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DYNAMIC LOAD IDENTIFICATION OF A SECOND STAGE LIQUID ROCKET ENGINE BASED ON TIKHONOV REGULARIZATION METHOD

Abstract

Accurate calculation of dynamic loads during steady operation of liquid rocket engine(LRE) is of great importance to the engine design. However, self-induced mechanical loads at the combustion chamber and turbopump can't be directly measured. A general identification method is through the acceleration response near the excitation sources and frequency response function(FRF) matrices obtained by testing or the finite element model. Unfortunately, multi-sources load identification problems are generally ill-posed. High condition number of FRF matrix will cause enormous error in the identification result. Aim of this paper was to validate the load identification technique on the rocket engine and Tikhonov regularization was carried out to stabilize the solution. The response cross power matrices were restructured by the proper orthogonal decomposition(POD) technique. Strategies to improve the identification result, weighting matrix and selecting the measurement points according to the condition number of FRF matrices, were adopted. Dynamic load identification experiment was performed on a second stage liquid rocket engine, which was tested with known force inputs from shakers attached to three well defined locations. Results showed that the random and sinusoidal dynamic loads were identified simultaneously with a satisfactory accuracy.