

Research on Solid/Hybrid Rocket: Development of RANS Solver for of Swirling-Oxidizer-Flow-Type Hybrid Rocket using Flamelet Combustion Model

Report Number: R18EU0802

Subject Category: Space and Astronautical Science

URL: <https://www.jss.jaxa.jp/en/ar/e2018/9177/>

● Responsible Representative

Toru Shimada, Institute of Space and Astronautical Science, Department of Space Flight Systems

● Contact Information

Toru Shimada (shimada.toru@jaxa.jp)

● Members

Toru Shimada, Mikiroh Motoe, Goutham Karthikeyan, Koki Kitagawa, Nobuhiro Kimura

● Abstract

We conduct this research to develop internal combustion flow modeling of solid rockets and hybrid rockets, develop numerical calculation techniques, and facilitate understanding of related physical and chemical phenomena.

● Reasons for using JSS2

To require a high-performance computer capable of handling fluid phenomena including three-dimensional and non-stationary complex physical and chemical processes

● Achievements of the Year

A RANS analysis code for a swirling-oxidizer-flow-type hybrid rocket motor have been developed using the Flamelet combustion model. The analysis target is shown in Figure 1, the eddy viscosity coefficient and temperature distribution are shown in Figure 2, the mass fraction distribution of methane and oxygen is shown in Figure 3, and the mass fraction distribution of OH and carbon dioxide is shown in Figure 4.

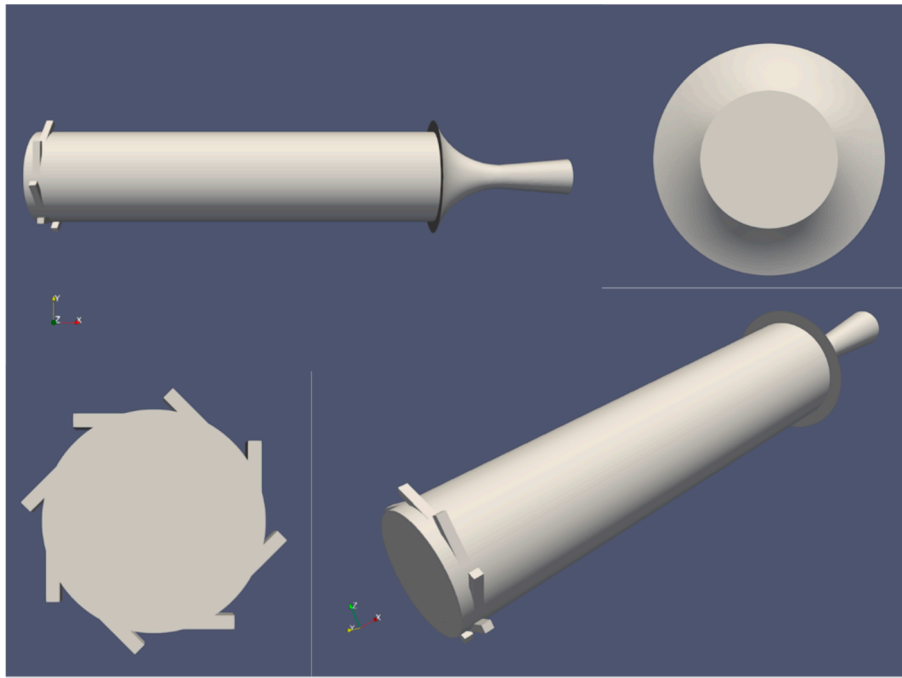


Fig. 1: Analysis object

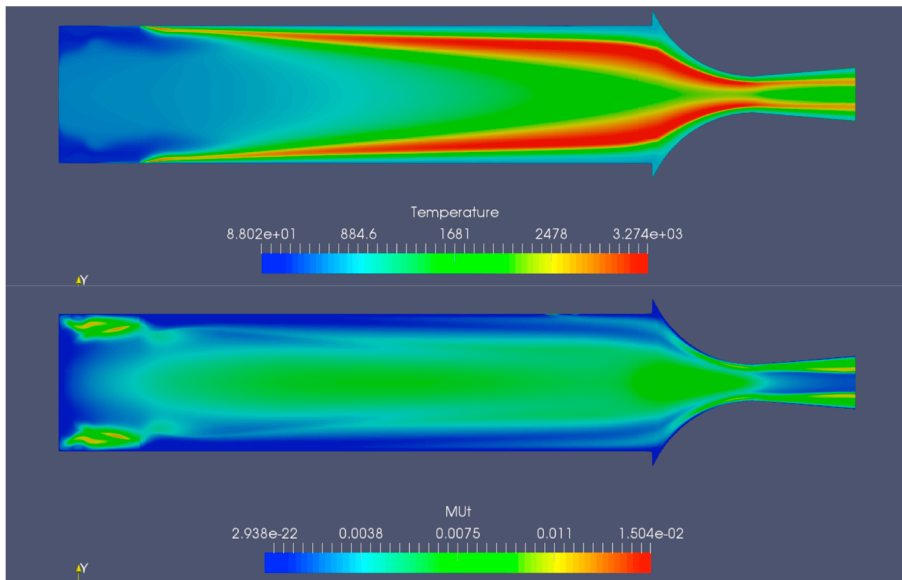


Fig. 2: Eddy viscosity and Temperature

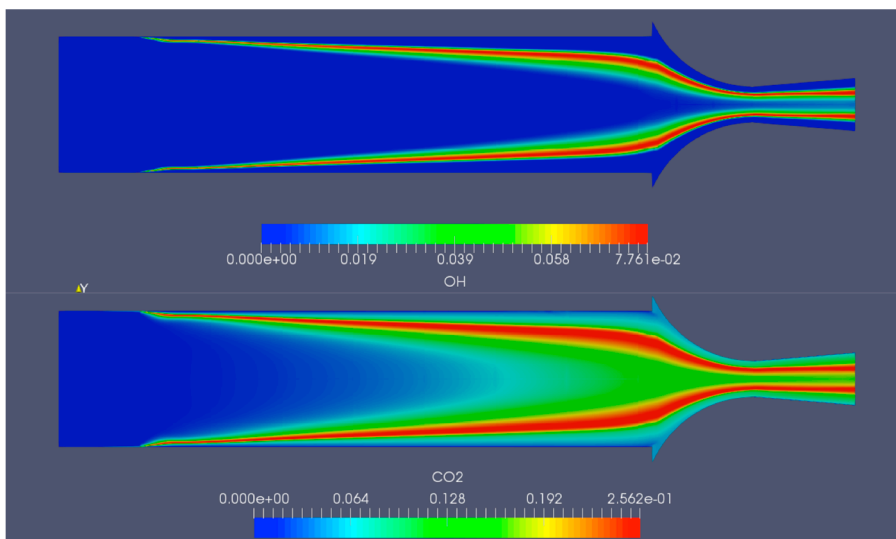


Fig. 3: Mass fraction of CH4 and O2

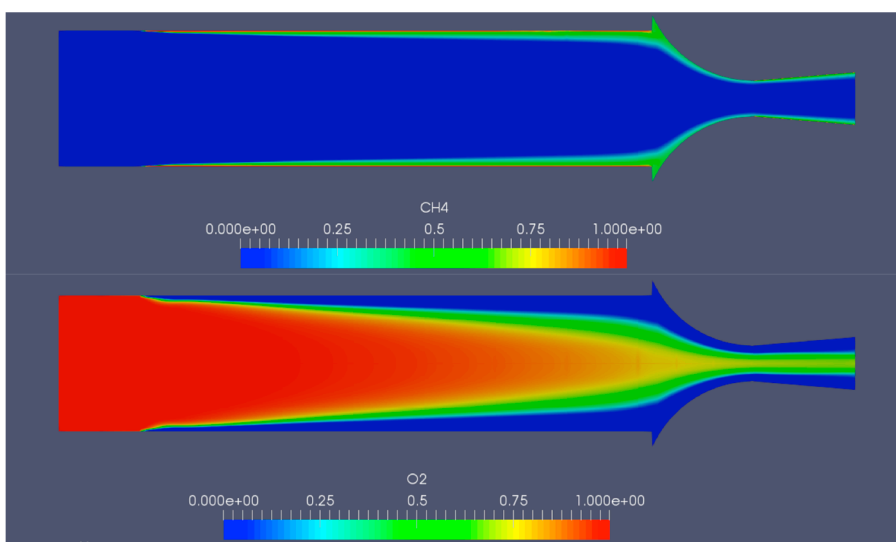


Fig. 4: Mass fraction of OH and CO2

● **Publications**

N/A

● **Usage of JSS2**

● **Computational Information**

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	688
Elapsed Time per Case	100 Hour (s)

● **Resources Used**

Fraction of Usage in Total Resources*1 (%): 0.20

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage*2 (%)
SORA-MA	1,799,522.96	0.22
SORA-PP	7.82	0.00
SORA-LM	0.00	0.00
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	1,106.47	1.14
/data	5,890.30	0.10
/tmp	7,463.73	0.64

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	6.38	0.22

*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.