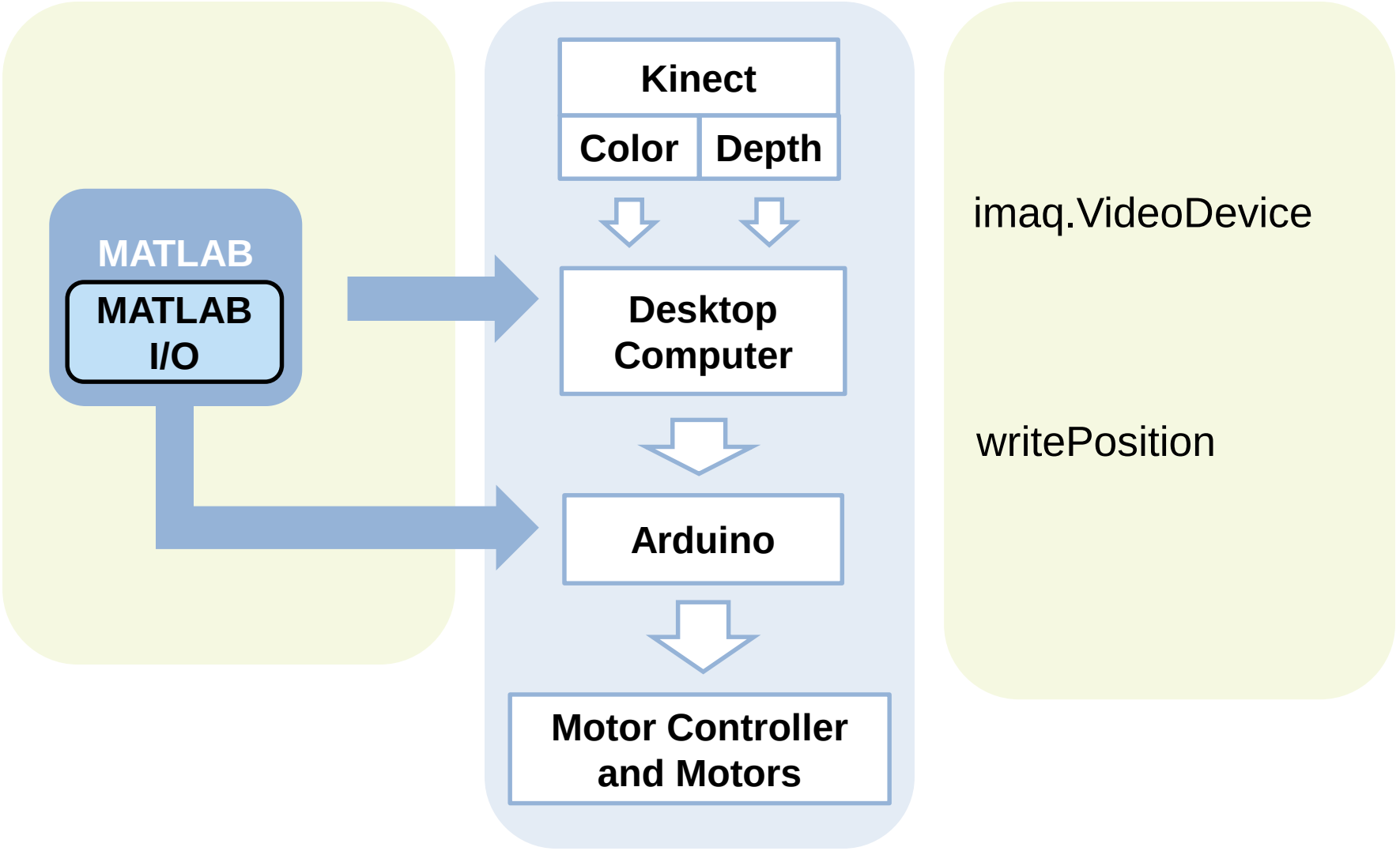
- Microsoft Kinect for Windows
- Standard Laptop
- Lynxmotion Rover with DC Motors and Encoders
- Arduino Mega 2560
- Arduino Ethernet Shield
- Sabertooth Motor Controller

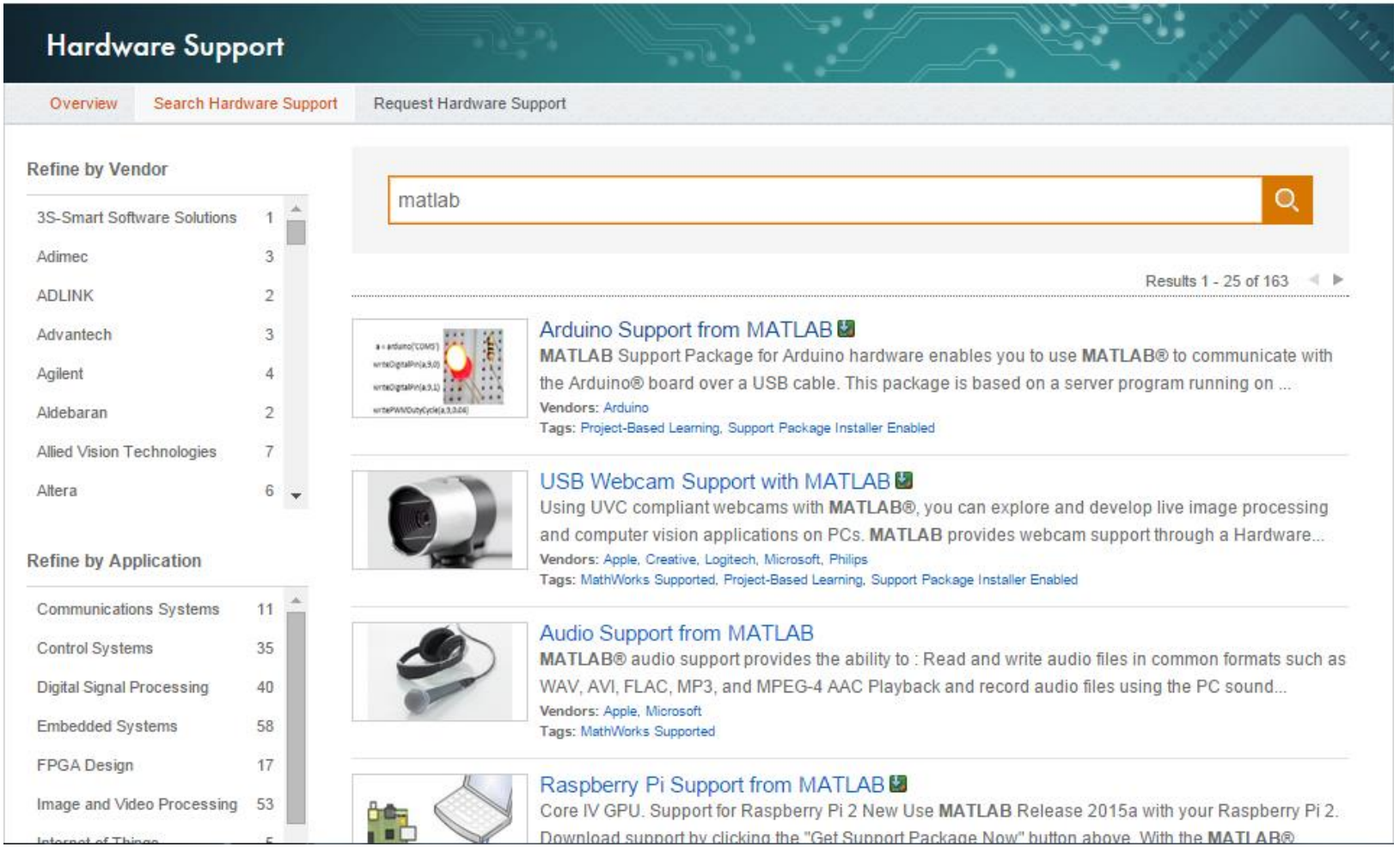


Hardware and Software Layout



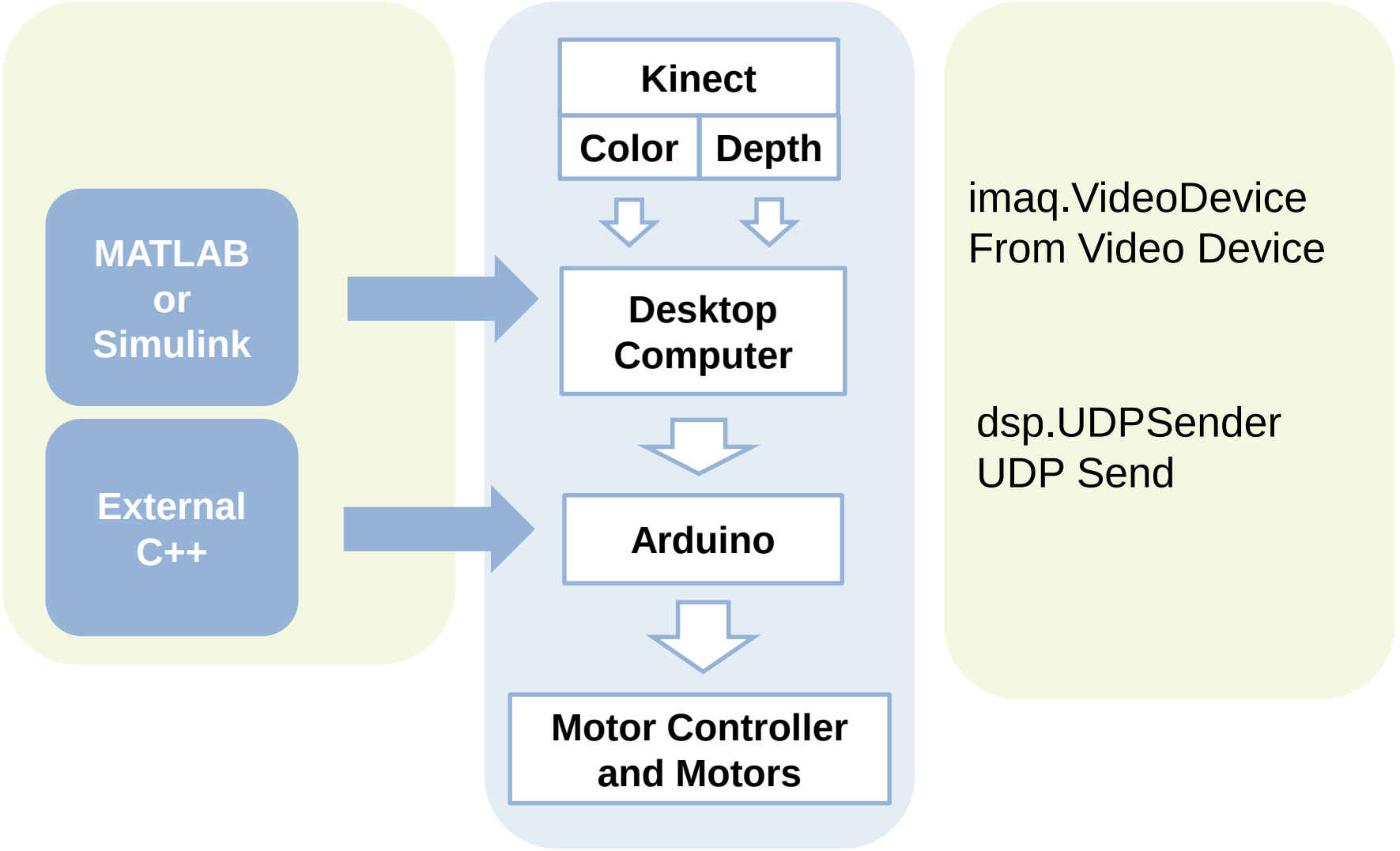
Demo 1: MATLAB with MATLAB Support Package for Arduino





http://www.mathworks.com/hardware-support/

Demo 2: MATLAB or Simulink with Executable Deployment



Deployment Options

- Both MATLAB and Simulink can be used to deploy algorithms to a Desktop Computer
- The three deployment options are:

	MATLAB	Simulink
Run in MATLAB or Simulink	Run code in MATLAB	Run code in Simulink
Generate Executable	buildExecutable using codegen and PackNGo	buildExecutable using slbuild and PackNGo
Algorithm Export	Generate C/C++ code only, use external IDE to build	Generate C/C++ code only, use external IDE to build

Algorithm Export

MATLAB Coder™ gener
generated source code i
MATLAB language featu
operations. It can genera
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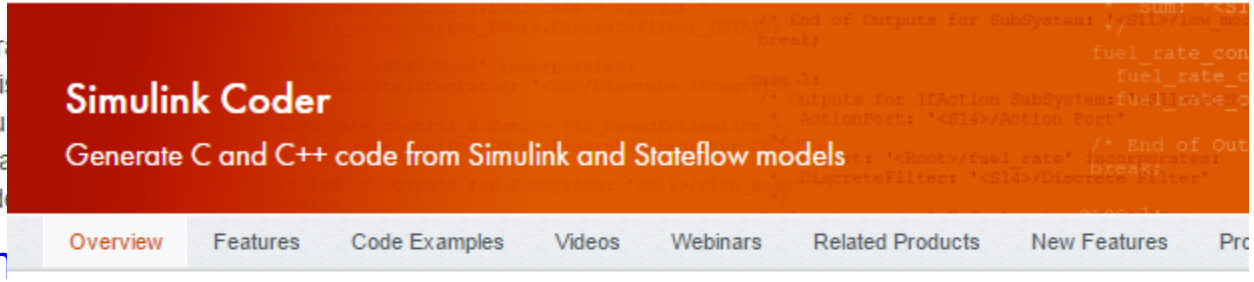
http://www.math



Simulink Coder™ (formerly Real-Time Workshop®) generates and executes C and C++ code from Simulink® diagrams, Stateflow® charts, and MATLAB® functions. The generated source code can be used for real-time and nonreal-time applications, including simulation acceleration, rapid prototyping, and hardware-in-the-loop testing. You can tune and monitor the generated code using Simulink or run and interact with the code outside MATLAB and Simulink.

http://www.mathworks.com/products/simulink-coder/

Getting Started Guide for AUVSI Foundation Competitions

- Contains examples showing how to deploy MATLAB and Simulink to a Desktop Computer

File Exchange

MATLAB App

Getting Started AUVSI

by MathWorks Student Competitions Team
04 Sep 2014 (Updated 02 Feb 2015)

Learn how to use MATLAB and Simulink to control and design algorithms for an Unmanned Vehicle System

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Code covered by the BSD License

Overview of Getting Started Guide

- Included topics
  - Video Acquisition
  - Communication i.e. udp
  - MATLAB Acceleration
  - Deployment to Executable
- Included functionality
  - buildExecutable - converts MATLAB and Simulink to deployable executable with one function call
  - Simulink Soft Real-Time block
  - dec2ascii - decimal to ascii function
  - Others…

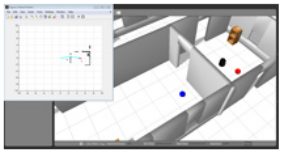
MathWorks Robotics

Robotics System Toolbox™ provides algorithms and hardware connectivity for developing autonomous mobile robotics applications. Toolbox algorithms include map representation, path planning, and path following for differential drive robots. You can design and prototype motor control, computer vision, and state machine applications in MATLAB® or Simulink® and integrate them with core algorithms in Robotics System Toolbox.

The system toolbox provides an interface between MATLAB and Simulink and the Robot Operating System (ROS) that enables you to test and verify applications on ROS-enabled robots and robot simulators such as Gazebo. It supports C++ code generation, enabling you to generate a ROS node from a Simulink model and deploy it to a ROS network.

Robotics System Toolbox includes examples showing how to work with virtual robots in Gazebo and actual ROS-enabled robots.

- Key Features
- Interactive Data Exploration
- Algorithm Design and Testing on a Robot Simulator
- Algorithm Testing on a Physical Robot
- Log File Import and Analysis
- Code Generation and Deployment
- Multiplatform and Multimaster Support for ROS



Documentation Functions Data Sheet

TRY OR BUY

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Pricing and Licensing

What's New

From Yanliang Zhang, Robotics System Toolbox Technical Expert

Hands-on Tutorial on Robotics System Toolbox at ICRA 2015

» Email Yanliang

Technical Resources

Support
Technical Articles
System Requirements

User Community

Answers
File Exchange
Link Exchange

http://www.mathworks.com/products/robotics/