

Discovering Templates of Engineering Design Hidden in Nature's Transducers

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Abstract

Nature uses a plethora of micro and nano-scale sensors in its creations. While many of such sensors and actuators have been identified and studied for their functions in animals and insects, we are only beginning to discover the underlying design templates that Nature uses and creates multiple variants of the design with parameter tweaking. Understanding such design templates is essential as they often contain natural scaling of underlying transduction principles and their implementation with physical designs. The modern tools of imaging and characterization are making the discovery of these design templates possible as we are now able to construct the whole system from the information on its pieces from biological studies and piece-together simulations that tell us the whole story. We have been studying the bioacoustics of crickets in order to understand transducer design for efficient sound amplification as well as directional sound detection. We have been also studying insect halteres as gyroscopes to see how such a simple design lends itself to 3-axis rate of rotation sensing. This talk contains some details of these studies that are targeted at discovering the underlying engineering design and a more generic design template.