A tribute to the memory of Prof. Yasutaka NAGANO

Professor Nagano, the former chair of the JSME Thermal Engineering Division, passed away at the age of 71 on June 6, 2015. We shall always remember him, his gentle smile and his excellent contribution to the studies of turbulent heat transfer, e.g., turbulence measurement using hot- and cold-wire techniques, two-equation turbulence modeling and direct numerical simulations.

Main achievements

Simultaneous measurement of velocity and temperature fluctuations

- Analog circuit for simultaneous measurement of velocity and temperature fluctuations (JHT, 1978)
- Reynolds shear stress and turbulent heat fluxes in natural convection TBL (IJHMT, 1988)
- Instantaneous velocity vectors and temperature fluctuations measured by multi-wire probe composed of submicron cold-wires (IJHFF, 2008)

Accurate prediction of complex turbulent heat transfer by the two-equation model

- Two-equation model for heat transfer
  \[-\overline{u_j\partial \overline{\theta}} = \frac{\partial \overline{e_j}}{\partial x_j}\]
- Modeling of eddy diffusivity for heat
  \[\alpha_t = C_\lambda f_\lambda (k^2/\varepsilon) f(R)\]
  \[R = \frac{T_\theta}{\tau_u} = \frac{k_\varepsilon}{\varepsilon}/\varepsilon\]

The eddy diffusivity for heat is modeled using the time scale ratio \(R\) (see the left column) without using the turbulent Prandtl number. This novel formulation at the two-equation level not only increases the universality of numerical calculation of turbulent heat transfer but also provides reliable predictions of the variance of temperature fluctuations.

Detailed understanding of turbulent heat transfer by DNS

Direct numerical simulation (DNS) enables us to elucidate turbulent heat transfer phenomena in the vicinity of the wall.

- DNS based on the finite-difference method for thermally-stratified turbulent boundary layer over a 2-dimensional hill (ICJWSF, 2013)
- DNS for turbulent heat transfer in plane impinging jet (IJHFF, 2004)
- Streamwise averaged velocity vectors and temperature fluctuations in non-rotating/rotating channel flows by DNS of spectral method (JoT, 2003)
Professor Yasutaka Nagano
— Main research fields and key achievements —

I. Experimental Investigation of Turbulent Transport Phenomena

II. Modeling of Turbulent Heat and Momentum Transfer

III. DNS and LES of Turbulent Heat and Fluid Flows