Study on combustion instability

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Abstract

In this study, LES analysis was carried out for Continuously Variable Resonant CoContinuously Variable (CVRC), and the contraction model which can predict the occurrence of vibration combustion was developed based on the obtained result, aiming at the prediction of vibration combustion.

Reasons and benefits of using JAXA Supercomputer System

LES analysis and analysis of the results require large computational resources.

Achievements of the Year

In this study, a model combustor for liquid propellant rocket engines, the Continuously Variable Resonance Combustor (CVRC), was numerically analyzed using compressible Large-Eddy Simulation. By adjusting the temperature of the oxidizer inlet, the vibration combustion of the primary longitudinal mode can be generated. In the analysis at 700 K and 720 K, an amplification of the longitudinal combustion instability was observed. It was found that the combustion instability is governed by the period of the stationary wave in the combustor, the period of the traveling wave propagating in the oxidant inlet post, and the time until the disturbance reaches the combustor inlet and propagates through the fuel/oxidant shear layer to release and mix heat. Based on the obtained results, a reduced model to predict the occurrence of oscillatory combustion was tried based on the Matveev and Culick (Combust.Sci.Tech. 175 (6) 2003) model. From the original model, two points are extended: modeling of traveling waves in an oxidant inlet post and handling of diffusion flames. The development of the contraction model will be continued.

Publications

N/A

Usage of JSS

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	8 - 32
Elapsed Time per Case	10 Hour(s)

JSS3 Resources Used

Fraction of Usage in Total Resources[*1](%): 0.03

Details

Computational Resources		
System Name	CPU Resources Used (core x hours)	Fraction of Usage[*2](%)
TOKI-SORA	770,625.60	0.03
TOKI-ST	11,703.04	0.01
TOKI-GP	0.00	0.00
TOKI-XM	0.00	0.00
TOKI-LM	177.80	0.01
TOKI-TST	0.00	0.00
TOKI-TGP	0.00	0.00
TOKI-TLM	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	77.43	0.06
/data and /data2	13,605.23	0.08
/ssd	0.00	0.00

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	99.25	0.36

*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.

- **ISV Software Licenses Used**

ISV Software Licenses Resources		
	ISV Software Licenses Used (Hours)	Fraction of Usage*2 (%)
ISV Software Licenses (Total)	229.43	0.10

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