# **Title:** Predictive coding of natural self-motion: Implications for perception & action

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**Abstract:** A fundamental question in neuroscience is: How does the brain compute accurate estimates of our self-motion and orientation relative to the world to ensure accurate behavior and stabile perception in everyday life. In this talk, I will describe my laboratory's recent research addressing this question. First, we have explored the statistics of natural self-motion signals experienced by mice, monkeys, and humans, and established the neural coding strategies used by early vestibular pathways to encode these natural stimuli. Second, I will explain how the brain builds predictive 'internal models' of the expected sensory consequences of self-generated movements. Notably, our recent work has established that a cerebellar-based mechanism underlies our ability to distinguish sensory inputs that are actively generated versus passively experienced. Furthermore, when there is a mismatch between the sensory input that is expected versus experienced during active behaviors, this mechanism rapidly updates the brain's internal model to re-enable the vital distinction between active and passive sensory input. Taken together, our findings have important implications for our understanding of the brain mechanisms that ensure accurate perception and behaviour during everyday activities, including how motor-based predictions are dynamically updated as the relationship between a voluntary motor command and its sensory consequences changes.

**Short Biography:** Dr. Cullen is a Professor at the Johns Hopkins University in the Department of Biomedical Engineering. She got her PhD in Neurobiology from the University of Chicago in 1991, and then moved to McGill University for her postdoc. After that, she was a Professor in the Department of Physiology at McGill University from 1994-2016, where she also served as the Director of the Aerospace Medical Research Unit and was affiliated with the Depts. of Biomedical Engineering, Neurology and Neurosurgery, and Otolaryngology. Dr. Cullen held a William Dawson Chair in recognition of her work in Neuroscience and served as Communications Lead for the Brain@McGill. In July 2016, she moved to Johns Hopkins University, where she is currently a Professor in Biomedical Engineering, and co-director of the Center for Hearing and Balance. In addition to her research activities, Dr. Cullen serve as the Program Chair and Vice President of the Society for the Neural Control of Movement. The central focus of her lab is to understand how the brain integrates multisensory information to ensure the maintenance of balance and posture. Specifically, she studies the neural encoding of vestibular information, and how this information is combined with proprioceptive, visual, and motor signals during everyday activities. Her expertise spans the fields of Neuroscience and Biomedical Engineering, combining behavioral, neurophysiological and computational methodologies in humans and animal models.