Turbulent Flows

Stephen B. Pope
Cambridge University Press, 2000

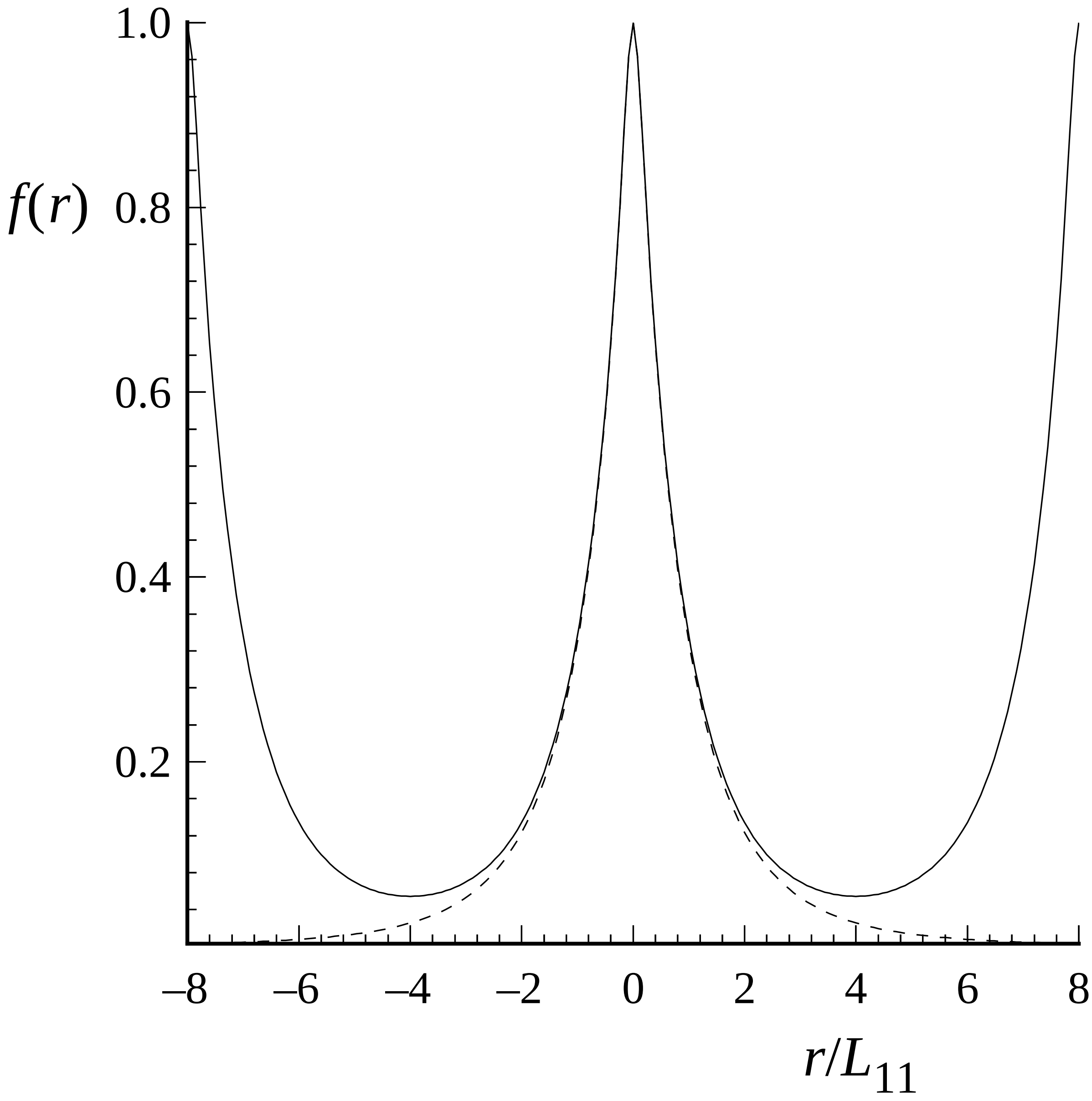

Figure 9.1: Effect of periodicity on the longitudinal velocity autocorrelation function. Dashed line, $f(r)$ for the model spectrum at $R_\lambda = 40$; solid line, $f(r)$ for the periodic velocity field ($\mathcal{L} = 8L_{11}$), with approximately the same spectrum.

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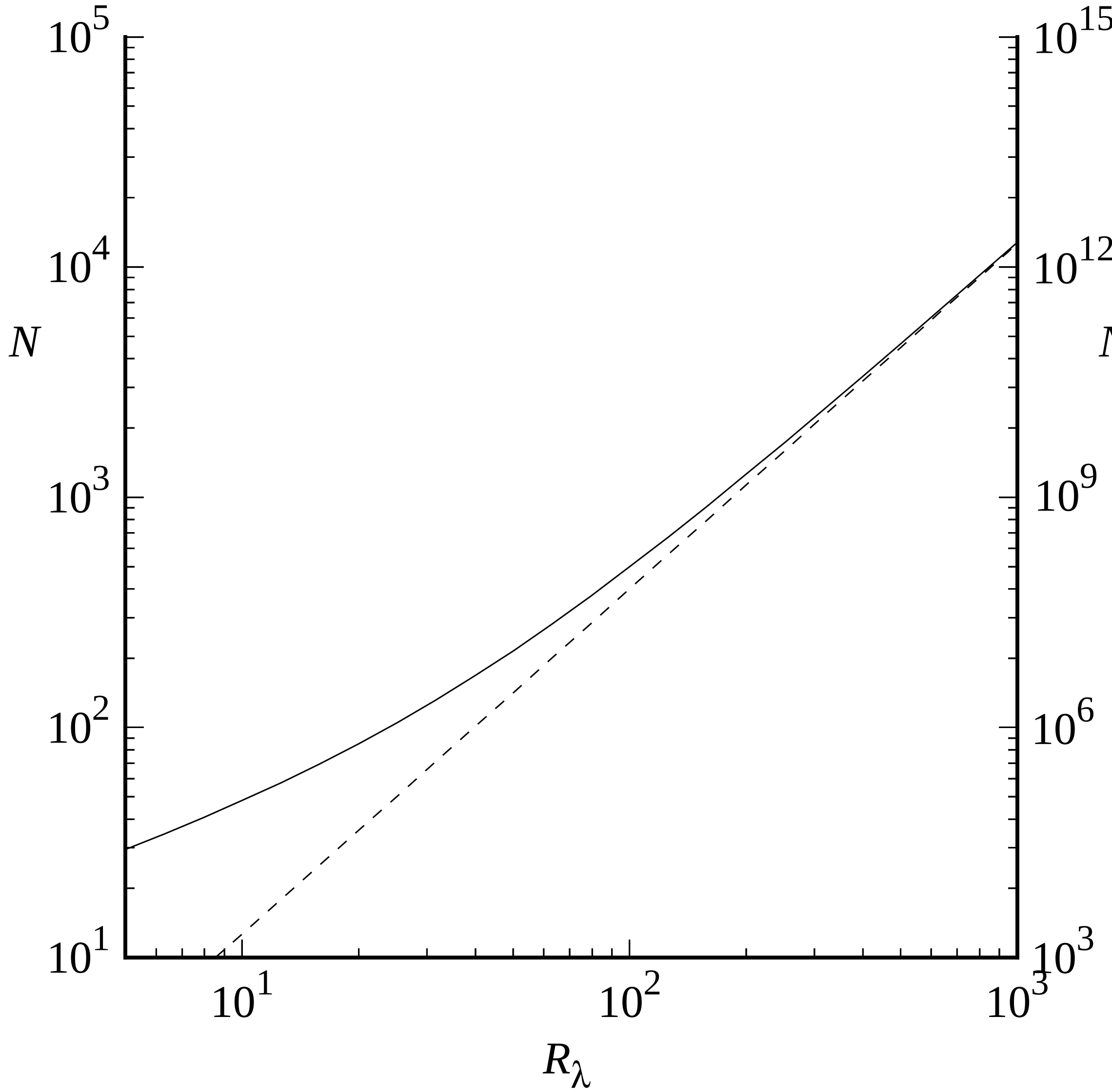

Figure 9.2: Number of Fourier modes (or grid nodes) N in each direction required for adequate resolution of isotropic turbulence. Solid line, Eq. (9.7); dashed line, asymptote, Eq. (9.8). The right-hand axis shows the total number of modes required, N^3.

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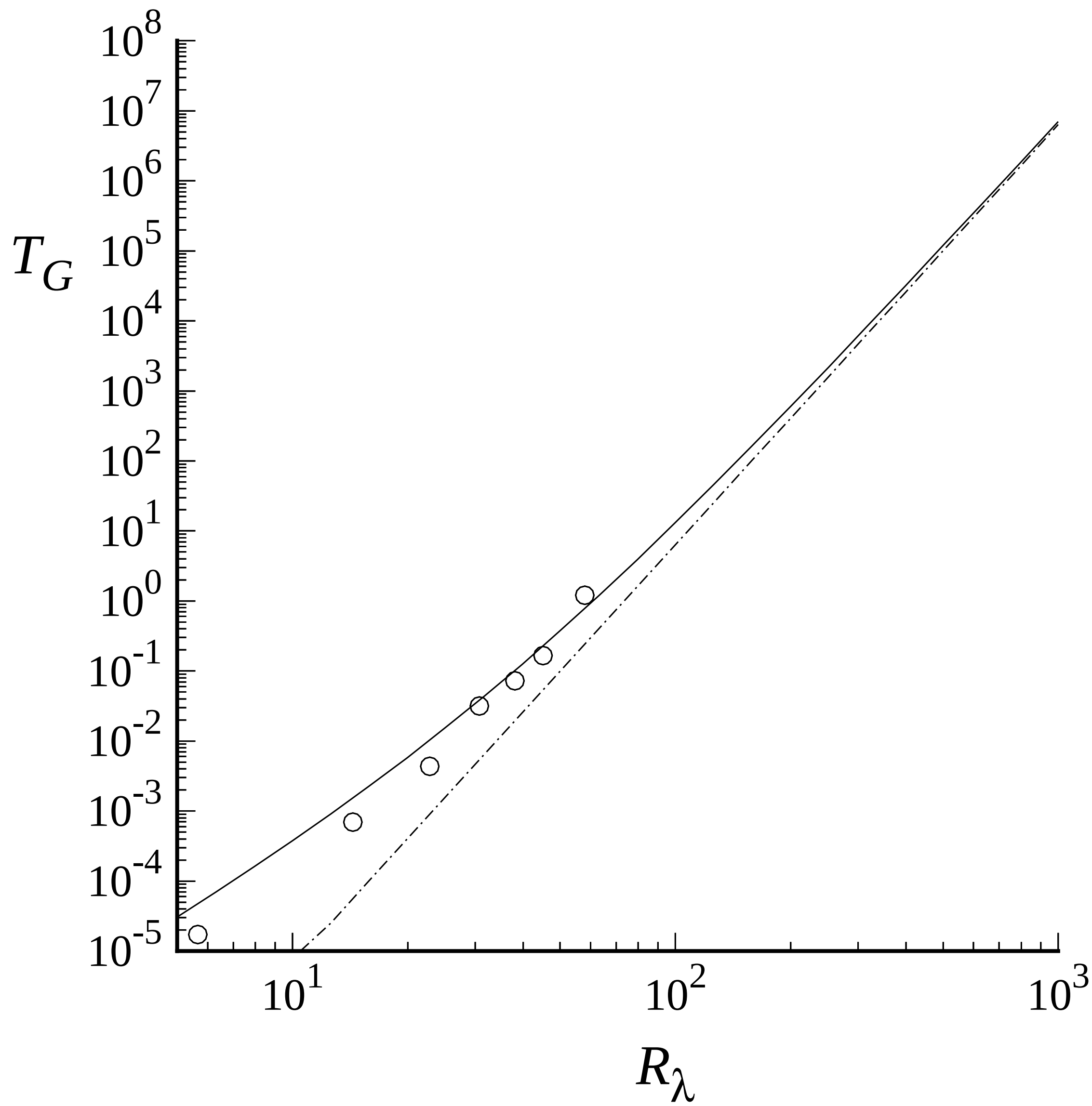

Figure 9.3: Time in days T_G to perform DNS of homogeneous isotropic turbulence on a gigaflop computer as a function of Reynolds number. Solid line, estimate from Eqs. (9.7), (9.11) and (9.13); dashed line, asymptote $(R_\lambda/70)^6$; symbols, based on DNS timings for a 40 node IBM SP2.

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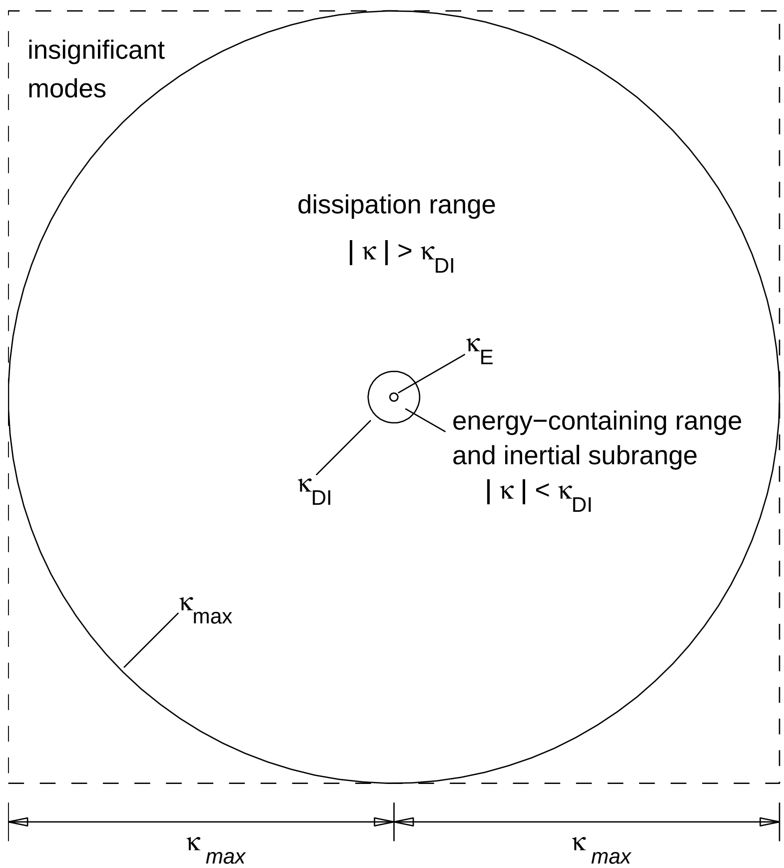

Figure 9.4: Solution domain in wavenumber space for a pseudo-spectral DNS of isotropic turbulence. Represented modes lie within the cube of side $2\kappa_{\rm max}$ (dashed line). The three spheres shown are: of radius $\kappa_{\rm max}$, the maximum wavenumber resolved in all directions ($\kappa_{\rm max}\eta = 1.5$); of radius $\kappa_{\rm DI}$, the wavenumber of the largest dissipative motions ($\kappa_{\rm DI}\eta = 0.1$); and of radius κ_E, the wavenumber corresponding to the peak of the energy spectrum at $R_\lambda = 70\,(\kappa_E L_{11} = 1.3)$. Only 0.016% of the represented modes lie within the sphere of radius $\kappa_{\rm DI}$, corresponding to motions in the energy-containing range and in the inertial subrange.

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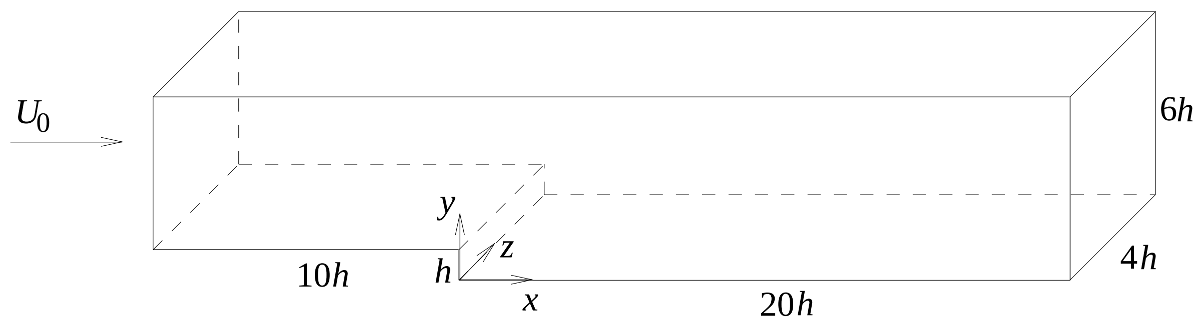

Figure 9.5: Sketch of the solution domain used by Le *et al.* (1997) for DNS of flow over a backward-facing step. Dimensions are in units of the step height, h.