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Mechanical manipulation and bifurcation dynamics of stereociliary bundles SEUNG JI, LEA FREDRICKSON-HEMSING, ROBIJN BRUINSMA, DOLORES BOZOVIC, UCLA — We propose a numerical model for the mechanical response of hair cells of the inner ear. These mechanically sensitive cells have been described previously using systems of nonlinear differential equations, that captured the main features of the experimental phenomena. Here we extend the study to include the effects of static and time-dependent forcing, and show it to induce transitions across different types of bifurcations. We compare the theory to the experimental measurements of the phase-locked response of spontaneously oscillating hair cells of the bullfrog sacculus, under varying mechanical deflections. For a static deflection, when adaptation phenomena play an important role, the offset generates a critical point where the frequency but not the amplitude vanishes, as opposed to the expected Hopf bifurcation where the amplitude vanishes. On the other hand, for a periodic deflection, mode-locking of the spontaneous oscilliations to the drive period can proceed via different types of bifurcations, depending on the degree of detuning. We will present a simple dynamic systems framework that captures the main features of the experimentally observed behavior in the form of an Arnold Tongue.

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