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Hierarchical parcel-swapping (HiPS) representation of turbulent flow and mixing ALAN KERSTEIN, Danville, CA — An economical representation of effects of turbulence on the time-evolving structure of diffusive scalar fields is obtained by introducing a hierarchical (tree) network connecting fluid parcels, with effects of turbulent advection represented by swapping pairs of sub-trees at rates determined by turbulence time scales associated with the sub-trees [1]. The fluid parcels reside at the base of the tree. The tree structure partitions the fluid parcels into adjacent pairs (or more generally, p-tuples). Adjacent parcels intermix at rates governed by diffusion time scales based on molecular diffusivities and parcel sizes. This simple procedure efficiently accomplishes long-standing objectives of turbulent mixing model development, such as generating physically based time histories of fluid-parcel nearest-neighbor encounters and the associated spatial structure of turbulent scalar fields. With the introduction of velocity components as well as scalars, this hierarchical parcel-swapping (HiPS) formulation becomes a self-contained flow simulation, as illustrated by its application to fully developed channel flow [2]. [1] A. R. Kerstein, J. Stat. Phys. **153**, 142-161 (2013). [2] A. R. Kerstein, J. Fluid Mech. **750**, 421-463 (2014).

Alan Kerstein
Danville, CA

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