Sensing with Whiskers: From Geometry and Mechanics to the Statistics of the Array

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The ability of the nervous system to integrate information about the sense of touch and transform these sensory inputs into motor commands can be challenging for individuals with neurological disorders. Treating such diseases requires an understanding of how neurons encode tactile information, currently an open question in the field of computational neuroscience. Investigating this problem in humans poses many challenges. Therefore, we use the rodent whisker system, a widely applied model that parallels human neural pathways, to study how neurons encode tactile information. The whisker array serves as a biological sensor for acquiring tactile information that, like many sensory modalities, will be influenced by the geometry, mechanics, and material properties of individual whiskers. In the present work, we provide a detailed statistical quantification of whisker properties that influence the mechanosensory input received by the rat during active, tactile-based sensing. We also compare the morphology of the whisker array to that of other species, including the mouse and harbor seal. Finally, using our quantification of individual whiskers, we have developed a dynamic model of the entire rat whisker array, which paves the way for future research studying the statistical patterns of active, tactile exploration.