Development of 3D CFD core-software of automotive engine combustion chamber

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Abstract

Enhancement of CAE utilization in automotive engine research by developing an engine combustion simulation software that is sharable in Japan automotive research community

Ref. URL: https://www.jst.go.jp/sip/event/k01_hinoca/index.html

Reasons for using JSS2

Massive-parallel large scale simulation, Large number of simulations fo software validation

Achievements of the Year

Conservation level has been largely improved by developing a novel IB (Immersed Boundary) method.

Engine combustion simulation software HINOCA which enables combustion simulation directly from engine data without mesh generation, has been constructed by installing sub-models developed in the SIP combustion technology project.

The cylinder pressure histories and their cycle to cycle variations in a mass-production engine have been well reproduced for both stoichometry and lean conditions.

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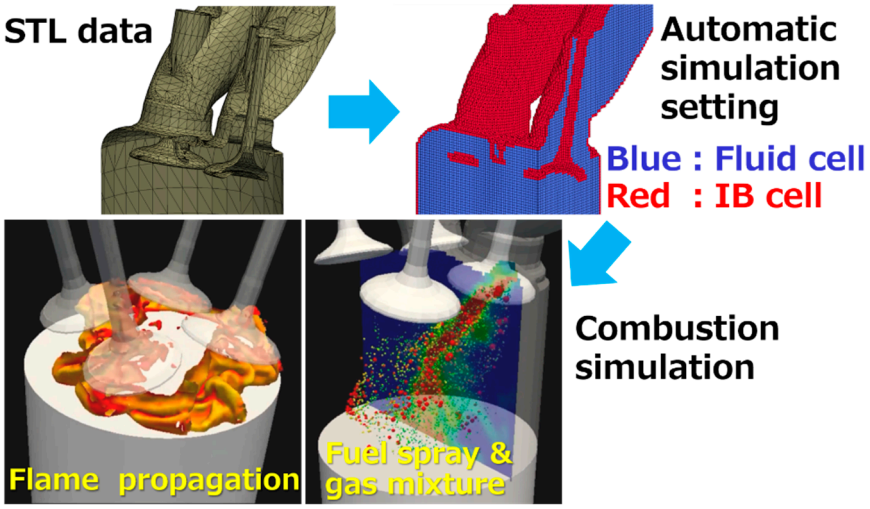

Fig. 1: Combustion simulation directly from engine data without meshing process.

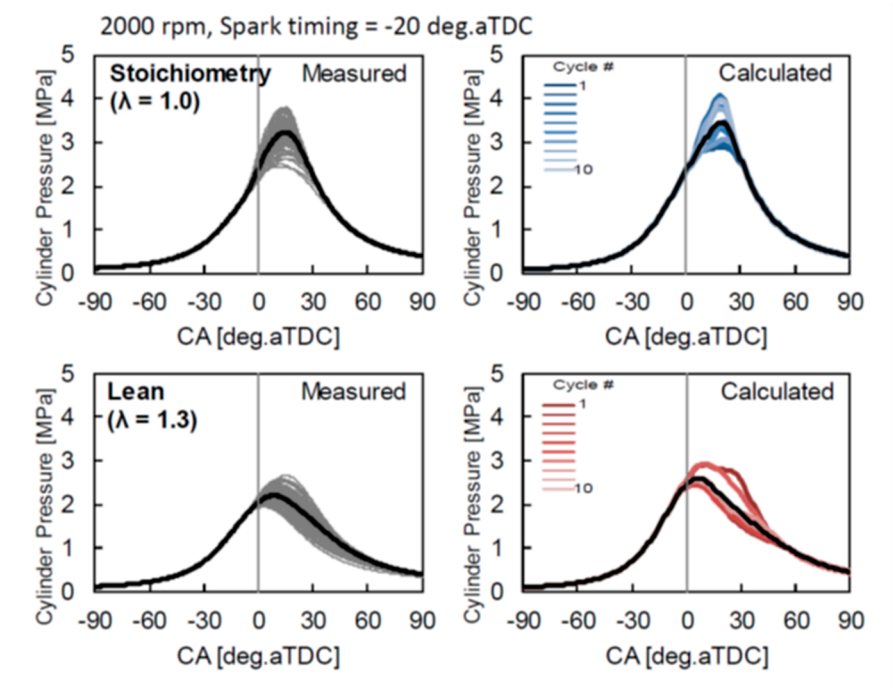

Fig. 2: Reproduction of pressure history (left) and cycle to cycle variation (right) of a mass-production engine for stoichiometric (upper) and lean (lower) conditions.

Publications

- Non peer-reviewed papers

Yasuhiro Mizobuchi, Automotive Engine Combustion Simulation Software “HINOCA”, Journal of Society of Automotive Engineers of Japan, Vol. 72 No. 4 (2018).

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- Oral Presentations

Takashi Kaminaga, Akira Kikusato, Beini Zhou, Yuuhi Morii, Taketo Yamada, Toru Takabayashi, Jin Kusaka, Shogo Yasuda, Hiroki Yao, Manabu Hishida, Taisuke Nambu, Yasuhiro Mizobuchi and Yuichi Matsuo, Large Eddy Simulation and Analysis of Cycle-by-Cycle Variations in a Spark Ignition Gasoline Engine, 2018 JSAE Annual Congress (Spring), May 2018.

Satoshi Kawauchi and Masahide Takagi, Study on Applicability of Breakup Model to Sprays of Gasoline and Diesel Engines, 2018 JSAE Annual Congress (Spring), May 2018.

Satoshi Kawauchi, Masahide Takagi, Satoshi Ideguchi, Beini Zhou and Jin Kusaka, Effect of Atomization Characteristics on Mixture Formation Process in Gasoline Spray Simulation, 2018 JSAE Annual Congress (Autumun), October 2018.

Tsukasa Hori, Modeling of the evolution from ignition kernel to planar flame, 56th Symposium (Japanese) on Combustion, November, 2018.

Tsukasa Hori, Development of spark ignition model for super lean-burn in SI engines, 29th Internal Combustion Engine Symposium, November, 2018.

Taisuke Nambu, Yasuhiro Mizobuchi, Takuhito Kuwabara, Ryohei Kirihara, Applying high-order compact scheme and block-based AMR to Compressible LES flow solver for IC engine, LES4ICE2018, IFPEN/Rueil-Malmaison, France, December, 2018.

Usage of JSS2

Computational Information

Process Parallelization Methods	MPI
Thread Parallelization Methods	OpenMP
Number of Processes	1 - 500
Elapsed Time per Case	500 Hour (s)

Resources Used

Fraction of Usage in Total Resources[*1] (%): 8.07

Details

Computational Resources		
System Name	Amount of Core Time (core x hours)	Fraction of Usage[*2] (%)
SORA-MA	70,455,231.76	8.63
SORA-PP	355,971.30	2.84
SORA-LM	12.78	0.01
SORA-TPP	0.00	0.00

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File System Resources		
File System Name	Storage Assigned (GiB)	Fraction of Usage*2 (%)
/home	2,139.83	2.21
/data	503,079.69	8.88
/ltmp	47,564.70	4.07

Archiver Resources		
Archiver Name	Storage Used (TiB)	Fraction of Usage*2 (%)
J-SPACE	50.08	1.75

*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.

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