Johns Hopkins University, Department of Mechanical Engineering
2020 Fall Virtual Seminar Series: Class 530.803

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"Lessons from the cockpit of a fly: changing course is hard, but flying straight is harder"

Presented by Professor Michael Dickinson
Abe and Esther Zarem Professor of Biology and Bioengineering, California Institute of Technology

Flies represent nearly 10% of all species described by science and are arguably unmatched among flying organisms in their aerial agility. The flight trajectory of flies often consists of crisp straight flight segments interspersed with rapid changes in course called body saccades. Recent advances in genetic tools have made it possible to explore the neurobiological circuitry underlying these two distinct modes of fly flight behavior. Whereas the rapid turns are controlled by just a single pair of descending command interneurons, the animals' ability to fly straight appears to rely on a much larger number of descending neurons that work collectively via a population code. This relatively larger number of control neurons is necessary so that the flies can sustain large, yet precise, bilateral differences in wing motion that are required due to either wing damage or asymmetries generated during development. Whether regulating straight flight or generating rapid turns, the commands from descending neurons are executed via a small population of tiny steering muscles that echo the functional stratification of the upstream circuitry. Collectively, this new research provides insight into some general questions related to the neurobiological basis of animal flight.

Michael Hughes Dickinson was born in Seaford, Delaware in 1963, but spent most of his youth in Baltimore and Philadelphia. He attended college at Brown University, originally with the intent of majoring in Visual Arts, but eventually switched to Neuroscience, driven by a fascination for the mechanisms that underlie animal behavior. While in college, he studied the roles of neurons and neurotransmitters in the control of feeding behavior in leeches. He received a Ph.D. in Zoology at the University of Washington in Seattle in 1991. His dissertation project focused on the physiology of sensory cells on the wings of flies. It was this study of wing sensors that led to an interest in insect aerodynamics and flight control circuitry. Dickinson worked briefly at the Max Planck Institute for Biological Cybernetics in Tübingen, Germany, and served as an Assistant Professor in the Dept. of Anatomy at the University of Chicago in 1991. He moved to University of California, Berkeley in 1996 and was appointed as the Williams Professor in the Department of Integrative Biology in 2000. Dickinson served on the faculty at Caltech from 2002 to 2010. From 2010 to 2014, he was the Ben Hall Professor of basic life science in the Department of Biology at the University of Washington. He is now the Abe and Esther Zarem Professor of Biology and Bioengineering at Caltech.