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Title:
Dynamics of spontaneous otoacoustic emissions: Theory and experiment

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The vertebrate ear both responds to and emits sound. Sounds from the ear, known as otoacoustic emissions (OAEs), provide a means to probe the biophysics of auditory transduction and amplification. While the existence of spontaneous emissions (SOAEs) provides compelling evidence for an "active" ear, the mechanisms that produce them, and whether they vary among species, are still not well understood. The present study focuses on a relatively simple ear that exhibits robust SOAE activity, that of a lizard. The approach is two-fold. First, we develop a theoretical description 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, to help assess the validity of SOAE models, we report recent measurements from lizards that explore the dynamics of SOAE activity in response to transient external stimuli (e.g., clicks and tone bursts). While the large parameter space and the complicated nonlinear dynamics both present challenges, preliminary findings indicate that the model captures some features of the data (e.g., the generation of distinct SOAE spectral peaks) but not others (e.g., SOAE bandwidths and the dynamic range of their response to stimuli). We also found that oscillators within a "frequency cluster" exhibit complicated motions and poor phase coherence, indicating that clusters have significant internal dynamics.