**Flow, Turbulence and Combustion formerly `Applied Scientific Research'**
An International Journal published in association with ERCOFTAC
Article Abstract



PREVIOUS ABSTRACT | PDF | NEXT ABSTRACT

Export Citation: Text RIS
doi:10.1023/B:APPL.0000004934.22265.74
Flow, Turbulence and Combustion
**70** (1-4): 153-181, 2003


# On Fokker–Planck Equations for Turbulent Reacting Flows. Part 2. Filter Density Function for Large Eddy Simulation

**Stefan Heinz**
*Fachgebiet Strömungsmechanik, Technische Universität München, Boltzmannstr. 15, D-85747 Garching, Germany; E-mail: heinz@flm.mw.tum.de*

**Abstract**
The application of large eddy simulation (LES) to turbulent reacting flow calculations is faced with several closure problems. Suitable parametrizations for filtered reaction rates for instance are hardly available in general. A way to overcome these problems is investigated here. This is done by extending LES equations for filtered velocities and scalars (mass fractions of species and temperature) to equations that involve subgrid scale (SGS) fluctuations. Such equations are called filter density function (FDF) methods because they determine the FDF, which is essentially the probability density function of SGS variables. The FDF model considered involves only three parameters: $C_0$ that controls the generation of velocity fluctuations and two parameters which determine the relaxation of velocity and scalar fluctuations. The consideration of this model may be seen as the analysis of a limiting case: the implications of the most simple equations for the dynamics of SGS fluctuations are investigated in this way. These equations were proved recently by various simulations. Here, the FDF model is used analytically to improve simpler methods. Existing models for the SGS stress tensor in velocity LES equations and the diffusion coefficient in scalar FDF equations are generalized in this way. The advantages of these models compared to existing ones are pointed out. These investigations provide further evidence for the suitability of the FDF model considered and they provide its parameters. A theoretical value $C_0 = 19/12$ is derived, which agrees very well with the results of direct numerical simulation. This estimate implies the same value for the universal Kolmogorov constant of the energy spectrum, which is consistent with the results of many measurements. The other two model parameters can be obtained then by dynamic procedures. Therefore, the closure problems of LES equations are overcome in this way such that adjustable parameters are not involved.

**Keywords**
filter density function, large eddy simulation, stochastic model for subgrid-scale turbulence, subgrid-scale stress tensor, turbulent diffusion coefficient

**Article ID:** 5146371