IAF SPACE PROPULSION SYMPOSIUM (C4)
Joint Session between IAA and IAF for Small Satellite Propulsion Systems (8-B4.5A)

Author: Ms. Shreesha Madhu
R.V.College of Engineering, India, shreesham.ae16@rvce.edu.in

Ms. Sanjukta Mandal
R V College of Engineering, Bengaluru, India, sanjuktamandal.ae16@rvce.edu.in
Ms. Devika R
R V College of Engineering, Bengaluru, India, devikar.ae16@rvce.edu.in

FLUIDIC THRUST VECTORING IN SMALL SATELLITES BY EMPLOYING COMBINED SHOCK VECTORING AND SONIC PLANE SKEWING TECHNIQUE TO DUAL THROAT NOZZLE.

Abstract

Currently developing technique for thrust vectoring of satellite is Dual Throat Nozzle (DTN). Thrust vectoring is necessary for precise maneuvering which helps in attitude correction and orbit keeping of satellites. Design of DTN consists of a cavity between upstream throat and exit of micronozzle. Asymmetric Fluidic blowing is injected at the upstream minimum area creates a skewed sonic plane and maximizes pressure differences in the cavity producing fluid vectoring. Dual throat nozzle – fluidic thrust vectoring technique helps to achieve thrust vectoring efficiency without sacrificing the thrust efficiency as it combines both fluidic sonic-plane skewing and shock-vector control method.

The research focuses on optimization of 2D model by varying converging and diverging angles keeping thrust efficiency as the criteria. The optimized 2D model is then varied for different aspect ratios and thrust efficiencies are calculated for constant ideal thrust value. The 3D model with highest thrust efficiency is then employed with asymmetric secondary injection. The required NPR, secondary blowing rates, deflection angles and thrust vectoring efficiency are calculated.

The optimized 3D model along with secondary injection is manufactured and fabricated. The nozzle is tested in controlled experimental setup. The nozzle is facilitated with a shaft and bearing which enables it to rotate about the shaft for the computation of thrust vectoring parameters. The thrust magnitude is measured using force transducers. The experimental and analytical results are validated. Comparison between dual throat nozzle with and without secondary injection is also studied in the paper.