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Computational Study of Rocket Thrust Vectoring Propulsion Control System Characteristics for Surface Landing Trajectory Paths

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Abstract content
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In this paper we mathematically formulate the space motion of a rocket in order to investigate different specified surface landing trajectory paths/orientations through an analysis of thrust vectoring forces that are used as control system inputs. The underlying rocket trajectory physical model is formulated in terms of Newton's second law for the translational motion and the corresponding Euler equations for the rotational motion which yield a coupled system of simultaneous non-linear differential equations amenable to numerical solution. Refinements in the rocket's path/orientation are then incorporated through the use of a finite number of control thrusters whose magnitudes are allowed to vary with time with fixed directional orientations relative to the axis of the rocket's main propulsion engine thus introducing known external force and torque loading conditions. Different rocket trajectory paths/orientations are then computationally investigated by incorporating the physical model into an optimization problem to minimize the differences in the predicted and specified paths/orientations through refinements of the control thruster's characteristics subject to spatial and velocity constraints for safe rocket surface landing conditions.

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