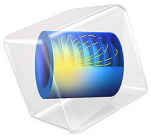

Add-in created in COMSOL Multiphysics 6.4

State-Space Controller

Introduction

A state-space representation of a physical system is constructed as a mathematical model. The model consists of input, output, and state variables related by first-order differential equations. Of specific interest in this case are time-invariant state-space models, which take the general form

$$\dot{x}(t) = Ax(t) + Bu(t),$$

$$y(t) = Cx(t) + Du(t),$$

where the state-vector $x(t)$, output-vector $y(t)$, control-vector $u(t)$, as well as B, are all vectors, and A, C, and D are matrices. Furthermore, in time-invariant state-space models, A, B, C, and D are time invariant. In the case where $D = 0$ the system can easily be controlled by letting $u(t) = -Lx(t)$ be a scalar input-variable, where L is a vector of compatible dimension. If the system is controllable, the poles of the closed-loop system can be placed at a desired location in the left half of the complex plane. Since the pole locations correspond directly to the behavior of the system, placing them can be of great interest.

You can use the State-Space Controller to place the poles of any system which is controllable, by defining the matrices A and C, the vector B, as well as initial conditions to the system, and where to place the poles. The add-in is imported from the COMSOL Multiphysics Add-in Library, and added to the model from the **Add-ins** menu on the **Developer** tab.

Add-in Library path: `COMSOL_Multiphysics/state_space_controller`

Once you have defined all parameters, click the **Create** button ( ) to add a 0D component that implements the controller using global equations. When the creation of the State-Space controller is successful, you get a message about the available output variables.

EQUATIONS

This section displays the state-space equations, with the variables to be defined.

DIMENSION

Here, you select the dimension of the system you want to set up.

VARIABLES

Before applying the State-Space controller you must define the matrices A and C, the vector B, as well as initial conditions to the system, and decide where to place the poles.

INFORMATION

This section displays information about the name of the output variables, as well as the 0D component that defines the state-space controller.