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Corresponding author: LI Junwei
e-mail of corresponding author: david78lee@bit.edu.cn
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Title

Experimental study of pulsed triggering oscillation in T-burner

Authors

Ruyao Wang [1], Junwei LI [2], Deyou Wang [3], Jiajin Zeng [4], Ningfei Wang [5]*

** Corresponding author*
[1] School of Aerospace Engineering, Beijing Institute of Technology, 100081 Beijing, China, ruyaowang@163.com
[2] School of Aerospace Engineering, Beijing Institute of Technology, 100081 Beijing, China, david78lee@bit.edu.cn
[3] School of Aerospace Engineering, Beijing Institute of Technology, 100081 Beijing, China, 3120195075@bit.edu.cn
[4] School of Aerospace Engineering, Beijing Institute of Technology, 100081 Beijing, China, 18810520628@163.com
[5] School of Aerospace Engineering, Beijing Institute of Technology, 100081 Beijing, China, wangningfei@bit.edu.cn

Abstract

Pulse triggering is easy to excite pressure oscillation in large aspect ratio solid rocket motors, which can lead to serious consequences on rocket [1-2]. The aim of this study was to investigate the characteristic of pressure oscillation after a pulse triggering. We designed a pulse ignition system based on T-burner to measure pressure change and compared the amplitude-frequency characteristics of pressure oscillation by changing pulse charge and chamber pressure. The pulser, which was put inside the T-burner, was installed at the end of the chamber. The ignition control system sent an ignition signal to the pulser, then the black powder in pulser burnt quickly to form a pressure pulse. Due to the special structure of the T-burner, the pressure pulse wave propagated and reflected in chamber, then triggered the pressure oscillation. The pressure signal was recorded by three transducers which were installed at different positions in chamber. The oscillation waveform, amplitude, frequency, pulse wave propagation speed and pulse wave attenuation coefficient were explored at cold and hot firing test simultaneously. The results show that the pulse not only excites the axial oscillation in the chamber, but also excites the tangential modes. The amplitude of pressure oscillation increases with the pulse charge and chamber pressure. With the increase of pulse charge and chamber pressure, the amplitude of pressure oscillation, vibration frequency and attenuation coefficient all increase, while the propagation speeds of pulse wave gradually slow down. With the increase of combustion chamber pressure, the pulse wave front is steeper and the compression degree is enhanced. The results indicate that there is a way to identify the validity of the pulse to trigger instability in rocket engine, and is potentially useful for motor designers to evaluate the stability of motor.

References

[1] F. E. C. Culick. Unsteady motions in combustion chambers for propulsion systems, Technical report, AGARDograph, NATO/RTO-AG-AVT-039 (2006).
[2] J. D. Baum, J. N. Levine. Modeling of nonlinear longitudinal instability in solid rocket motors, Acta Astronautica 13(6) (1986) 339-348.