

A Numerical Study on the Variation of Internal Flow Field of the External Pintle Nozzle with Pintle Radius

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Abstract

The external pintle nozzle is shaped such that the pintle is located in the expansion portion of the supersonic nozzle. This pintle is called an external pintle, and the internal flow field is changed by the external pintle according to the atmospheric pressure so that the effective expansion ratio increases according to the altitude. In addition, with the altitude compensation effect, the main feature of the external pintle nozzle is that the nozzle length can be reduced. At this time, the shape of the external pintle acts as a main variable for determining the flow field and thrust in the nozzle. Therefore, research on the shape of external pintle was actively carried out in the University of Bristol, UK, DLR in Germany, UNSW in Australia, and so on, and in South Korea, Chungnam national university(CNU) is actively conducting research. Previous studies conducted in Europe and Australia have analyzed the effect of the design method and design parameters of external pintle nozzles on the thrust. Referenced on the research of the university of Bristol, CNU has been carrying out basic research to analyze the thrust characteristics and the internal flow field by designing an external pintle nozzle. There are some variables such as nozzle throat angle, pintle inflection angle, pintle radius, and so on.

Here, We present numerical simulations to investigate the internal flow field and the thrust coefficient according to the pintle radius using ANSYS Fluent. The analysis used the 2-dimensional axisymmetric and SST k- ω turbulence model. The inlet conditions are selected as pressure inlet conditions and using combustion gas of Methane/LOx. As a result, when the pintle radius is large, it is possible to reduce the size of the separation bubble occurred near the nozzle throat, and it is found that the thrust coefficient is increased.

Keywords: *External Pintle Nozzle, Numerical Analysis, Pintle Radius*

Biography

Hansol Kim graduated from Chungnam National University, Department of Aerospace Engineering. Research interests are methane rocket engine and external pintle nozzle.