Study on spacecraft dynamics

Report Number: R19ECWU24
Subject Category: Cooperative Graduate School System
URL: https://www.jss.jaxa.jp/en/ar/e2019/11574/

Responsible Representative

Shujiro Sawai, Institute of Space and Astronautical Science, Department of Space Flight Systems

Contact Information

Yusuke Maru(maru.yusuke@jaxa.jp)

Members

Haruaki Seta, Yusuke Maru

Abstract

design and evaluation of an intake for an ATR (Air-Turbo Rocket) engine for a reusable sounding rocket with an airbreathing propulsion system.

Reasons and benefits of using JAXA Supercomputer System

The use of JSS2 enables very high-speed analysis when evaluating the characteristics of the designed intake by CFD, so that performance evaluation under a variety of flight conditions can be performed.

Achievements of the Year

In order to combine the reusable sounding rocket with the airbreathing engine, it is necessary to install an air intake on the airframe. The purpose of the present study is to design the intake of the reusable sounding rocket with the Air-Turbo Rocket (ATR) engine and to evaluate the characteristics.

The characteristics of the designed intake shape were evaluated by CFD. From the inviscid analysis, it was confirmed that the flow field formed as designed (Fig.1). On the other hand, from the viscosity analysis, it was found that the influence of the boundary layer greatly affected the intake performance.(Fig.2) However, if the mainstream Reynolds number was tripled, the performance degradation due to the boundary layer was mitigated. (Fig.3)

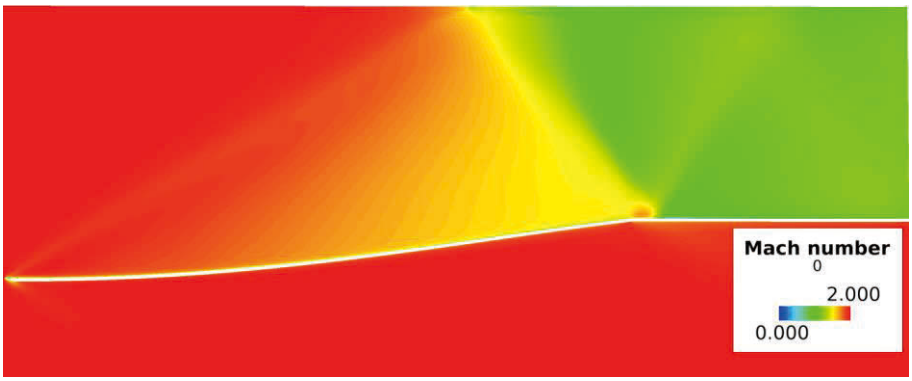

Fig. 1: Flow Mach number contours in the designed intake in inviscid flow.

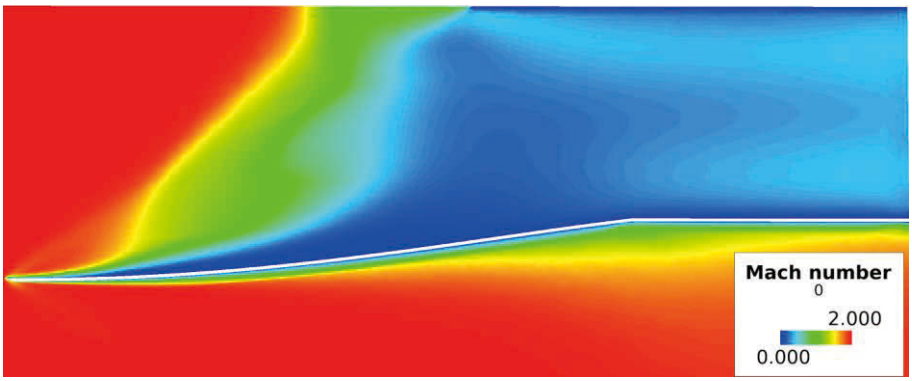

Fig. 2: Flow Mach number contours in the designed intake in viscous flow.

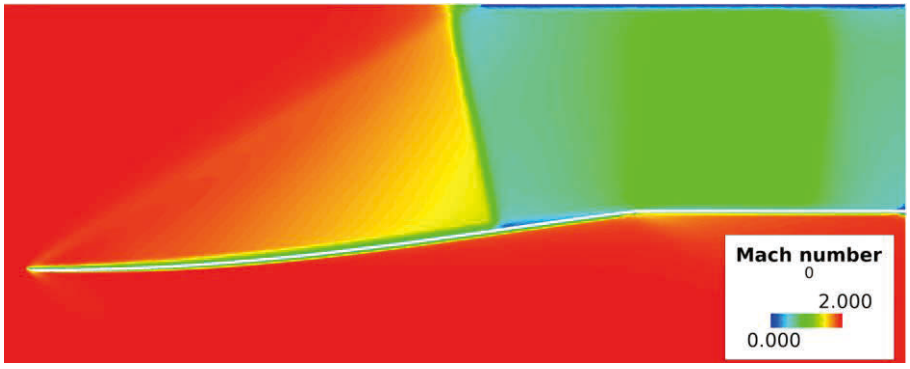

Fig. 3: Flow Mach number contours in the designed intake in viscous flow and triple Reynolds number.

Publications

N/A

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	256
Elapsed Time per Case	8.3 Hour(s)

Resources Used

Fraction of Usage in Total Resources[*1](%): 0.05

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	321,558.47	0.04
SORA-PP	9,957.36	0.06
SORA-LM	276.23	0.12
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	484.78	0.40
/data	9,845.10	0.17
/ltmp	3,580.73	0.30

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	0.00	0.00

[*1]: Fraction of Usage in Total Resources: Weighted average of three resource types (Computing, File System, and Archiver).

[*2]: Fraction of Usage：Percentage of usage relative to each resource used in one year.