Abstract Submitted
for the DFD11 Meeting of
The American Physical Society

A fractal dynamic SGS combustion model for turbulent premixed flames ITARU YOSHIKAWA, YOUNGSAM SHIM, MAMORU TANAHASHI, TOSHIO MIYAUCHI, Tokyo Institute of Technology — A dynamic subgrid scale (SGS) combustion model for large eddy simulation (LES) of turbulent premixed combustion has been developed based on the fractal characteristics of turbulent premixed flames and the scale separation of turbulence. This model locally predicts the fractal dimension of a flame surface and the local flame surface area. To give the lower limit of the flame surface area, the contribution of dilatation across the flame is also considered. The local turbulent flame speed is then determined supposing the flamelet concept. In the model formulation, the Kolmogorov length scale is described with the grid scale (GS) variables to yield the inner-cutoff of the flame surface. It is achieved by assuming that, in high Reynolds number turbulence, most of the turbulence energy is dissipated in the SGS level and the dissipation balances with the energy production that is given by an SGS turbulence model. A series of static tests have been performed to examine the model by filtered data of direct numerical simulation (DNS). Gaussian or tophat filters with different widths within the range of the inner- and outer-cutoffs of the flame surface are applied as the LES and the test- filters. The results show that the predicted flame surface area agrees well with that extracted from the DNS data regardless of the filter type and the widths.

Itaru Yoshikawa
Tokyo Institute of Technology

Date submitted: 06 Aug 2011 Electronic form version 1.4