Advanced Core for Energetics, Hiroshima University Vol. 45

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Activities of the Core

Sep.23, 2020	Prof. Nishida gave a lecture at Summer Webinar.
Sep.23, 2020	The 49th HU-ACE Steering Committee Meeting
Sep.28, 2020	The 87th Hiroshima University Biomass Evening Seminar (co-organization)

Promotion video of the HU-ACE has been made.

What is expected to us is that many people know our activities and we get the understanding and cooperation so that we can make solid achievement and return it to the society. However, the opportunities to explain our activities for easy understanding are limited. Considering this situation, we made a promotion video to introduce the activities of HU-ACE. With the research activities of the HU-ACE members, it shows from establishment through purpose to the future of HU-ACE in about 8 min. English version is also available. Presently, it can be accessed from YouTube and web page of HU-ACE. WE would be grateful if you could watch it. The URL is as follows.
https://hu-ace.hiroshima-u.ac.jp/en/

One frame from the promotion video.

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Research Topics

Numerical and experimental analysis of flow in automotive engines

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Research fields: Fluid engineering, Mechanical engineering

Keywords: CFD, Turbulent flow, Internal combustion system

Abstract

Background

Laminar and turbulent flows, and fluid structure interaction can be simulated by improvement of computer, parallel computing, and numerical scheme accuracy. Thus, CAE (Computer Aided Engineering) has become mainstream for research and development (R&D) of industrial products. As for automotive engines, mixture formation and heat transfer in combination with spray behavior inside an engine cylinder, and pulsatile turbulent flow in exhaust manifold outside the cylinder are quite complicated in views of fluid dynamics as well as numerical simulations. Such flows are very important for R&D and they have been able to be analyzed by large scale simulations. However, these numerical simulation has to be verified and validated (V&V) from experimental and theoretical points of views.

Methods

Steady and pulsatile flow fields in an S-shaped double-bend duct that simulates exhaust manifold in real engines are investigated. The flow is turbulent with large Reynolds number and high frequency, and POD (Proper Orthogonal Decomposition) analysis and so on are used for velocity vector obtained by PIV (Particle Image Velocimetry). Then, significant flow structure can be extracted to find out such turbulent pulsatile flows.

Results

Pulsatile turbulent flows with high Womersly number characteristics, such as separation and vortex generation at bends of in a curved duct, are figured out by joint research with Mazda Motor Corporation. Local flow reversal can be viewed as flow separation, and it is peculiar to the pulsatile flow because adverse pressure gradient occurs along the entire duct when flow decelerates, and curvature effect in combination with the pressure causes reverse flow from inner wall. POD analysis found out that first and second modes with the largest energy indicate main stream and its reversal, respectively, and POD coefficients of each mode change along with time variation of mainstream. Elucidation of turbulent flow structure is expected by finding dominating flow characteristics and improvement of simulation modeling for CAE.

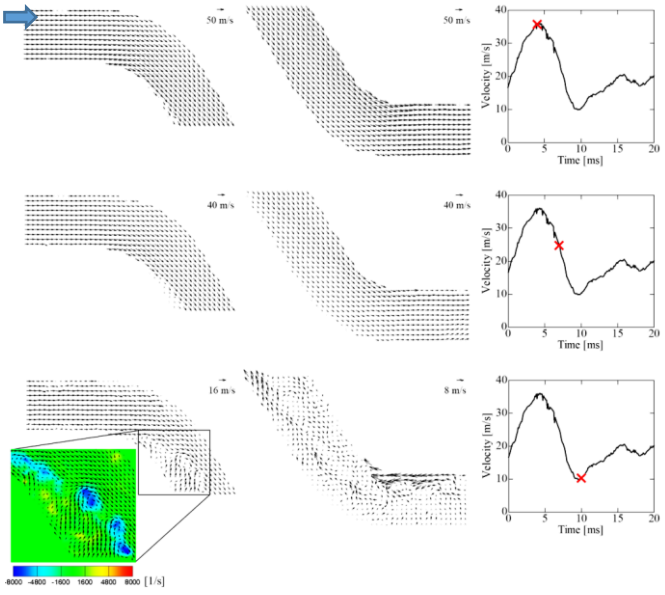

Fig. 1 Flow velocity vectors obtained by PIV results
Left : 1st bend, Center : 2nd bend, Right : Inlet speed[2]

References

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