

Control System Design: Getting Started with Arduino and MATLAB

Supplemental Information

The original Japanese-language version of this textbook was published in 2012, so there have been some updates and changes to various aspects that are not included in the main text. A description of these changes, at the time of writing (January 22, 2016), is detailed below, along with a table of recommended programs and products needed for the experiments.

	Recommended	Also Confirmed
OS of host PC	Windows 7 32bit	Windows 7 64bit
MATLAB/Simulink Version	R2012a	R2012a student version R2015b
MATLAB/Simulink Toolbox	Control System Toolbox (required)	
Arduino IDE	v1.01 (arduino.cc)	v1.7.8 (arduino.org) v1.6.7 (arduino.cc)
Arduino IO	Version 4.2	Version 4.5
Arduino Board	Mega 2560 R3 or Uno R3	

Programs [Section 1.5 – Source Code and Supplementary Information]

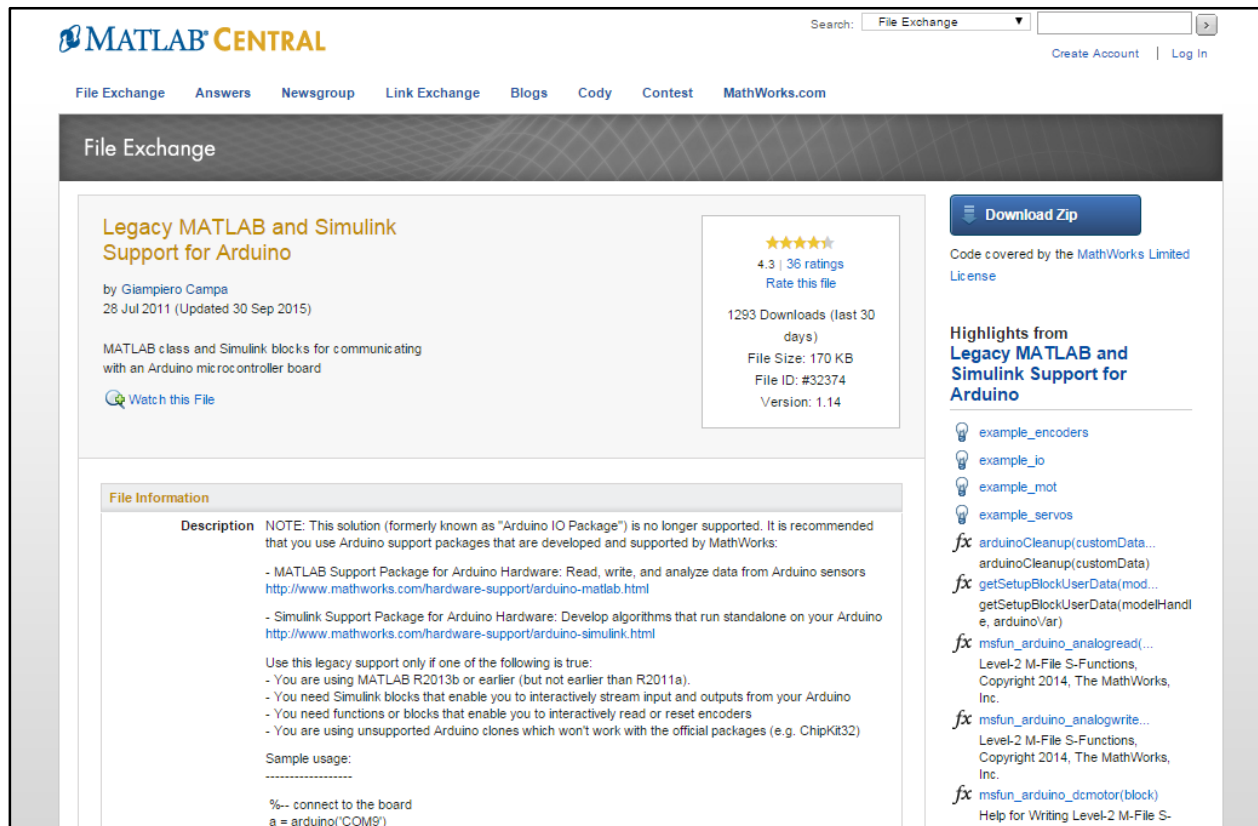
All of the scripts and Simulink models described in the book are provided and can be added to your Matlab library. Note that these programs may vary slightly from the pictures in the textbook. The main code will be the same, but wherever there is a variable that the book instructs you to change, the default number could be different than expected. *Always make sure that the variable values are the ones that you have calibrated for your setup, so that you do not damage the motors.* Additionally, the COM port selection will have to change for each Simulink model. Be aware of this when there is a Matlab Script that executes a Simulink model automatically.

Download instructions for the source code are available on the website for this book.

ArduinoIO [Section 2.5 - Installing ArduinoIO]

This package is no longer officially supported by Mathworks. However, it can still be downloaded and used normally, at the time of writing this. It is recommended for use with Matlab R2013b or earlier. At the time of writing, the latest version is 4.5, which is confirmed to work, with only a few slight differences from 4.2.

To download ArduinoIO, go to <http://jp.mathworks.com/matlabcentral/fileexchange/32374-legacy-matlab-and-simulink-support-for-arduino> and click “Download Zip” on the top right. After that, see section 2.5 of the textbook for details of installation.



The screenshot shows the MATLAB Central File Exchange page for the file "Legacy MATLAB and Simulink Support for Arduino". The page includes a search bar, navigation links, and a detailed description of the file. The description notes that the solution is no longer supported and provides links to hardware support pages for MATLAB and Simulink. It also lists sample usage code: `%-- connect to the board` and `a = arduino('COM9')`. The page features a "Download Zip" button and a list of highlights from the file, including example files like `example_encoders`, `example_io`, and `example_mot`.

<http://jp.mathworks.com/matlabcentral/fileexchange/32374> [January 20, 2016]

ArduinoIO [Section 2.5.3 – Sketch upload to Arduino]

The main difference between ArduinoIO v4.2, which is described in the textbook, and v4.5, which is the latest version, is the `adiosrv.pde` file that no longer exists. Instead of uploading that sketch to your board, you will upload `adios.pde`.

File location: `C:\Arduino\ArduinoIO\pde\adios\adios.pde`

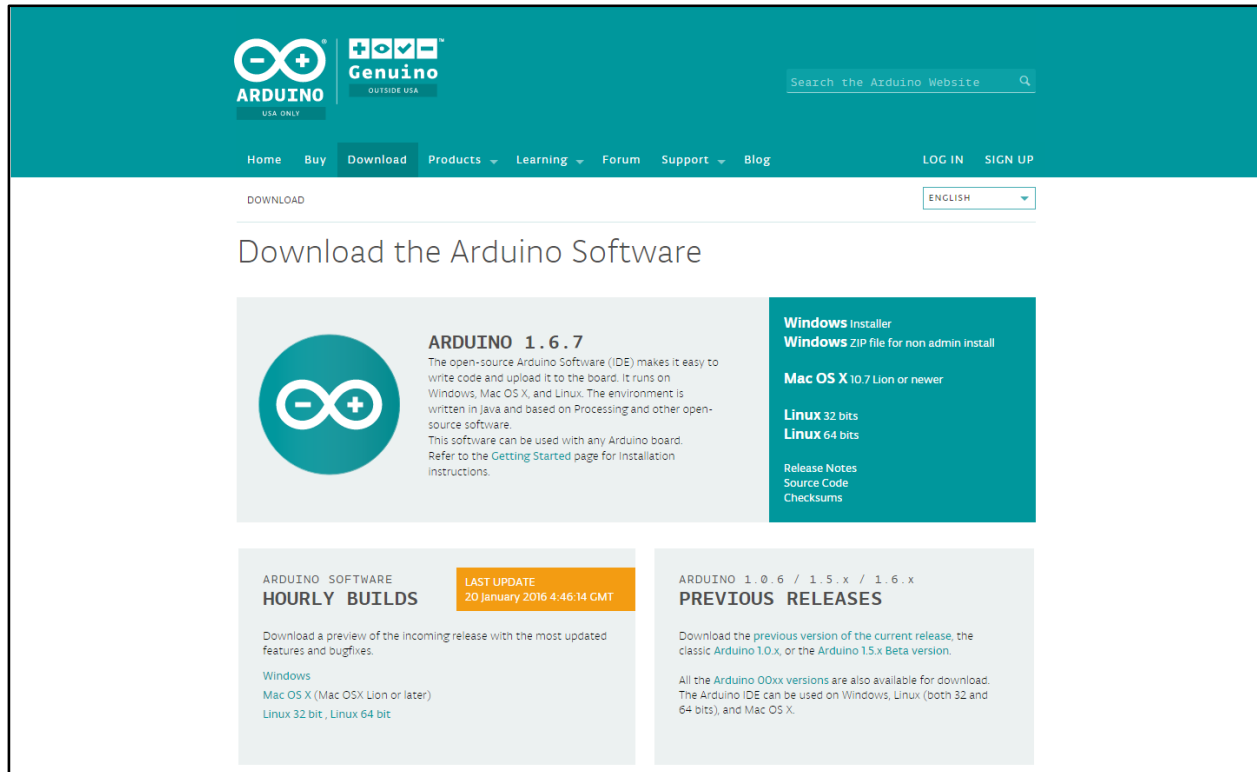
These files are almost identical. For information on how to install the Adafruit Motor Shield library in the latest version of ArduinoIO, read the `readme.txt` file in the ArduinoIO folder.

Arduino Group and Hardware [Section 1 - Introduction]

After this textbook was published, there was a split in the Arduino Group. The Italian branch (Arduino SRL) operates off of Arduino.org and the USA branch (Arduino LLC) operates off of Arduino.cc. The experimental kit uses products from Gheo SA, which has a contract with the Italian branch at the time of writing. It is unlikely that the Arduino Uno or Mega will be effected by the split, but in the case of divergence in hardware or utility, refer to the documentation on Arduino.org.

Arduino Software [Section 2.2 - Installing Arduino IDE]

There has been some divergence in the available software. To download the classic Arduino IDE 1.0.1 version described in the book, you must go to Arduino.cc, as described in section 2.2 of the textbook. However, that version of the IDE is outdated and no longer supported by the development team. The oldest release available on Arduino.org is 1.0.6.1.



The screenshot shows the Arduino Software download page. The header includes the Arduino logo (USA ONLY) and the Genuino logo (OUTSIDE USA). A search bar is present in the top right. The main navigation menu includes Home, Buy, Download, Products, Learning, Forum, Support, and Blog. The page title is "Download the Arduino Software". The main content area features a large section for "ARDUINO 1.6.7" with a description: "The open-source Arduino Software (IDE) makes it easy to write code and upload it to the board. It runs on Windows, Mac OS X, and Linux. The environment is written in Java and based on Processing and other open-source software. This software can be used with any Arduino board. Refer to the Getting Started page for Installation instructions." To the right of this section are links for "Windows installer", "Windows ZIP file for non admin install", "Mac OS X 10.7 Lion or newer", "Linux 32 bits", and "Linux 64 bits", along with "Release Notes", "Source Code", and "Checksums". Below this are two smaller sections: "ARDUINO SOFTWARE HOURLY BUILDS" with a "LAST UPDATE 20 January 2016 4:46:14 GMT" badge, and "ARDUINO 1.0.6 / 1.5.x / 1.6.x PREVIOUS RELEASES".

Arduino LLC (USA) website, www.arduino.cc/en/Main/Software [January 20, 2016]

The most recent release available at the time of writing is 1.7.8. To download this, visit <http://www.arduino.org/software>. Note that the textbook only has instructions for Arduino IDE, not Arduino Studio, or any other new development environment. Once you download the zip, the instructions for installation are the same as described in section 2.2 of the textbook.

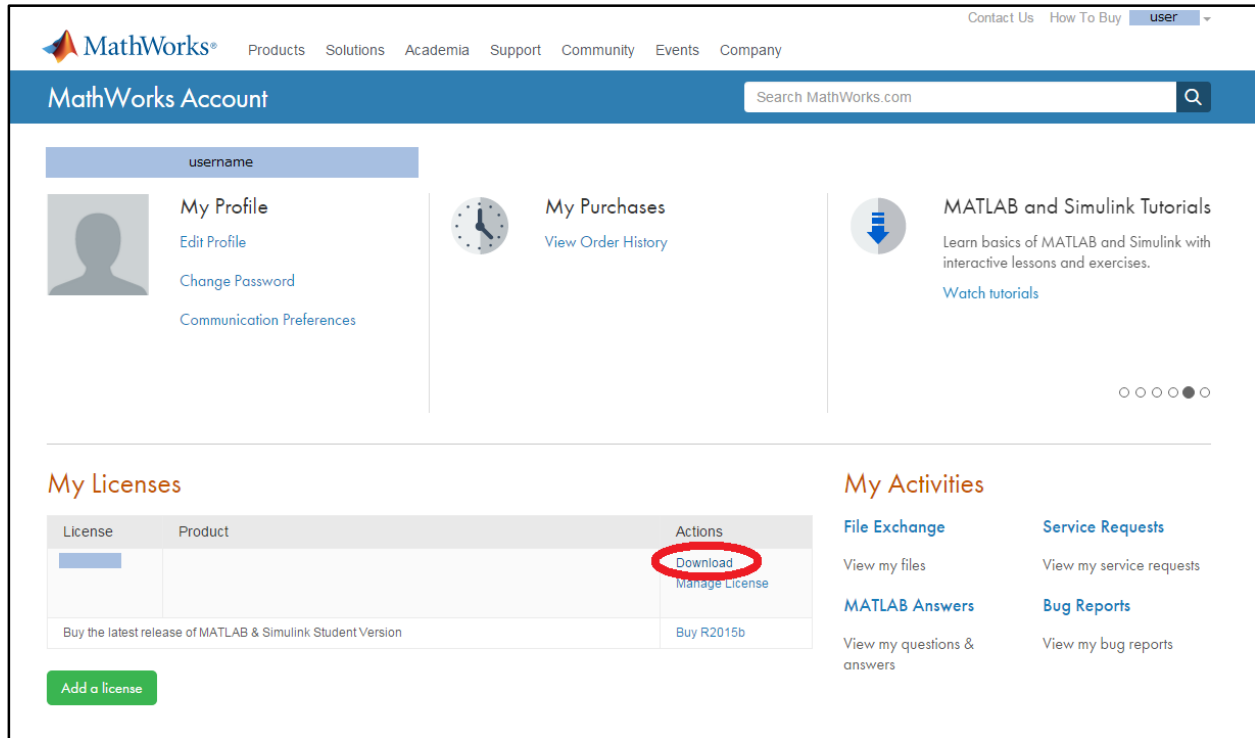
The screenshot shows the 'Software' section of the Arduino website. On the left is a navigation menu with links for HOME, PRODUCTS, DISTRIBUTORS, SOFTWARE, BLOG, MAKERS, LABS, and STORE. The main content area features the Arduino logo at the top, followed by the 'Arduino IDE' section. This section includes a description of the IDE, the version 'v1.7.8', and a list of download links for Windows (Installer and ZIP file) and Linux. Below this is a link to the 'Arduino IDE LABS Page' and a button for the 'Arduino IDE Forum'. The 'Arduino Studio' section is also visible, describing it as a new development environment with version 'v0.0.5 alpha'. Social media icons for Facebook, Twitter, and YouTube are located in the top right corner.

Arduino SRL (Italy) website, <http://www.arduino.org/software> [January 20, 2016]

If you use Arduino IDE v1.6.1 or later from Arduino.cc with your board from the experimental kit, you may get a message that says “This board comes from an uncertified manufacturer. We won’t be able to provide any support if it doesn’t work as expected.” This is because of the Arduino group differences. It is still safe to use the board and the IDE together.

Matlab [Section 1.4 - Environment for Implementing the Content]

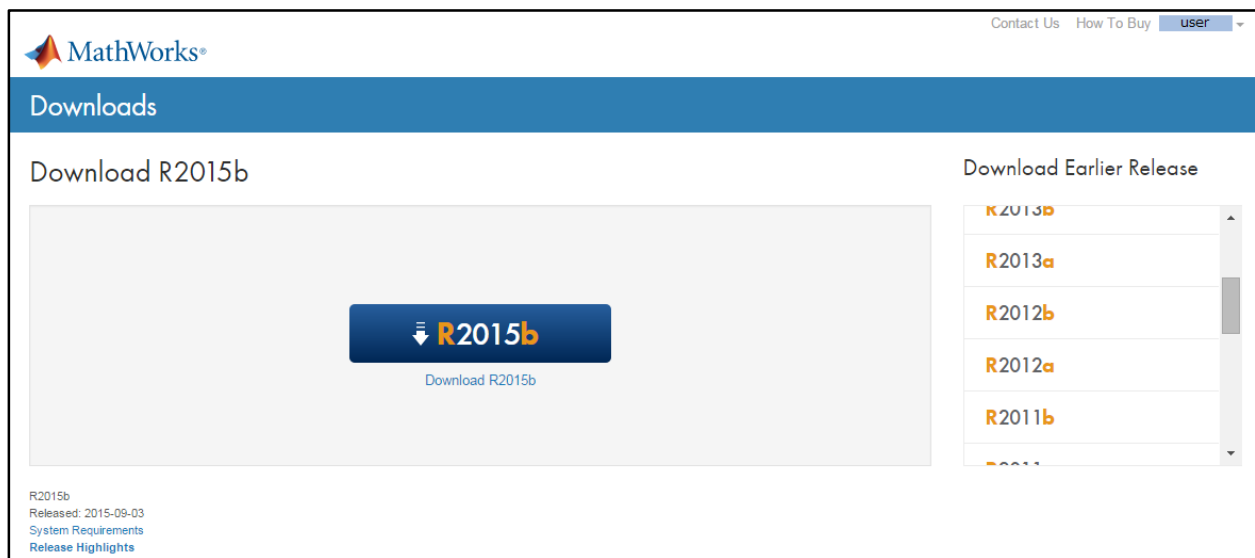
In order to download a previous version of Matlab, log into your Mathworks account and go to “my account” at <https://www.mathworks.com/mwaccount/>. Go to the downloads section and click on “Download Products.” There should be a “Download Earlier Release” option on the right side of the page at https://www.mathworks.com/downloads/select_release, where you can choose R2012a, the version of Matlab described in the book.



The screenshot shows the MathWorks Account page. The navigation bar includes the MathWorks logo, a search bar, and links for Contact Us, How To Buy, and a user profile dropdown. The main content area is divided into sections: My Profile (with links for Edit Profile, Change Password, and Communication Preferences), My Purchases (with a View Order History link), and MATLAB and Simulink Tutorials (with a Watch tutorials link). Below these are My Licenses and My Activities. The My Licenses section contains a table with columns for License, Product, and Actions. The 'Download' button in the Actions column is circled in red. The My Activities section includes links for File Exchange, Service Requests, MATLAB Answers, and Bug Reports.

License	Product	Actions
	Buy the latest release of MATLAB & Simulink Student Version	Download Manage License
		Buy R2015b

<https://www.mathworks.com/mwaccount> [January 20, 2016]



The screenshot shows the MathWorks Downloads page. The navigation bar includes the MathWorks logo, a search bar, and links for Contact Us, How To Buy, and a user profile dropdown. The main content area is divided into sections: Download R2015b (with a large blue button labeled 'Download R2015b') and Download Earlier Release (with a list of previous versions: R2015b, R2013a, R2012b, R2012a, R2011b). The 'Download R2015b' button is highlighted.

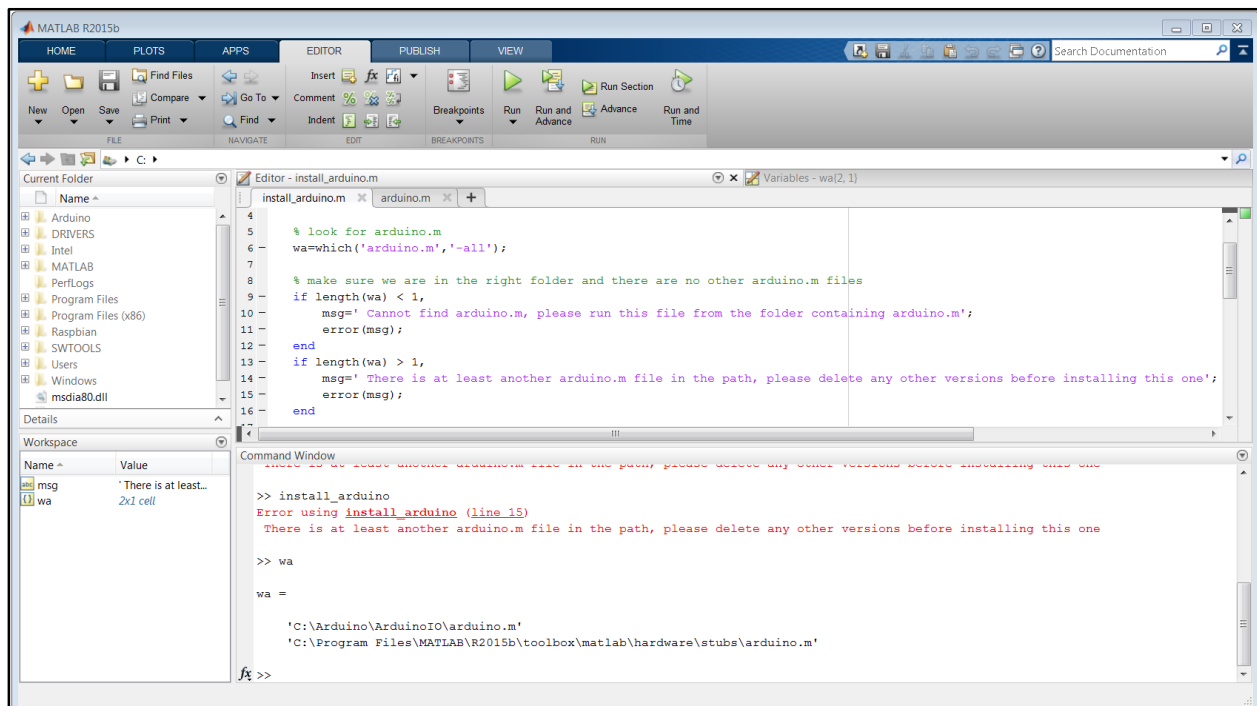
https://www.mathworks.com/downloads/select_release [January 20, 2016]

Matlab [Section 2.5.2– Setting MATLAB/Simulink]

If you choose not to downgrade to an older version of MATLAB, there are some compatibility issues that you will have to fix. At the time of writing, all of these issues are fixable in R2015b.

When you run the *install_arduino* script, the Matlab Toolbox folder may already have a file named *arduino.m* so you will get an error that says “*There is at least another arduino.m file in the path, please delete any other versions before installing this one.*” After running *install_arduino*, there will be a variable called “*wa*” that holds the file location names of each instance of the name “*Arduino.m*”. Type “*wa*” into the command line to view this location. You will need to remove it from the path.

Navigate the “Current Folder” window in MATLAB to the folder you want to add or remove from the path. Only files in the path will be executable. You can only add/remove folders, not individual files, in the path. To add/remove in the path, right click on the desired folder, and select the appropriate option. You can also use the “Set Path” window, which you can find in the “HOME” tab in MATLAB.



The screenshot shows the MATLAB R2015b interface. The Editor window displays the `install_arduino.m` script with the following code:

```
4
5 % look for arduino.m
6 wa=which('arduino.m','-all');
7
8 % make sure we are in the right folder and there are no other arduino.m files
9 if length(wa) < 1,
10     msg=' Cannot find arduino.m, please run this file from the folder containing arduino.m';
11     error(msg);
12 end
13 if length(wa) > 1,
14     msg=' There is at least another arduino.m file in the path, please delete any other versions before installing this one';
15     error(msg);
16 end
```

The Command Window shows the execution of `install_arduino` resulting in an error:

```
>> install_arduino
Error using install_arduino (line 15)
There is at least another arduino.m file in the path, please delete any other versions before installing this one

>> wa

wa =

'C:\Arduino\ArduinoIO\arduino.m'
'C:\Program Files\MATLAB\R2015b\toolbox\matlab\hardware\stubs\arduino.m'
```

The Workspace window shows the variables `msg` and `wa` with their respective values.

MATLAB *arduino.m* error message [January 22, 2016]

The Simulink library may be in *.mdl* format, but it needs to be in *.slx* format for some newer versions of MATLAB. Open your Simulink library browser and click the error message at the top of the window that should show up if you have this issue. Follow the instructions onscreen to update the file type. You can also do this manually from the folder location. The Simulink models in the source code folders will not load properly until this is done.

Note that during simulations run from Simulink, you will not see status messages in the command line. Instead, you can view them in the “Diagnostic Viewer”