Research Area : Numerical Analysis of Flow Phenomena

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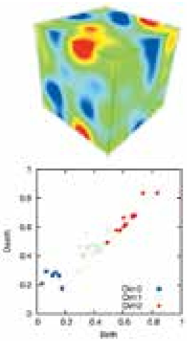
Computational and data science of multiscale/multiphysics complex flow phenomena

Transport and diffusion of dust particles by atmospheric air turbulence and highly efficient and clean combustion in internal combustion engines are themes related to environmental problems. These are multiscale/multiphysics complex flow phenomena. To solve these phenomena, a more comprehensive understanding of turbulence physics is important. By developing reliable and effective methods for direct numerical simulations (DNSs) of the Navier-Stokes equations, performing large-scale DNSs of turbulence using supercomputers, and conducting data science based on the DNSs, we are studying turbulence physics related to various complex flow phenomena.

Cluster structure of high vorticity regions in high Reynolds number turbulence obtained by large-scale DNS

Mathematical and scientific information reduction and visualization of large-scale time series data

A method for efficiently extracting important information from huge time series datasets obtained from large-scale numerical simulations is required. Flow visualization and analysis of conditional statistics are effective for understanding turbulence phenomena. Persistent homology analysis enables us to systematically extract remarkable "changes" in the spatio-temporal space of a scalar field. By combining these, we are developing methods for detecting and understanding important events in complex turbulent flow phenomena.



A scalar field and its persistent diagram