Report template Lab 4

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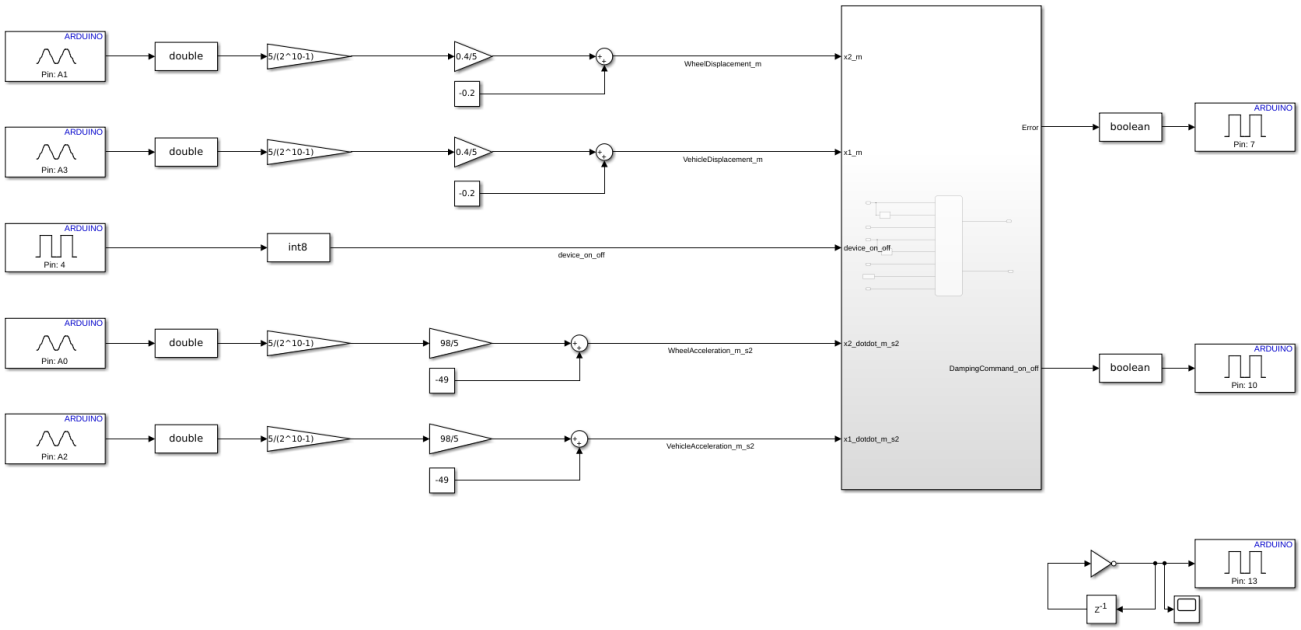

I/O interfaces

The controller implemented in Arduino is reading some voltages from the analog input ports that simulate the measurements taken by the sensors of displacement and acceleration needed by the Skyhook controller. The Raw value of voltage is then converted in Vin transforming the value range from 0-1023 to 0-5 then is mapped via a suitable transformation in displacement or acceleration. For the displacement it is assumed that the value can vary from 0.2 to -0.2 m while the acceleration is estimated to vary from 49 m/s2 to -49 m/s2 ($\pm\ 5G$).

Name	Unit	Type[4]	Conversion formulas	Min[5]	Max
x2 (Wheel Displacement)	m	AI	$RAW * \frac{5}{2^{10}-1} * \frac{0.4}{5} - 0.2$	0.2	-0.2
x1_dotdot (Wheel Acceleration)	m/s^2	AI	$RAW * \frac{5}{2^{10}-1} * \frac{98}{5} - 49$	49	-49
x1 (Vehicle Displacement)	m	AI	$RAW * \frac{5}{2^{10}-1} * \frac{0.4}{5} - 0.2$	0.2	-0.2
x2_dotdot (Vehicle Acceleration)	m/s^2	AI	$RAW * \frac{5}{2^{10}-1} * \frac{98}{5} - 49$	49	-49
device_on_off		DI		N.A	N.A
Error		DO		N.A	N.A
DampingCommand_on_off		DO		N.A	N.A

4

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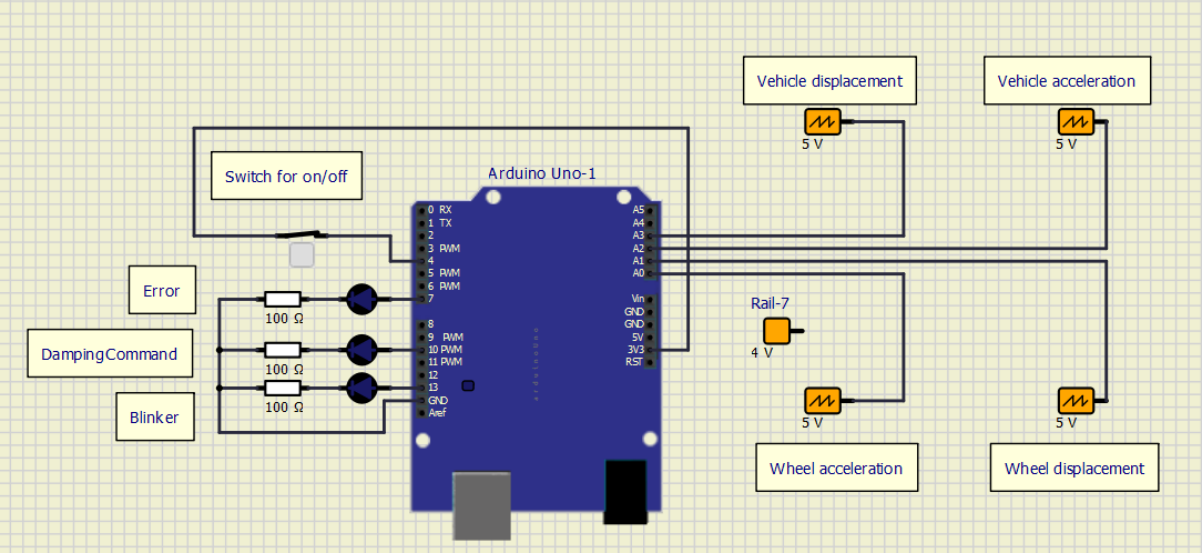
Code generation for Arduino

At a first instance we tried to generate a controller working at 1 kHz, but we verified that it misses some iterations, so we decided to implement it at a lower frequency (100 kHz). In this way we obtained that the check of the error is no longer performed each 0.02 sec but each 0.2 sec.

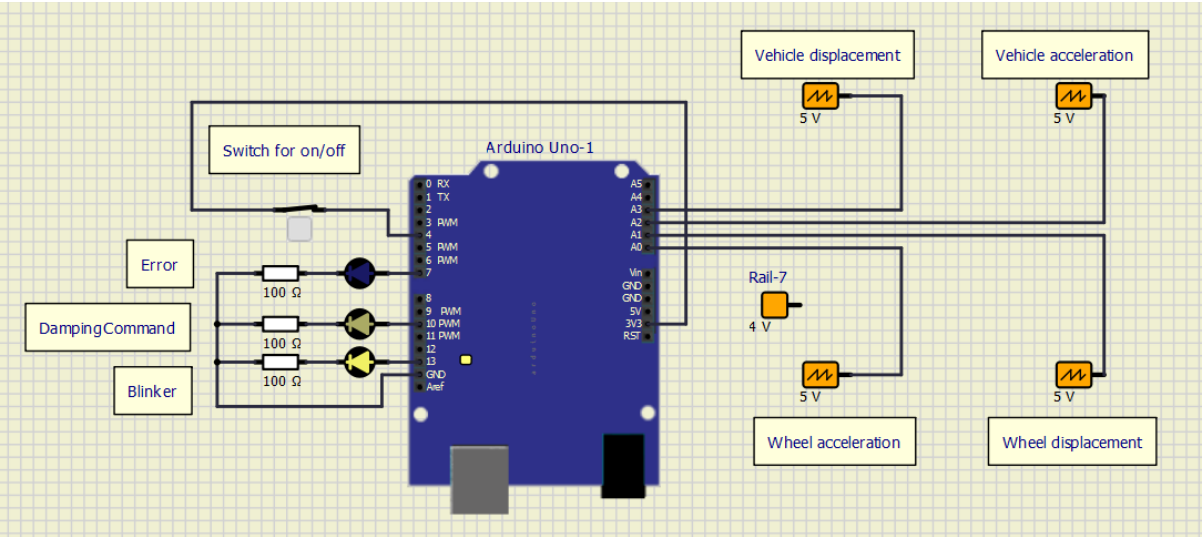
Since it has to be deployed on an Arduino Uno board, we selected the appropriate toolchain in the parameters of the model and we selected Arduino Uno as board of deployment.

Harness



We implemented the firmware with the following setup. As we can see to highlight the values of error and damping we implemented two led that are high or low depending on the value of the Boolean variable. The device_on_off is implemented using a switch which will be closed to activate the controller and open when the controller logic is shut down.

Test stimuli



The system is stimulated with four sine waves to simulate the measurements. They are at a frequency of 3.3 and 7.3 so that the waves are never in phase and we can observe either the activation of the high damping coefficient (Ch) and the activation of the lower damping

coefficient (Cl). If we want to simulate an error it is only needed to disconnect a sine wave or substitute it with a constant value. As we can see, in case of error, the value of the damping coefficient, when the device is on, is set to Ch (HIGH) and the error is correctly reported by the first led .