The Auditory System and Human Sound-Localization Behavior

Exercises Chapter 6

Problem 6.1 Derive Eqn. 6.8.

(*Hint:* First calculate the FT of Eqn. 6.7. Note that the FT of the cosine term gives two delta functions: $S(f) = \frac{1}{2}[e^{-j\phi} \cdot \delta(f + f_{cf}) + e^{j\phi} \cdot \delta(f - f_{cf})]$. Then, show that the FT of the prefactor, $g(t) = t^{n-1} \cdot e^{-at}$ is given by: $G(f) = \frac{(n-1)!}{(a+j2\pi f)^n}$. Now combine the two FT's: *H(f)=S(f)*G(f)*, with * convolution. Finally, note that one of the two terms arising from the cosine transform may be neglected relative to the other term.)

Problem 6.2 Calculate the Fourier spectrum (frequency, amplitude, phase) of the rectified (positive only) modulated sinusoid, which describes the firing of a phase-locked AN fiber, as given by Eqn. 6.14 (see also Chapter 2).

Problem 6.3 Verify Eqn. 6.13.

Problem 6.4 Get a feeling for the validity of Eqn. 6.17, by deriving the expressions explicitly for N=2 and N=3:

a) Calculate A and Ψ from:

$$a \cdot e^{i\cdot(\omega_1 t+\varphi_1)} + b \cdot e^{i\cdot(\omega_2 t+\varphi_2)} = A \cdot e^{i\cdot(\psi)}$$

b) Use the result from (a) to extend to 3 components:

$$a \cdot e^{i\cdot(\omega_1 t+\varphi_1)} + b \cdot e^{i\cdot(\omega_2 t+\varphi_2)} + c \cdot e^{i\cdot(\omega_3 t+\varphi_3)} = A \cdot e^{i\cdot(\psi)}$$

Problem 6.5 Verify (analytically, or through a numerical simulation) that Eqn. 6.16 lets the time constant τ(t) vary between τ_{Narrow} and τ_{Wide}.