Study for Embedded Large Eddy Simulation

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Abstract

We are developing new low-cost numerical simulation technology for aerodynamic problems, including transonic buffet and aeroacoustics. We aim to achieve high accurate simulation without expensive computational cost using Embedded-LES method. ELES allows us to execute embedded unsteady simulations that localize the high-numerical-cost region without suffering the accuracy of prediction.

Reasons and benefits of using JAXA Supercomputer System

The project needs vast computational resources so that we can validate the ELES method in turbulent flow conditions. Using the JAXA supercomputer system surely enhances our works by providing easy access to resources.

Achievements of the Year

In the past year, we have worked for developing the Embedded Large Eddy Simulation method so that we can get accurate results in numerical simulation of three-dimensional unsteady flow fields. Improvement of numerical schemes and its implementations for our code allowed us to use the ELES method for complex flow fields such as high-Reynolds number flow over a slat.

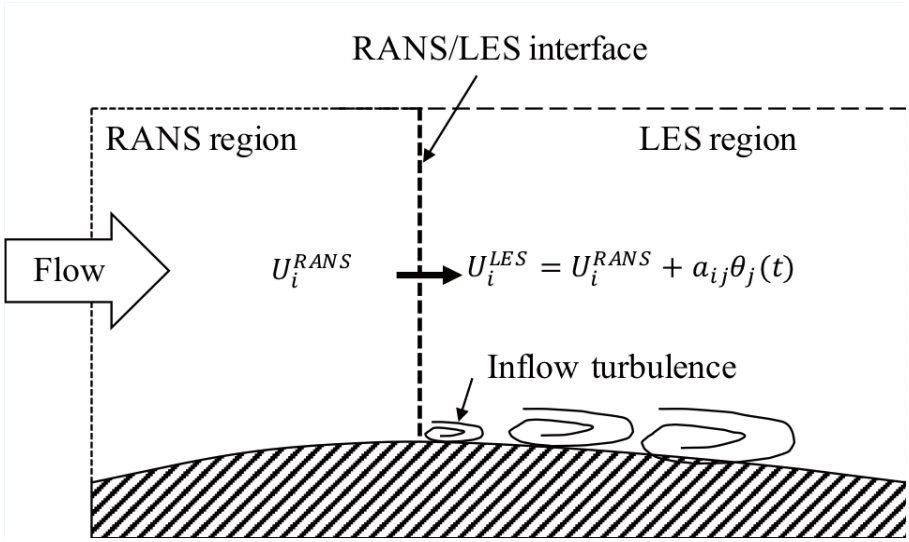

Fig. 1: Schematic of Embedded-LES method

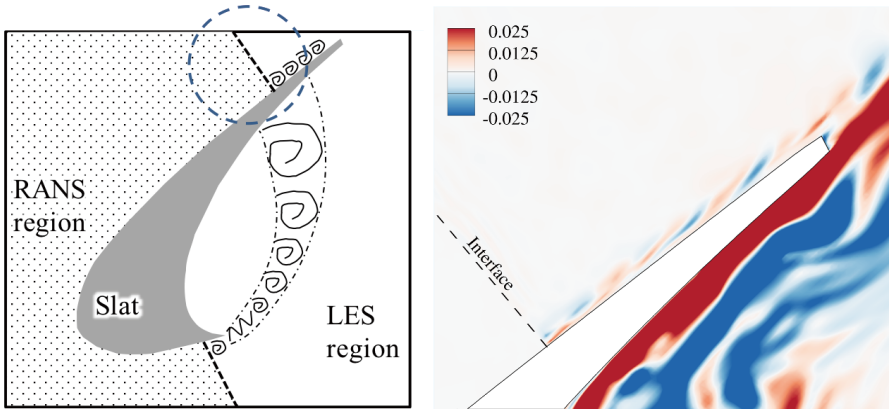

Fig. 2: Instantaneous span-wise velocity field around a RANS/LES interface in the slat flow case (around the trailing edge)

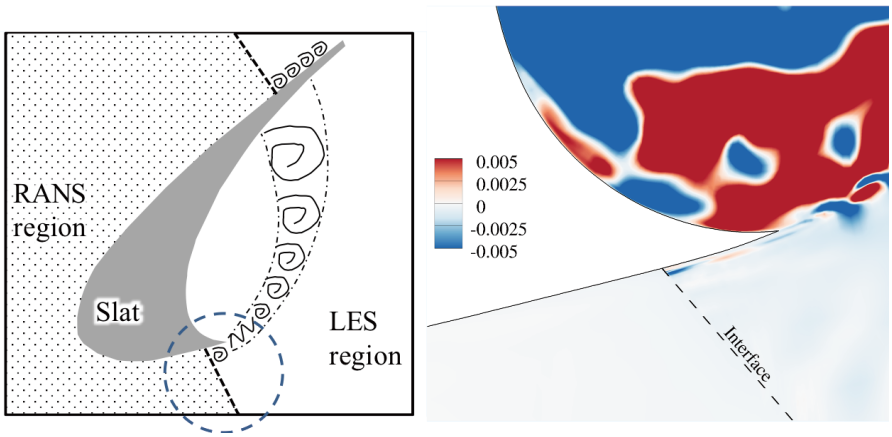

Fig. 3: Instantaneous span-wise velocity field around a RANS/LES interface in the slat flow case (around the cusp)

Publications

- Oral Presentations

Kojima, Y., Ishida, T., Hashimoto, A. & Aoyama, T., "Numerical Simulation of Unsteady Flow over a 30P30N Slat by Embedded-LES," AIAA Scitech 2020 Forum (2020) AIAA2020-2065.

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	N/A
Number of Processes	1024 - 1728
Elapsed Time per Case	300 Hour(s)

Resources Used

Fraction of Usage in Total Resources[*1](%): 0.11

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2](%)
SORA-MA	675,465.42	0.08
SORA-PP	49,231.91	0.32
SORA-LM	61.91	0.03
SORA-TPP	0.00	0.00

File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2(%)
/home	47.68	0.04
/data	12,207.04	0.21
/ltmp	976.56	0.08

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2(%)
J-SPACE	97.58	2.46

*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.