Research on Nozzle Performance in Scramjet

J. P. Li, W. Y. Song, Y. Xing

School of Power and Energy, Northwestern Polytechnical University, Xi'an 710072, China

Email: lijianping001@mail.nwpu.edu.cn

Abstract

The scramjet is a great potential superiority and has a good prospect in the field of aeronautics and astronautics in the future. The scramjet is composed of inlet, isolator, combustor and nozzle. Nozzle is an important component of the scramjet, which produce thrust. The nozzle performance is related with geometric parameters, free-stream Mach number, flight dynamic pressure, attack angle and the performance of inlet and combustor. The influence of geometric parameters on the nozzle performance are emphasized by researchers in the world for decades.

In this paper the verification is made on the nozzle design by both CFD and experiments. The internal flow field of nozzle is simulated by FLUENT. The influence of geometric parameters (divergent angle, nozzle total length, height ratio, and cowl angle) on the nozzle performance is studied. The research conclusions provide instruction for the choice of geometric parameters in the nozzle design.

The results indicate that with the increasing of divergent angle, thrust coefficient C_T is increasing; lift coefficient C_N is decreasing; pitching moment coefficient C_M varies small; with the decreasing of nozzle total length, C_T decreases a little; C_N and C_M decreases distinct. Less total length should be selected prior in condition that ensure the nozzle performance; with the increasing of height ratio, C_T increases; C_N and C_M decreases and the range of C_N gets extended; with the increasing of cowl angle, C_T is almost constant; C_N and C_M are decreasing.

REFERENCES

1. Small W J, Weidner J P, Johnston P J. Scramjet nozzle design and analysis as applied to a highly integrated hypersonic research airplane. NASA TND-8334, 1976
2. Shigeya W. Scramjet nozzle experiment with hypersonic external flow. *Journal of Propulsion and Power*, 1993; **9**(4): 521-528
3. Tohro M, Shuichi U, et al. Validation studies of scramjet nozzle performance. *Journal of Propulsion and Power*, 1993; **9**(5): 725-730
4. Ryan P. S, Falcon R, Darryll P. Coupled waverider/trajectory optimization for hypersonic cruise AIAA-2005-530
5. Emanuel G. Gas dynamics Theory and Application. New York: AIAA Education Series. 1986
6. Lee S H, Tohru M. Reactive flow in scramjet external nozzle, AIAA-99-0616