

# **Neural coding of natural signals: theory, computation, and data**

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Neural codes must serve a wide range of sensory tasks. With a myriad of possible codes, why do biological sensory systems use the codes they do? Can we develop theories that explain sensory coding in terms of fundamental principles? One such principle is efficient coding theory. This postulates that the goal of sensory coding is to encode signals accurately and efficiently. In this talk, I will review recent progress in this area and focus on how this theoretical approach can be extended to learn efficient auditory codes using a spiking population code. In this model, idealized spikes encode the precise temporal positions and magnitudes of underlying acoustic features. When the set of acoustic features is adapted to optimally encode natural sounds, the spike code achieves far greater coding efficiency than conventional representations. Furthermore, the inferred features show both striking similarities to measured cochlear filters and a similar bandwidth versus frequency dependence across the population. These results provide evidence that the neural coding of auditory signals approaches an information theoretic optimum. Finally, I will present evidence that suggests speech itself is adapted to the coding capacity of the mammalian auditory system.