Spacecraft Control Toolbox Version 7.0
Three Axis Control

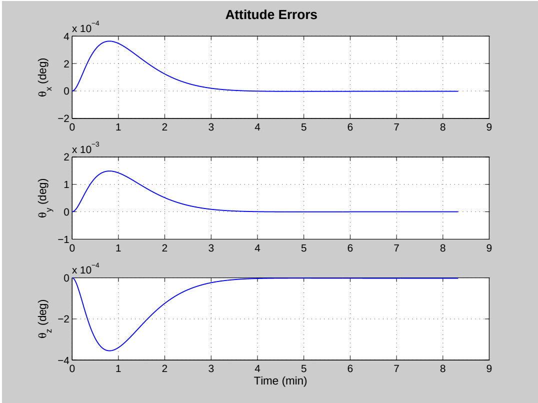
Most modern spacecraft use 3-axis control systems. Three axis control requires 3-axis attitude information and control over all three axes. Reaction wheels are often used for 3-axis control but in spacecraft that are required to make changes in the orbit an all-thruster control system is often required. Some form of momentum unloading system is also required for a spacecraft using momentum exchange devices since secular torques will cause a momentum build-up. This can be done with magnetic torquers in earth orbiting satellites but if the spacecraft has a stationkeeping requirement (which is the case with all geostationary spacecraft) then the propulsion system can also be used to unload momentum.

Three Axis Control Script

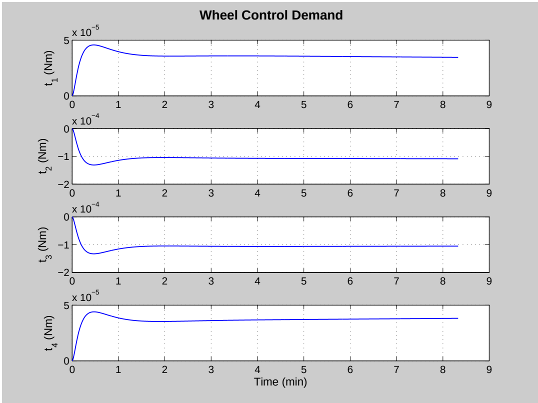
`ThreeAxisControl.m` performs a design and simulation of a 3-axis control system that can use either reaction wheels or thrusters. The controller in both cases is a PID controller. The control automatically handles inertia cross-coupling. The simulation assumes that an attitude quaternion is available. Control is about a nominal earth-pointing, or inertial attitude. The latter is for transfer orbits. The spacecraft has 4 wheels in a pyramid and 16 hydrazine thrusters for attitude control. Four of those thrusters are on the same panel as the LAE (liquid apogee thruster) and are only used during transfer orbit. The 3-axis torque demand is converted to reaction wheel torque demand using a pseudo-inverse. The same demand is converted to thruster pulsewidths using simplex. Simplex can accommodate thrusters that are simultaneously being used for stationkeeping by off-pulsing those thrusters. It can also handle the thruster max constraint and will fire more thrusters if one saturates.

The script automatically calculates the spacecraft inertia from a list of components. It also computes the solar pressure disturbance, which is the major source of attitude disturbances in geosynchronous orbit.

A typical transient response is shown. The dynamical model is a full nonlinear model but the response looks very linear, as it should for small angle control.



The wheel torque demand is also shown. As is evident, the wheels will spin up (since there is a bias disturbance) and require momentum unloading at regular intervals.



Upgrading to Version 7.0

If you have purchased or upgraded the Spacecraft Control Toolbox within the last year, you will receive this release for free. Prior customers should contact us for their upgrade price.

For More Information

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