Behavior of Pulsed and Proportional Thrusters

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42 supports two modes of thruster operation. Each thruster is designated as either PULSED or PROPORTIONAL in its definition in the SC_ input file. This note compares the commanding and response of the two modes.

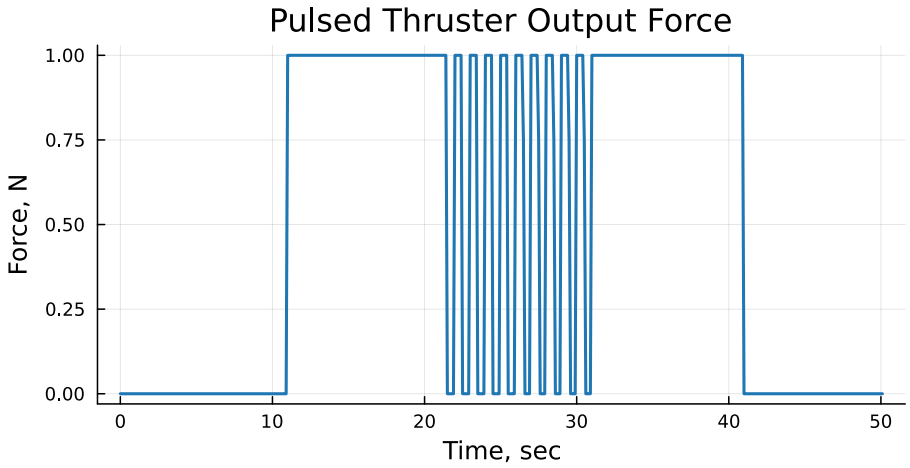
A pulsed thruster has a constant thrust level, and is commanded by setting a pulsewidth command, SC[-].AC.Thr[-].PulseWidthCmd, in your flight software model. The pulsewidth command is in units of seconds. A proportional thruster may vary its thrust level, and is commanded using the variable SC[-].AC.Thr[-].ThrustLevelCmd, also provided in your flight software model. The thrust level command is the fraction of the maximum thrust desired, ranging from 0.0 to 1.0.

These variables are also available as commands in the command script (eg. Inp_Cmd.txt). We'll use those commands for this demonstration. For this demonstration, these commands were executed:

```
10.0 SC[0].AC.Thr[0].PulseWidthCmd = 1.0
10.0 SC[0].AC.Thr[1].ThrustLevelCmd = 0.75

20.0 SC[0].AC.Thr[0].PulseWidthCmd = 0.5
25.0 SC[0].AC.Thr[0].PulseWidthCmd = 0.575

30.0 SC[0].AC.Thr[0].PulseWidthCmd = 1.0
30.0 SC[0].AC.Thr[1].ThrustLevelCmd = 0.25

40.0 SC[0].AC.Thr[0].PulseWidthCmd = 0.0
40.0 SC[0].AC.Thr[1].ThrustLevelCmd = 0.0
```

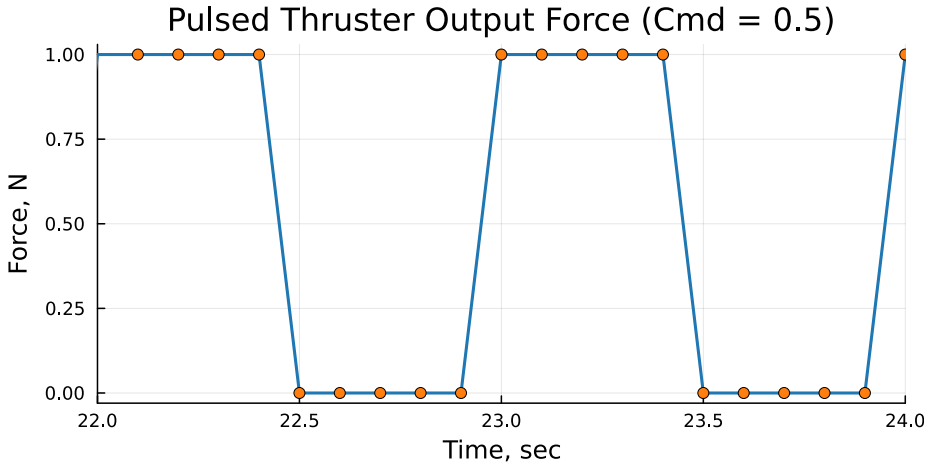
The simulation timestep is 0.1 sec. The flight software timestep is 1.0 sec. The data plotted below is logged at 0.1 sec. Thr[0] is a pulsed thruster, and Thr[1] is a proportional thruster. Both thrusters have a maximum force output of 1.0 N.

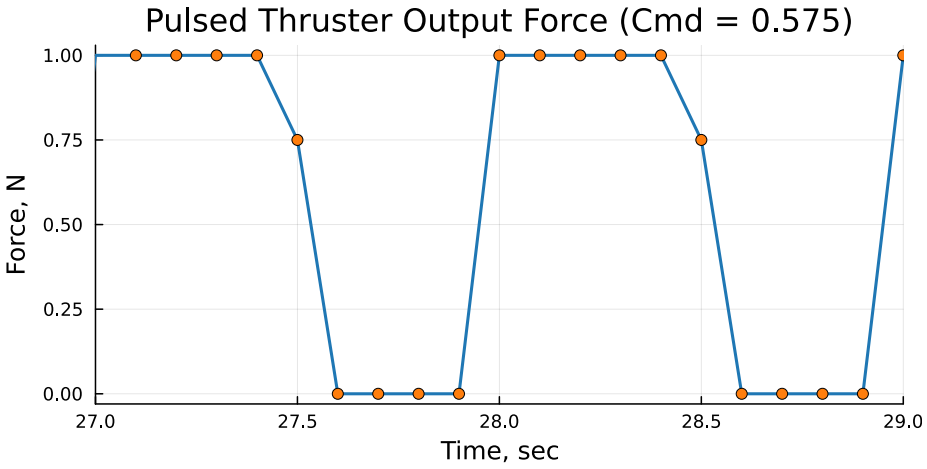
Pulsed Thruster Response



When the thruster pulsewidth command is equal to (or greater than) the FSW timestep, the thruster stays on continuously. When the pulsewidth command is less than the FSW timestep, the thruster force is full on for a fraction of the FSW timestep, and off for the remainder.

Note that there is a one-second delay from the command to the thruster output. This is because it takes one FSW cycle to copy the command to the thrusters.

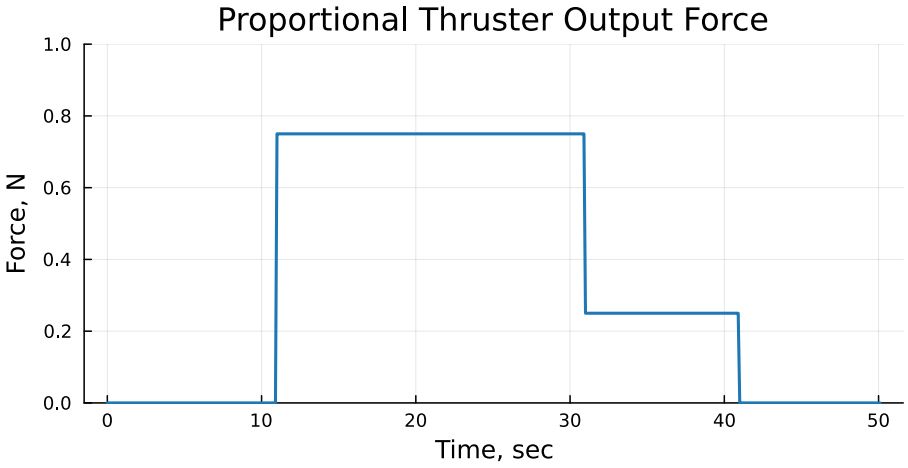




When the pulsewidth command is a non-integer number of simulation timesteps, the tail of the response is scaled so that the correct total impulse is delivered.

The thruster force is always held constant over the duration of a simulation timestep.

Proportional Thruster Response



A proportional thruster scales its maximum output force by the ThrustLevelCmd. It maintains its commanded thrust level until the command is changed.