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Simulating electrically evoked emissions in the cochlea

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Electrical stimulation of the cochlea is a means for investigating the electromechanics of the organ. In this study, we use a mechanical-electrical-acoustic cochlear model to make predictions of the effect of intracochlear bipolar electrical stimulation on the basilar membrane velocity and stapes velocity. Bipolar stimulation provides for a localized means of stimulating the outer hair cells (OHC) and is a well-established technique for evoking otoacoustic emissions. We show that both fast, fluid-borne, and slow, fluid-structure waves are possible. Whether the fast or slow waves dominate the overall response depends on the level of activity in the cochlea, the frequency and location of excitation, and the boundary conditions at the stapes and round window. We show that forward propagating traveling waves may dominate the basilar membrane response even with intracochlear stimulation apical to the measurement site. These results bear direct impact on the interpretation of noninvasive measurements using otoacoustic emissions.