
Abstract #XXX *(to be filled by the organizers)*
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Title

Pressure Model of Buzz Oscillation in a Ramjet Intake

Authors

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Abstract

One of the most important matters to realize supersonic/hypersonic airbreathing engines is preventing structural damage caused by the buzz. The buzz is the self-excited oscillation of the shock wave occurring in supersonic/hypersonic intakes. This phenomenon causes the severe pressure oscillation inside the intake, so it can result in the structural damage to the engine and the airframe. Therefore, buzz models to estimate the pressure amplitude and the frequency in the design stage are required and some research has been conducted. For example, Tan [1] constructed the new buzz model which can be applied to the buzz that the flow inside the intake becomes supersonic. This model can calculate the buzz frequency precisely, but the model requires the results obtained by CFD or experiments to calculate the frequency, so the elucidation of the buzz mechanism and the construction of models to estimate the required variables are important for the practical usage. Therefore, this paper provides the attempt to model the intake exit pressure during the buzz.

A numerical simulation was conducted on the buzz occurring in the ramjet intake for High-Mach Integrated Control Experiment, HIMICO, which is the hypersonic flight experiment using the S-520 sounding rocket. The ramjet intake for HIMICO is composed of ramps, a cowl, a diffuser, a rear duct, and a nozzle exit, and the length is 540 mm. The freestream Mach number was set at 3.4 in the numerical simulation.

In this paper, a cycle of the buzz is divided into the two periods, the pressure increasing period and the pressure decreasing period. As a result of the numerical simulation, the terminal shock wave moved upstream inside the intake pushed by the high-pressure region expanding from the rear side of the intake during the pressure increasing period of the buzz. The intake exit pressure increased rapidly at the beginning of the pressure increasing period. This rapid pressure increase was revealed to be calculated by applying the governing equations of the moving normal shock wave. Next, the intake exit pressure became stable until the terminal shock wave reached the diffuser entrance. The moving speed of the terminal shock wave during this time was found to be also calculated by the governing equations of the moving normal shock wave although the terminal shock wave was the pseudo-shock wave in this time. In the presentation, the detail of this newly constructed intake exit pressure model for the buzz will be shown.

References

[1] Tan, H. J., Sun, S., and Yin, Z. L., "Oscillatory Flows of Rectangular Hypersonic Inlet Unstart Caused by Downstream Mass-Flow Choking," *Journal of Propulsion and Power*, Vol. 25, No. 1, 2009, pp. 138-147.