Relevant length scales and time scales in shear flow turbulence

Benjamin D. Mater[1], Subhas Venayagamoorthy[2], Lakshmi Dasi[3]
Department of Civil and Environmental Engineering, Colorado State University

Abstract. Shear flow turbulence has been the subject of fundamental research due to its ubiquitous presence in engineering and natural flows. In this study, we take a fresh approach using dimensional arguments tempered by physical reasoning to gain further insights on its phenomenology. Beginning with the four basic quantities: turbulent kinetic energy k, dissipation rate ε, kinematic viscosity ν, and mean shear S, we construct six length scales and two time scales that are most relevant to this classical problem and discuss their implications on phenomenology. High-resolution DNS data of turbulent channel flow and homogeneous shear flow are used to highlight important transitions in the flow dynamics and provide a framework to explain the energy cascade process.

[1] Civil Engineering Department
Colorado State University
Fort Collins, CO 80523-1372
e-mail: benjamin.mater@colostate.edu
[2] Civil Engineering Department
Colorado State University
Fort Collins, CO 80523-1372
Tel: (970) 491-1915
e-mail: karan.venayagamoorthy@colostate.edu
[3] Mechanical Engineering Department
Colorado State University
Fort Collins, CO 80523-1372
Tel: (970) 491-3706
e-mail: lakshmi.dasi@colostate.edu