

SPACE TRANSPORTATION SOLUTIONS AND INNOVATIONS SYMPOSIUM (D2)
Future Space Transportation Systems Verification and In-Flight Experimentation (6)

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RESEARCH ON HYPERSONIC FLUTTER TEST TECHNIQUE FOR HYPERSONIC VEHICLES

Abstract

In order to evaluate the wing and rudder flutter characteristics of next generation hypersonic aerospace transportation vehicle, the hypersonic flutter test technique was established and tested. The flutter test technique was based on modal parameter identification technique of structure response signal and flutter margin prediction technique. The stochastic subspace identification method was used to identify the modal frequency and damping of the vibrating structure which excited by the turbulent of free hypersonic stream. Both Zimmerman-Weissenburger method and damping extrapolation method were used and compared in extrapolating the flutter dynamic pressure. The flutter onset points were also reached by increasing the dynamic pressure of the free stream at fixed Mach numbers. Several models was flutter tested in CAAA FD-07 hypersonic wind tunnel. During the test, the wind tunnel was operated both by stepped-changing and continuous-changing of the dynamic pressure. The time-frequency domain analysis method was used to trace the development of the nature frequencies with the increase of dynamic pressure and to identify whether the intense vibration was so called flutter or other kinds of vibration. The result showed that the modal frequencies and damping can be identified by stochastic subspace identification method both in stepped-changing and continuous-changing of dynamic pressure condition. Both Zimmerman-Weissenburger method and damping extrapolation method gave a high accuracy of predicting the flutter pressure compared with the flutter onset data.