Bio-Inspired Sensors, Actuation, and Information Processing

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Abstract

There are countless aspects of biological systems that intrigue and inspire engineers and scientists. As an Aerospace Engineer, it is easy to recognize bio-inspiration as the foundation of the field. For example, the Wright brothers and many of their peers credit years of studying avian models (i.e. bird-watching) with providing key insights and the essential understanding of flight control systems inherent in the designs that lead to the first successful powered flights. Biological models continue to inspire creative new directions for aeronautical research, as demonstrated by recent major NASA and DARPA investments in morphing vehicle technologies and in low Reynolds number microair vehicles. We have over a century of experience in drawing inspiration from the macroscale behaviors of biological systems. Recent advances in MEMs and NEMs sensor systems offer means for drawing inspiration from micro and even nano-scale attributes of biological systems, for design of engineered systems with a quantity, quality and density of sensed information that was not possible even a decade ago. Somewhere short of creating a brain, and/or embedding artificial intelligence or cognition in inanimate objects, lies enormous opportunity for: 1) developing and validating models of the biological processes with which biological systems efficiently manage and act on large quantities of time-varying, spatially-distributed and sometimes even competing sensory information and 2) transitioning these processes to engineered (man-made) systems.

Bibliography

Prof. Flatau is a Professor of Aerospace Engineering and Director of the Aerospace Engineering Undergraduate Program at the University of Maryland. She holds a B.S.E. in Chemical Engineering from the University of Connecticut and M.S. and Ph.D. in Mechanical Engineering from the University of Utah. She joined Department of Aerospace Engineering at the University of Maryland in 2002 after serving as

Program Director for the Dynamic Systems Modeling, Sensing and Control Program at the National Science Foundation from 1998-2002. Prior to that, she was on the Aerospace Engineering and Engineering Mechanics faculty at Iowa State University (1990-1998). Her experience also includes four years at the National Small Wind Systems Test Center in Golden, CO where she was a Senior Research Engineer in the Test Program. Her research interests are in dynamics of smart structures, with emphasis on actuator and sensor technologies and their application in noise, vibration and position control applied to rotorcraft and other aerospace systems. One of her key research areas is the development and application of magnetostrictive material actuators and sensors. A second research area is on the application of smart transduction materials in micro-systems, including synthetic jet design and bio-inspired micro- and nano-sensors. As the author of over 30 archival journal and book chapter contributions, Dr. Flatau currently serves as an Assistant Editor for the *Journal of Smart Structures and Materials* and she is the PI on a large team Multidisciplinary University Research Initiative (MURI) program on Structural Magnetostrictive Alloys.