and

$$L_t(t) = \frac{\alpha^6|\omega|\sqrt{\omega^2 + 4\alpha^2}}{(\omega^2 + \alpha^2)^4} \cos(\omega t - \delta)\,.$$

with

$$\delta = 8 \arctan\left(\frac{\omega}{\alpha}\right) + \arctan\left(\frac{2\alpha}{\omega}\right) - \pi\,.$$

From these results, verify the selectivity curves in figures 2.15 and 2.16. In addition, plot δ as a function of ω.

7. Numerically compute the spatial part of the linear response of a simple cell with a separable space-time receptive field to a sinusoidal grating, as given by equation 2.31. Use a stimulus oriented with $\Theta = 0$. For the spatial receptive field kernel, use equation 2.27 with $\sigma_x = \sigma_y = 1°$, $\phi = 0$, and $1/k = 0.5°$. Plot L_s as a function of K taking $\Phi = 0$ and $A = 50$. This determines the spatial frequency selectivity of the cell. What is its preferred spatial frequency? Plot L_s as a function of Φ taking $1/K = 0.5°$ and $A = 50$. This determines the spatial phase selectivity of the cell. What is its preferred spatial phase?

8. Consider a complex cell with the spatial part of its response given by $L_1^2 + L_2^2$, where L_1 and L_2 are linear responses determined by equation 2.31 with kernels given by equation 2.27 with $\sigma_x = \sigma_y = 1°$, and $1/k = 0.5°$; and with $\phi = 0$ for L_1 and $\phi = -\pi/2$ for L_2. Use a stimulus oriented with $\Theta = 0$. Compute and plot $L_1^2 + L_2^2$ as a function of K taking $\Phi = 0$ and $A = 5$. This determines the spatial frequency selectivity of the cell. Compute and plot $L_1^2 + L_2^2$ as a function of Φ taking $1/K = 0.5°$ and $A = 5$. This determines the spatial phase selectivity of the cell. Does the spatial phase selectivity match what you expect for a complex cell?

9. Consider the linear temporal response for a simple or complex cell given by equation 2.32 with a temporal kernel given by equation 2.29 with $1/\alpha = 15$ ms. Compute and plot $L_t(t)$ for $\omega = 6\pi/s$. This determines the temporal response of the simple cell. Do not plot the negative part of $L_t(t)$ because the cell cannot fire at a negative rate. Compute and plot $L_t^2(t)$ for $\omega = 6\pi/s$. This determines the temporal response of a complex cell. What are the differences between the temporal responses of the simple and complex cells?

10. Compute the response of a model simple cell with a separable space-time receptive field to a moving grating

$$s(x, y, t) = \cos(Kx - \omega t)\,.$$

For D_s, use equation 2.27 with $\sigma_x = \sigma_y = 1°$, $\phi = 0$, and $1/k = 0.5°$. For D_t, use equation 2.29 with $1/\alpha = 15$ ms. Compute the linear estimate of the response given by equation 2.24 and assume that the