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Models of Hair Cell Bundle Functioning

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Animals utilize sensory (vestibular, lateral-line, auditory) systems with hair cells to detect a variety of mechanical stimuli from their environment. The forces exerted on the hair cell (cilia) bundle (HCB) due to its interaction with the moving environment result in deformation of the special fine strands (tip-links) located between cilia. It leads to cell polarization that modulates neural activity of the afferent. Two extreme cases of the HCB interaction with the moving gel (vestibular system) were modeled: 1) the HCBs exactly follow the gel displacement; 2) stiff stereocilia and weak surrounding gel allow the motion of the bundle relative to the gel. The results suggest that the HCB structure with stereocilia of varying heights is designed to transform the temporal pattern of external acceleration (or its time derivative) in temporal pattern of cell depolarization by measuring spatial distribution of displacements (or velocities) of the gel caused by this acceleration.

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