0.0.1 Root

The top level of the model, also known as the model root, is depicted in Figure 0.1.

The model root is contains the three primary components of the system:

- Plant
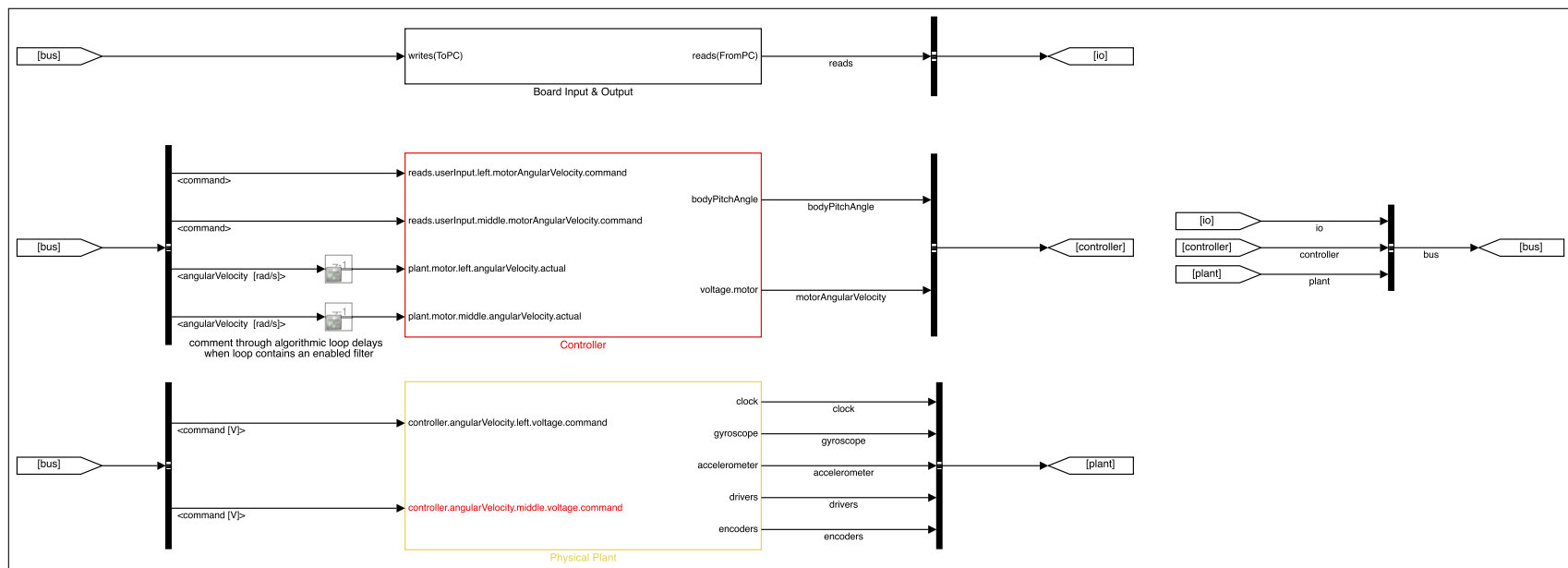- Controller
- Board Inputs and Outputs

Figure 0.1: [Simulink]: Root

0.0.1.1 Bus Structures

Bus structures are a means of routing large quantities of signals. They are similar to muxed signals; however, it is not necessary to separate all of the signals during the demux process.

It is evident in Figure 0.1 that all of the components are passed into separate bus structures, [*black bars on the right-side of the figure*], and that those bus structures are in turn merged into one global bus structure.

This grants the user the ability to call any significant signal wherever it is needed using bus selectors, [*black bars on the left-side of the figure*]. The user should take care to implement a delay in the path of any signal which is implemented recursively [*as feedback*]. [*This prevents the formation of an algebraic loop*].

0.0.1.2 Variant Subsystems

A variant subsystem is a subsystem containing multiple subsystems, defined as variants. Only one variant can be active at one time. The variant subsystem serves as the switch between them. [*Note that the variant subsystem cannot switch between variants during operation/runtime*].

Several subsystems contained in this model are variant subsystems. These variant subsystems are used to switch system configurations. Examples of these variant configurations include:

- The plant:
  - Actual hardware drivers. [*Hardware implementation only.*]
  - Hardware-equivalent simulation model of nonlinear dynamics. [*Simulation only.*]
  - Hardware-equivalent simulation model of linear dynamics. [*Simulation only.*]

- The controller design:
  - PID. [*Primarily for initial hardware characterization.*]
  - Optimal.
  - Pole-placement.