Stochastic energy-cascade model for 1+1 dimensional fully developed turbulence

Jürgen Schmiegel
Thiele Centre for Applied Mathematics in Natural Science,
Aarhus University, DK–8000 Aarhus, Denmark
Jochen Cleve
ICTP, Strada Costiera, 11, 34014 Trieste, Italy
Hans C. Eggers
Department of Physics, University of Stellenbosch,
ZA–7600 Stellenbosch, South Africa
Bruce R. Pearson
School of Mechanical Materials, Manufacturing Engineering and Management,
University of Nottingham, Nottingham NG7 2RD, United Kingdom
and
Martin Greiner
Corporate Technology, Information&Communications,
Siemens AG, D-81730 München, Germany

Abstract

Geometrical random multiplicative cascade processes are often used to model positive-valued multifractal fields such as the energy dissipation in fully developed turbulence. We propose a dynamical generalization describing the energy dissipation in terms of a continuous and homogeneous stochastic field in one space and one time dimension. In the model, correlations originate in the overlap of the respective spacetime histories of field amplitudes. The theoretical two- and three-point correlation functions are found to be in good agreement with their equal-time counterparts extracted from wind tunnel turbulent shear flow data.