Model constants and added analysis on the affects of varying model parameters for "Dual traveling waves in an inner ear model with two degrees of freedom"

PARAMETERS

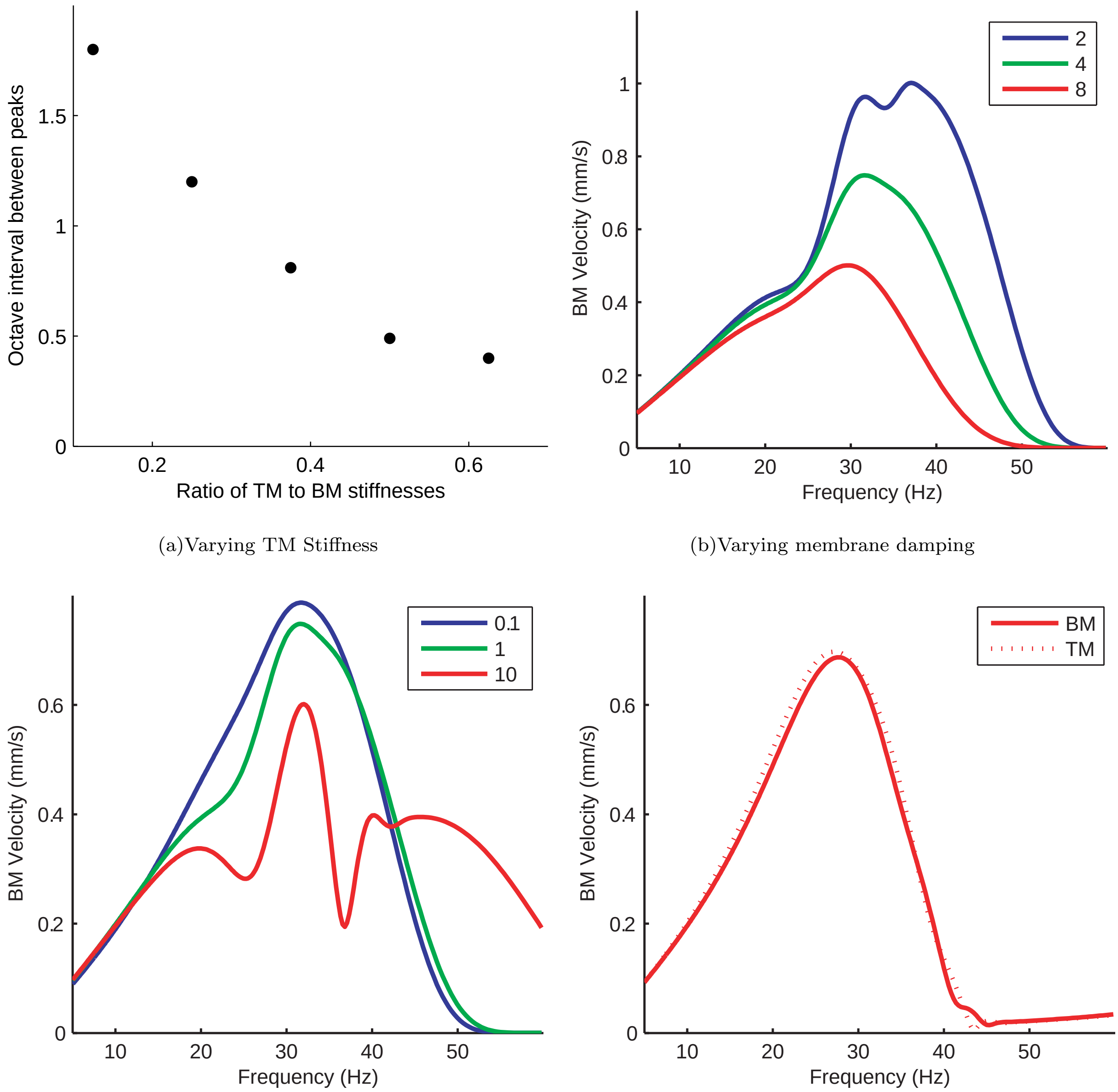
Constants	
ρ=1 $\frac{\mathrm{g}}{\mathrm{cm}^3}$	Density of water
H=0.35mm	Height of single fluid compartment
L=7 mm	Length of cochlea
H_{OC}=75μm	Height of the OC plus membranes
D=4 $\frac{\mathrm{g}}{\mathrm{s}}$	BM and TM internal damping
D_{12}=1 $\frac{\mathrm{g}}{\mathrm{s}}$	Coupling damping
S_{12}=5×10^5 $\frac{\mathrm{dyn}}{\mathrm{cm}}$	Coupling stiffness
z-dependent parameters	
$W(z)$=0.1$e^{0.7z}$mm	Width of cochlear partition in x
S_{TM}=2×10^7e^{-7z} $\frac{\mathrm{dyn}}{\mathrm{cm}}$	TM stiffness
S_{BM}=4×10^7e^{-7z} $\frac{\mathrm{dyn}}{\mathrm{cm}}$	BM stiffness

MATRICES

$$\mathbf{M}(z) = \begin{bmatrix} \frac{1}{2}\rho H_{OC} W(z) & 0 \\ 0 & \frac{1}{2}\rho H_{OC} W(z) \end{bmatrix}$$

$$\mathbf{D}(z) = \begin{bmatrix} D(z) + D_{12} & -D_{12} \\ -D_{12} & D(z) + D_{12} \end{bmatrix}$$

$$\mathbf{S}(z) = \begin{bmatrix} S_{\mathrm{TM}}(z) + S_{12} & -S_{12} \\ -S_{12} & S_{\mathrm{BM}}(z) + S_{12} \end{bmatrix}$$



(a)Varying TM Stiffness

(b)Varying membrane damping

(c)Varying Coupling Stiffness

(d)Strong Coupling

FIG. 1. **Examples** a) shows the separation between the characteristic frequencies of the TM and BM at z =1.75 mm while varying TM stiffness. This change mostly shifts the TM CF, but also has a small affect on the BM CF. b) depicts BM tuning curves with different internal membrane damping, D. As the damping becomes large, the CF peak and associated Q become smaller. However, if the damping is small additional bumps from coupling may appear on the tuning curve. The legend gives the damping values. c) demonstrates the effects of varying the coupling stiffness S_{12} on the BM tuning curve. If the coupling is weak, there is little sign of the TM on the BM tuning curve. If it is strong, there is wave interference causing multiple peaks. The legend indicates the multiplicative factor by which S_{12} varies from the the figures in the main text. d) shows tuning curves for the TM and BM when the coupling spring, S_{12}, is 100 times that in the paper. It is stiffer than the TM and BM. In this regime, the tuning curves for the TM and BM are nearly identical because the two bodies are entrained.

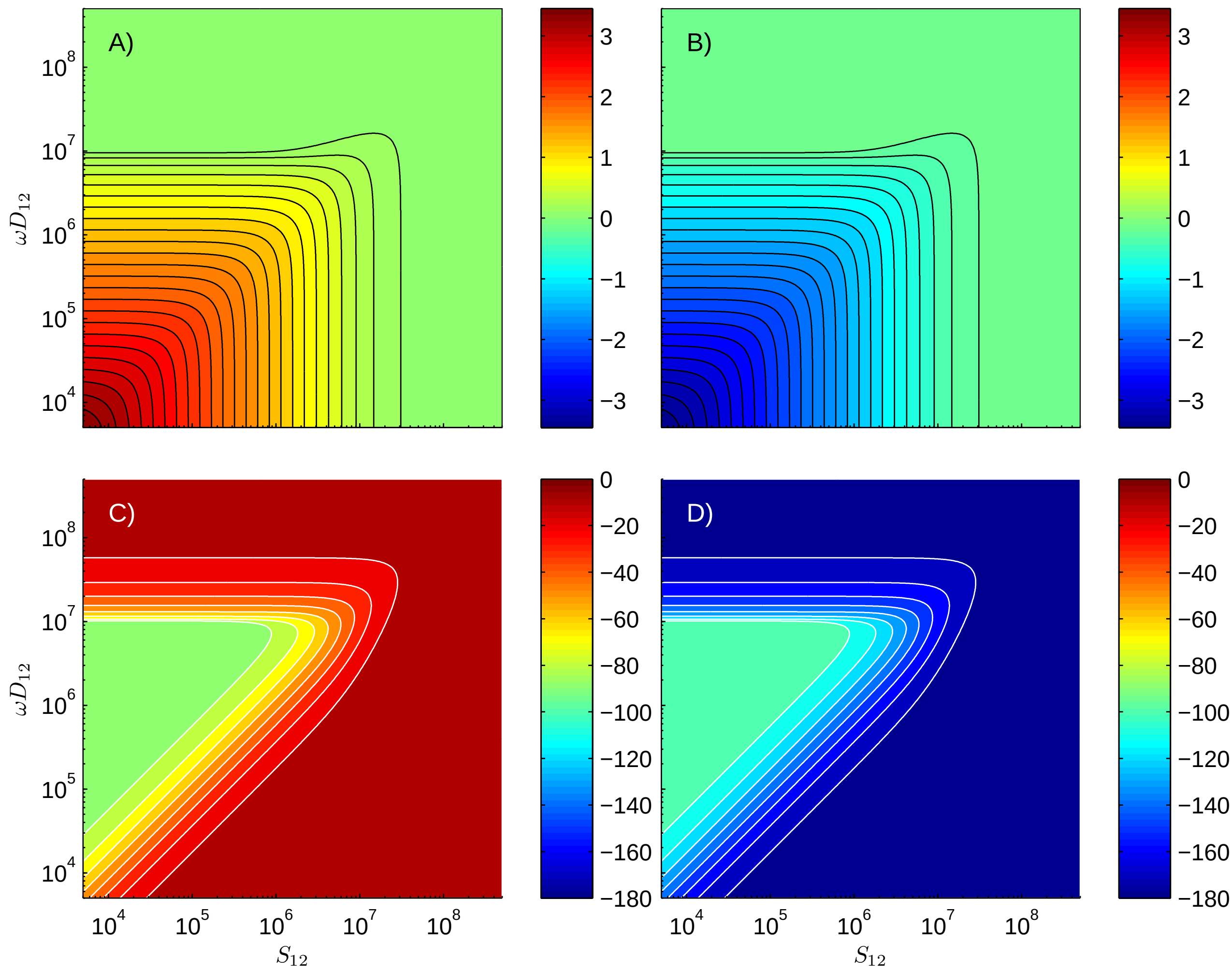


FIG. 2. **Visual analysis of eigenvector ratios.** These plots show quantities derived from $\alpha^{\pm}$ when $\Delta S = 2 \times 10^7$ dyn/cm. Plots A) and C) show the - mode and plots B) and D) show the + mode. Plots A) and B) show the log of the absolute value of alpha. If this is near 0 it indicates the amplitudes of the BM and TM are similar. If it is negative, the BM has a larger amplitude and if it's positive the TM has a larger amplitude. Plots C) and D) show the phase of $\alpha^{\pm}$, which largely determines the phase between TM and BM motions. Mode conversion can occur where the phase of α is near -90° and the absolute value is near 1. By examining these plots, it can be seen that such a condition occurs near $\omega D_{12} \approx 10^7$, or $\frac{1}{2}\Delta S$ unless $S_{12} < \frac{1}{2}\Delta S$.