ABSTRACT

Numerical Investigation of Moments of Inertia's Uncertainty Effects on LAPAN RX-200C Rocket

by

Faisal Tri Mulyawan

Triwanto Simanjuntak, PhD, Advisor

In this thesis the sensitivity analysis of LAPAN RX-200C rocket under moments of uncertainty (I_{xx}, I_{yy}, and I_{zz}) is investigated. The Monte Carlo method is performed to reveal patterns arising from the variations in the moments of inertia.

The dynamical modeling and simulations are done in MATLAB and Simulink. Two types of normally distributed moments of inertia uncertainty, constant and noise, will be considered. To isolate their individual influences, only one of moments inertia will be exposed to uncertainty at each run. A step sidewind disturbance will also be applied to the system to induce lateral-directional motions. Nonparametric kernel density estimation and parametric normal distribution approximation will be utilized to interpret the impact point results. The stability of the rocket will also be observed briefly through its angle of attack and sideslip angle trajectories.

The results show that the moments of inertia uncertainty produce various spread characteristics with I_{xx} having the largest spread influence in the impact points relative to the rest of moments of inertia. Further, the average final y position is shown to vary largely under most of the moments of inertia uncertainty. However, the final x position, average maximum range and average maximum altitude do not depend heavily on any of the uncertainties. Under uncertainty, the rocket is able to maintain zero angle of attack while minimizing sideslip angle in the range of -1 deg and +1 deg.

Keyword: *Ballistic Rocket, Monte Carlo, Moments of Inertia*