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AERSP 304 Project 1

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Discussion of MATLAB Results

Chart

Description automatically generatedChart, diagram

Description automatically generated with medium confidence

Figure 1 Figure 2

Fig (1) and (2) are the plots of the trajectories of a space craft at Lyapunov Orbit at L2 in a body frame and inertial frame respectively. The body frame plot was calculated in MATLAB using numeric analysis from the given equation (7) and (8) utilizing ODE45 in MATLAB. From the body frame, the inertial frame can be found for each time step with the DCM CNB.

Diagram

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Figure 3 Figure 4

Fig (3) and (4) are the plots of the trajectories of a space craft at Lyapunov Orbit at L4 in a body frame and inertial frame respectively. The body frame plot was calculated in MATLAB using numeric analysis from the given equation (7) and (8) utilizing ODE45 in MATLAB. From the body frame, the inertial frame can be found for each time step with the DCM CNB.

Chart, line chart, histogram

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Figure 5

Chart, line chart, histogram

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Figure 6

Fig (5) and (6) depict the departure from the nominal Lyapunov Orbit at L2 when the space craft is slightly perturbed at its initial position. Utilizing a similar method to figures (1), (2), (3), and (4) the given equations (7) and (8) were used to calculate out the trajectory for the perturbed conditions utilizing MATLAB’s ODE45. Once the trajectory was the δx was calculated by subtracting the perturbed position and velocity from the nominal position. Taking the magnitude of those position and velocity vectors and plotting them against time yields the plot above. We can see that L2 is unstable, as the small difference in initial position ends up leading to large departures in both the velocity and position as time gets further from t = 0.

Chart, line chart

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Figure 7

Chart, line chart

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Figure 8

Fig (7) and (8) depict the departure from the nominal Lyapunov Orbit at L2 when the space craft is slightly perturbed at its initial position. Utilizing a similar method to figures (1), (2), (3), and (4) the given equations (7) and (8) were used to calculate out the trajectory for the perturbed conditions utilizing MATLAB’s ODE45. Once the trajectory was the δx was calculated by subtracting the perturbed position and velocity from the nominal position. Taking the magnitude of those position and velocity vectors and plotting them against time yields the plot above. We can see that L4 is stable as the departure values for the position and velocity are small. Beyond that, we can also see that the oscillation of the departure position is decreasing in magnitude as t moves further away from t=0.

Chart

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Figure 9

Chart

Description automatically generated

Figure 10

Chart

Description automatically generated

Figure 11

Chart, line chart

Description automatically generated

Figure 12