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On the kinematics of scalar iso-surfaces in turbulent flow BRANDON C. BLAKELEY, JAMES J. RILEY, DUANE W. STORTI, WEIRONG WANG, University of Washington — The behavior of scalar iso-surfaces in turbulent flows is of fundamental interest and importance in a number of problems, e.g., the stoichiometric surface in non-premixed reactions, and the turbulent/non-turbulent interface in localized turbulent shear flows. Of particular interest here is the behavior of the average surface area per unit volume, Σ. We report on the use of direct numerical simulations and sophisticated surface tracking techniques to directly compute Σ and model its evolution. We consider two different scalar configurations in decaying, isotropic turbulence: first, the iso-surface is initially homogenous and isotropic in space, second, the iso-surface is initially planar. A novel method of computing integral properties from regularly-sampled values of a scalar function is leveraged to provide accurate estimates of Σ. Guided by simulation results, modeling is introduced from two perspectives. The first approach models the various terms in the evolution equation for Σ, while the second uses Rices theorem to model Σ directly. In particular, the two principal effects on the evolution of Σ, i.e., the growth of the surface area due to local surface stretching, and the ultimate decay due to molecular destruction, are addressed.

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