LABWORK
ELECTRIC SCOOTER HARDWARE-IN-THE-LOOP

1 OBJECTIVES

The objective of this coursework is to implement a Control Harware-in-the-Loop (HIL) testing platform for an electric scooter. This platform will be used to test scooter traction control algorithms without the need of a real plant.

Figure 1 shows the structure of the HIL platform. The device under test will be the embedded traction controller of the electric scooter. In this case, it is a Texas Instruments F28379d launchpad. In this board, the control will execute in real time.

In order to the controller to work under real operation conditions, the plant will be simulated in real time with a twin control board. This board will be responsible for:

- Measuring the control signals given by the controller.
- Solving the dynamic equations of the plant in real time.
- Giving the controller the signals that needs to execute the control properly.

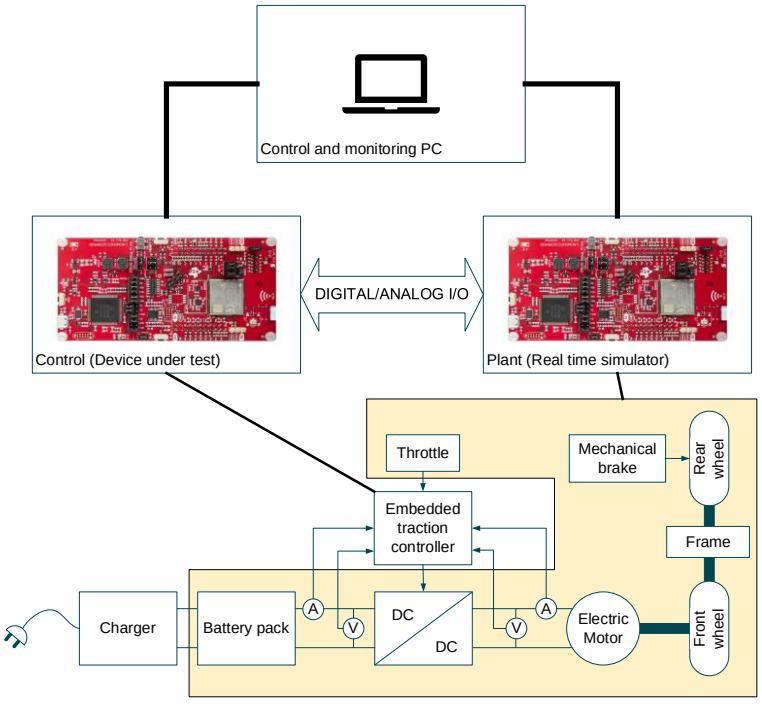

Figure 1 HIL platform architecture

All the software will be developed using MATLAB & Simulink and its Embedded Coder. The operation of the platform will be controlled and monitored also with Simulink from a host PC.

The learning outcomes of this coursework are:

- Understand the working principle of HIL platforms and real time simulations.
- Identify the main steps for the implementation of a HIL platform.
- Learn the procedure for the validation of a HIL platform.

2 TASKS

All the tasks described in the following sections shall be performed using a MATLAB project.

The simulation files needed to implement the HIL platform are available in GitHub. The MIL simulation used in the architecture coursework may be used as baseline for result comparison.

The work will be done in pairs. Each member of the pair will have a different role. One will be in charge of the controller and the other of the plant simulator.

2.1 Obtain MIL simulation results

Analyse the MIL simulation and understand the control structure.

Run the MIL simulation, identify its outputs and obtain the results under different operation conditions. These results will be used afterwards to validate the HIL platform.

2.2 Commissioning of the HIL platform

With these resources the tasks to be performed are:

- Analyse HIL simulation files (control, plant and host) and understand the software architecture of the HIL platform.
- Prepare the HIL hardware.
- Compile, build and execute real time models.

2.3 Verify the HIL platform

Taking as a reference the operation conditions established in section 2.1, compare the results of the HIL platform with the ones obtained in the MIL platform.

Analyse the results and justify any discrepancy found between different simulation platforms.

3 DELIVERABLES

In order to evaluate this coursework, a MATLAB project shall be delivered.

This project will contain:

- A Livescript report describing how the operation of the HIL platform has been verified. Comparison of the test results in MIL and HIL.
- All the files needed to execute the MIL and HIL simulations.

The HIL platform files should be integrated in the architecture exercise project and delivered together.

4 EVALUATION CRITERIA

The mark of this exercise will be integrated in the mark of the architecture exercise. The weight of this part will be 2 points evaluated by:

- Description of the process to convert the MIL simulation in a HIL simulation.
- Comparison of the test results in MIL and HIL.