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SUN-AVOIDANCE SLEW PLANNING ALGORITHM WITH POINTING AND ACTUATOR CONSTRAINTS

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A sun avoidance slew maneuver is described in this paper. The algorithm finds the angular velocity, angular acceleration, and quaternion profiles needed to avoid the sun vector that lies near the plane of a sensor's FOV onboard a spacecraft.

SIMULATION

A simulation is shown in the following figures. The initial, final, and sun position vectors were randomized for each run.

ϕ_1, ϕ_2, and ϕ_3 were found using the methods discussed in the algorithm description. Several intermediate frames had to be calculated for the simulation to run. In addition to the slew plane, a sun-to-position frame was constructed in order to calculate the path that the spacecraft takes around the sun vector. SP This path had to be traced by rotating the vector that connects the sun and P_1 vectors, which is the green line on the right in the figure below and will be called V. V was rotated from P_1 to P_2 by angle ϕ_2.

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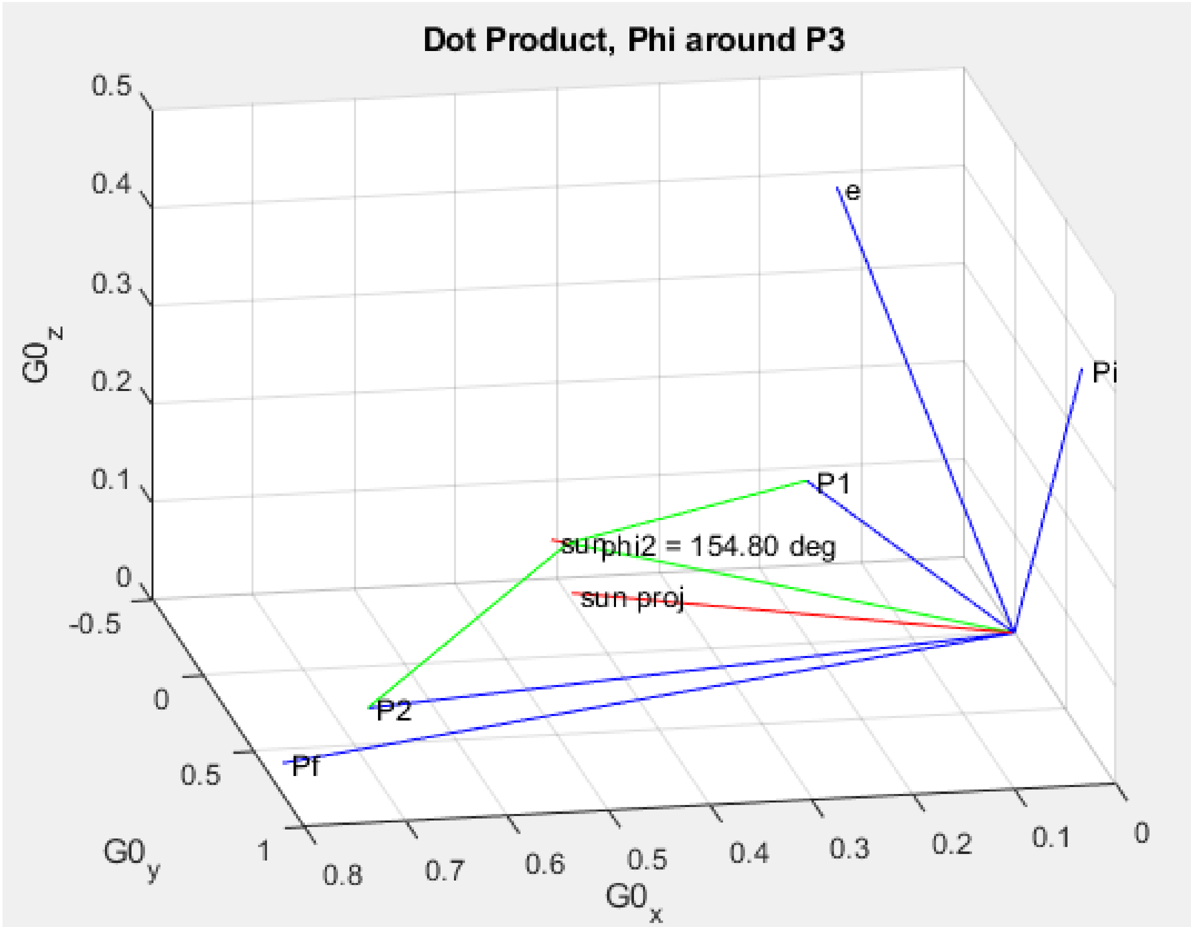

Figure 1. Chord geometry for finding ϕ_2

For the first leg of the slew, the spacecraft was rotated around the eigenaxis of the slew plane by ϕ_1. For the second leg of the slew, the spacecraft was rotated around the sun vector fixed in inertial space by ϕ_2. For the third leg of the slew, the spacecraft was rotated around the eigenaxis of the slew plane by ϕ_3. The attitude generated would look like the profile in Figure .

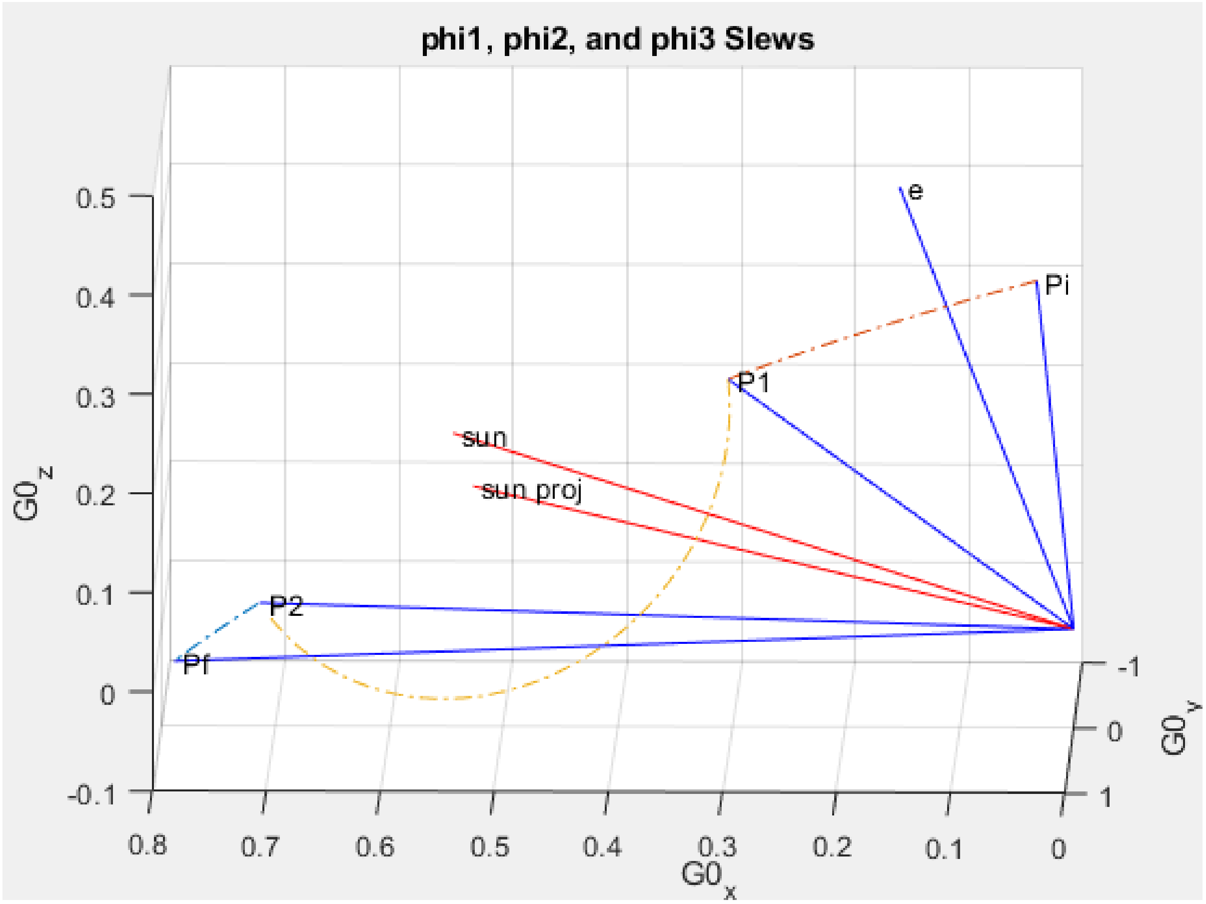

Figure 2. Attitude Profile of the Entire Slew

From randomizing the initial, final, and sun position vectors for this simulation, the values of ϕ were found and listed in the table below. The angular velocity and acceleration never exceeded the velocity and acceleration constraints for any axis. There is no noise modeled in the actuator system, as the purpose of this simulation was to validate the slewing maneuvers described by the algorithm.

Table 1. Slew Angles ϕ_1, ϕ_2, and ϕ_3

ϕ	1	2	3
Angle (rad)	0.29	2.70	0.13
Angle (deg)	16.61	154.80	7.33

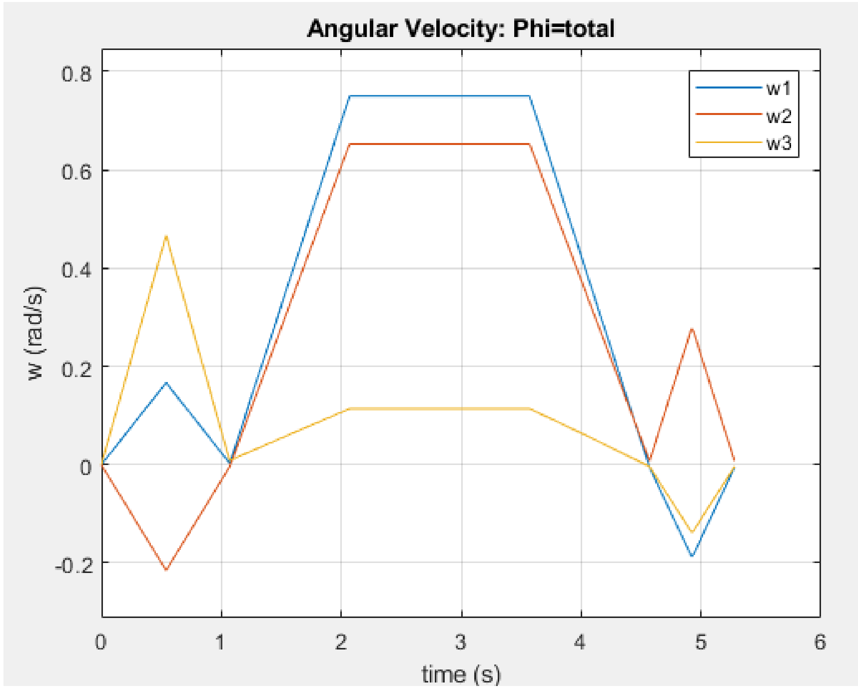

Figure 3. Angular Velocity in Spacecraft Frame

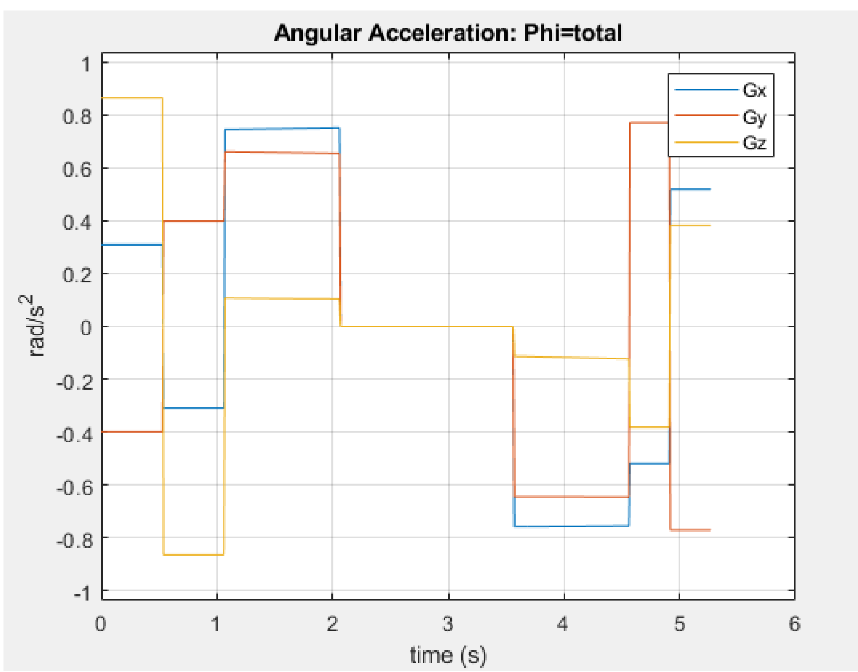

Figure 4. Angular Acceleration

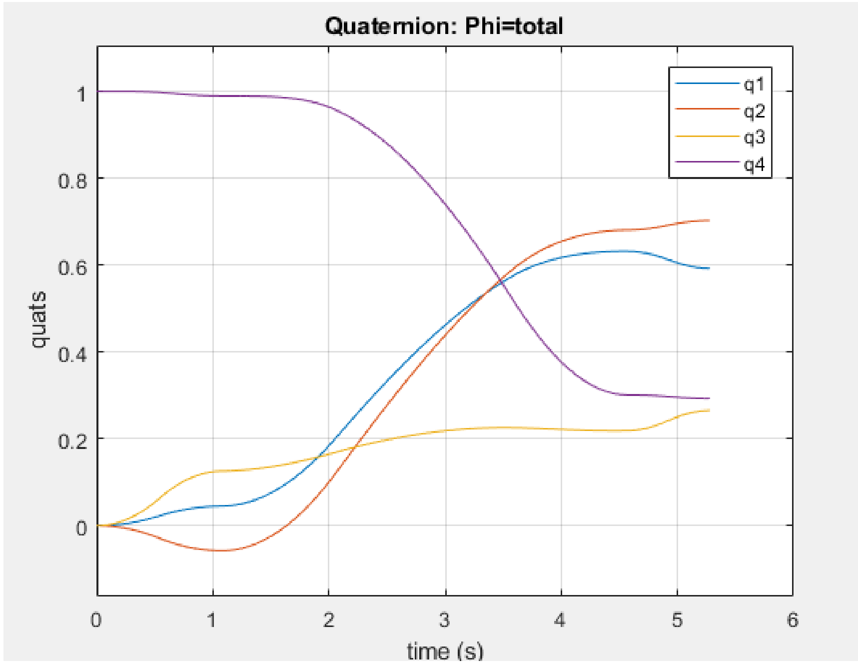

Figure 5. Quaternion Attitude

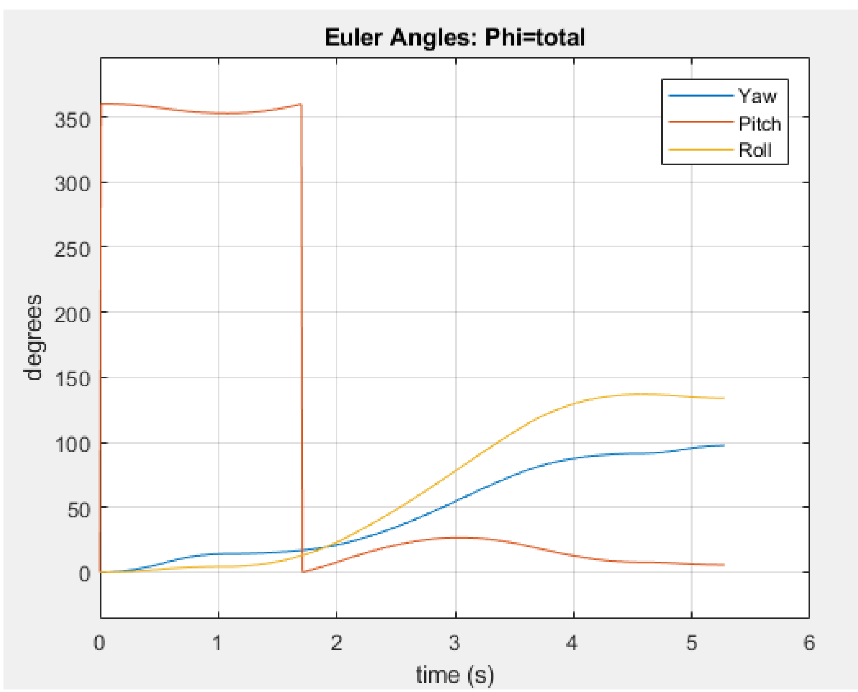

Figure 6. Attitude in Euler Angles

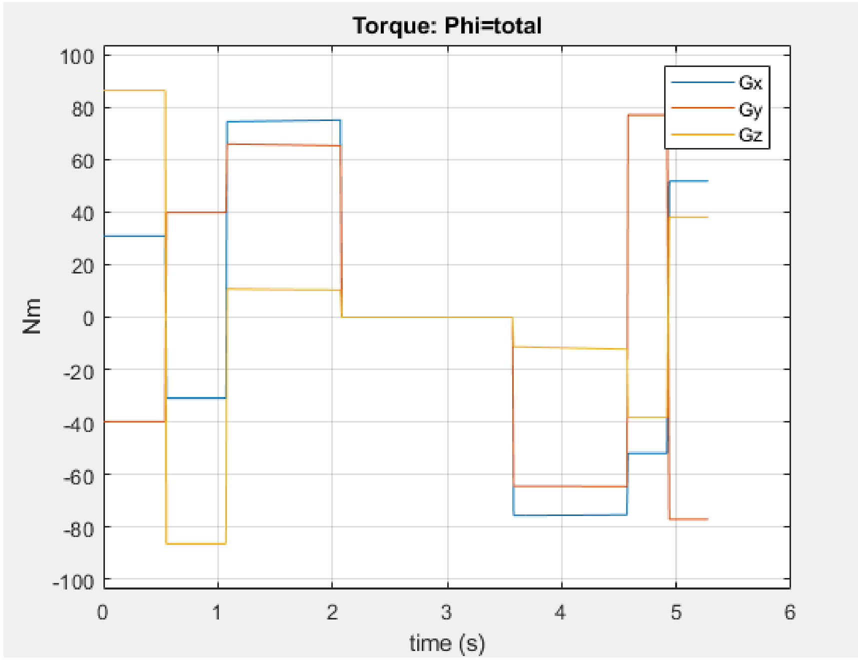

Figure 7. Torque Applied from Actuator System