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THE POGO STABILITY ANALYSIS OF LARGE LIQUID ROCKET CONSIDERING
LONGITUDINAL, LATERAL AND TORSIONAL MODE IN STRUCTURAL SYSTEM

Abstract

Traditional POGO oscillation analysises of the liquid rocket focus on the coupling propulsion system and structural system that only considerting longitudinal mode. But for large liquid rocket, the distribution of structural mode in space is complex. In the stability analysis of structural system coupling propulsion system, it is necessary to consider the lateral mode and the torsional mode. A coupling model between propulsion system and structural system which includes the longitudinal, lateral and torsional mode is derived in this paper for the first time. No algebraic equation in the coupling system equations was obtained because the nine basic independent components of the propulsion system in the coupling model were described by independent weight-displacements completely. Thus, the coupling model can be used in time-domain simulation without any manual modification. Frequency-domain analysis and time-domain simulation were applied in this paper. The eigenvalues and simulation curves were obtained using a self-complied program to analyze the stability of the coupling system. The result shows that the variations of accumulator energy value and pump gain parameter of the propulsion system caused the instability of the longitudinal and lateral mode in the coupling system, which further comfirmed the necessity to consider the longtidunal, lateral and torsional structural mode in the POGO stability analysis of large liquid rockets.