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ACOUSTIC ANALYSIS ON SUB-SCALED GAS GENERATOR

Abstract

Combustion instability in liquid rocket engine consists of unsteady combustion and disturbance propagation which includes three different forms, namely pressure wave, vorticity wave and entropy wave. To explain how the pressure wave propagates in combustion chamber should be within the scope of acoustic. In order to assess the stability margin of full-scaled gas generator, a sub-scaled gas generator will be chosen as a research object in this paper. Firstly, combined with simulation result of acoustic mode and experimental result of acoustic frequency response curve, this paper will show that how the response amplitudes of different acoustic mode vary along measuring position. This is important for actual engineering analysis because there is no enough dynamic pressure sensors in real measurement. Based on this, how the response amplitudes change with exciting source position is discussed as a instability mechanism. It is indicate that: for a given mode, its response amplitudes are positive correlated with the distance between measuring points and its node position, and similarly they are also positive correlated with the distance between exciting points and its node position when the measuring point is fixed. Secondly, combustion stability of gas generator will be analyzed with damping ratio distribution along mode frequencies. It is indicate that: acoustic damping effects of injection cavities can be concluded from the response curves that injection cavities can make the energy distribution more uniformly, which prevent energy accumulation to some single mode. Besides, sub-scaled gas generator has an increasing damping effect to acoustic mode order.