NEW TRENDS IN FLUID MECHANICS RESEARCH
Proceedings of the Fifth International Conference on Fluid Mechanics, *Aug.15-19, 2007, Shanghai, China*


# An Investigation of Scalar Dispersion in Grid Turbulence

P. E. Dimotakis[1,*], D. B. Lang[1], S. Lombeyda[2], J. Lindheim[2]

*California Institute of Technology, Pasadena, California 91125, U.S.A*
[1]*Graduate Aeronautical Laboratories*
[2]*Center for Advanced Computing Research*
Email: dimotakis@caltech.edu

**Abstract**
The structure of scalar dispersion from a continuous release point was investigated for moderate Reynolds number flow in grid turbulence. Using laser-induced fluorescence techniques, laser-volume scanning, a custom-designed fast-readout CCD focal plane array, and high-speed digital-imaging/-acquisition/-storage techniques, the instantaneous three-dimensional structure of a passive scalar was investigated in flow in water (high Schmidt number). Laser Doppler and scalar-correlation velocimetry were employed to measure th flow speed entering the test section and in the interrogated volume. Such scalar-dispersion structure away from the release point is typically modeled assuming a Gaussian profile. This provides a good description for the mean scalar profile as a function of the transverse distance from a line parallel with the flow and downstream of the release point, as also confirmed by experiment (Yamamoto & Sato 1979, Gad-el-Hak & Morton 1979, Nakamura et al. 1987, Sawford 2001). The instantaneous three-dimensional structure, however, reveals a rich topology of scalar structures that was found to persist in the volume interrogated, spanning a distance from the grid and release point between 22 and 30 grid mesh lengths, which is in the self-similar grid-turbulence regime where the present three-dimensional scalar-field measurements were conducted.

## REFERENCES

1. Yamamoto K, Sato Y. Measurements of Lagrangian behaviors of turbulent fluid. Study of Fundamental Engineering for Materials in Yokohama National University, 1979; **14**: 25-36
2. Gad-el-Hak M, Morton JB. Experiments on the diffusion of smoke in isotropic turbulent flow. *AIAA J.*, 1979; **17**: 558-562
3. Nakamura I, Sakai Y, Miyata M. Diffusion of matter by a non-buoyant plume in grid turbulence. *J. Fluid Mech*, 1987; **178**: 379-403
4. Sawford B. Turbulent relative dispersion. *Ann. Rev. Fluid Mech.*, 2001; 33: 289-317