

Visualization of large scale consecutive data of turbulence

Takashi Ishihara[1], Hiroyuki Komori[2], Kensaku Mori[3], Yasuhito Suenaga[1], Makoto Yagyu[4], Kazuki Hayashi[5], Yukio Kaneda[6]

[1] Dept. of CSE, Nagoya Univ, [2] Electrical and Electronics Eng. and Informaion Eng., Nagoya Univ, [3] Research Center for Advanced Waste and Emission Management, Nagoya Univ, [4] Phys. Sci. and Eng., Nagoya Univ, [5] Dept. of CSE, Nagoya University, [6] Dept. CSE, Nagoya Univ.

<http://www.fluid.cse.nagoya-u.ac.jp/~ishihara/>

We have developed a turbulence visualization system which can render preprocessed three-dimensional (3D) flow data in real time. We have selected a volume rendering method because it visualizes readily volumetric data (scalar data defined on each 3D grid point) by only defining a color and opacity lookup table. In recent years CPU performance on conventional personal computers (PC) has dramatically increased and CPUs are equipped with Single Instruction Multiple Data (SIMD) and cache control instructions for multimedia applications. Our visualization system achieves high speed of volume rendering by taking advantage of only these highly optimized instructions, without a need for specialized graphics hardware. It renders a set of volumetric data with 512 cubed grid points at about five frames per second (fps) and consecutive volumes on 128 cubed grid points at about two fps on a commercial PC (two Intel 1.7GHz Xeon processors and 2GB main memory). Rendering includes perspective projection, specular reflection, spotlighting, and light attenuation. We have also developed a non-interactive version, which has been used on a workstation equipped with 4GB main memory and 1TB raid system, to make animations of sequential data from a high resolution direct numerical simulation of turbulence with 512 cubed grid points.