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Title:
Introducing global coupling to nearest-neighbor models of SOAE generation

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While the existence of spontaneous otoacoustic emissions (SOAEs) provides the most salient evidence for an "active" ear, the underlying generation mechanisms are still not well understood. Both wave-based and local oscillator-based frameworks have been studied, but common ground between them remains unclear (e.g., standing waves versus frequency plateaus; Epp et al. MoH 2014). The present study sought to gain further insight (e.g., role of waves for dynamically coupling elements together) by focusing on a relatively simpler ear that exhibits robust SOAE activity, that of a lizard. The approach taken here is two-fold. First, a theoretical foundation is developed that combines active nonlinear oscillators (Vilfan & Duke, 2008, Biophys. J. 95:4622-4630) with global coupling via the rigid papilla (Bergevin & Shera, 2010, JASA 127:2398-2409). This framework is explored computationally and solved in the time domain. Second, we report some recent OAE data collected from lizards focused on characterizing dynamics of SOAE activity (e.g., response to clicks, tone bursts). The purpose is to use such data as a qualitative benchmark for assessing the validity of the model. While the large parameter space coupled with the nonlinearity introduces challenges, initial findings indicate that the model is capable of capturing some features apparent in SOAE data (e.g., the generation of peaks) but not others (e.g., limited dynamic range, width of peaks). It was also observed that oscillators within a "cluster" (i.e., plateau) exhibit relatively complicated motions and poor phase coherence, indicating the need to better characterize the biomechanical relevance of a cluster.