

Solution to Ex. 6.13

of *Turbulent Flows* by Stephen B. Pope, 2000

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Show from Eq. (6.118) that

$$F_{\boldsymbol{\kappa}} \{ \nabla^2 g(\mathbf{x}) \} = -\kappa^2 \hat{g}(\boldsymbol{\kappa}) \quad (1)$$

Solution

The Laplace operator in index form is

$$\nabla^2 = \frac{\partial^2}{\partial x_j \partial x_j} \quad (2)$$

then

$$F_{\boldsymbol{\kappa}} \{ \nabla^2 g(\mathbf{x}) \} = F_{\boldsymbol{\kappa}} \left\{ \frac{\partial^2}{\partial x_j \partial x_j} g(\mathbf{x}) \right\} \stackrel{\text{Eq. (6.118)}}{=} (i\kappa_j)(i\kappa_j) \hat{g}(\boldsymbol{\kappa}) = -\kappa^2 \hat{g}(\boldsymbol{\kappa}) \quad (3)$$