Biology by Design: From Vibrating Insoles to Synthetic Gene Networks

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Abstract

In this talk, I describe how nonlinear dynamical approaches can be used to study, mimic and improve biological function at multiple scales, ranging from whole-body dynamics to gene networks. I describe, for example, how input noise can be used to enhance human sensory function and motor control. Specifically, touch sensation and balance control in young and older adults, patients with stroke, and patients with diabetic neuropathy can be improved with the application of sub-sensory mechanical noise, for example, via vibrating insoles. I describe how this work has led to the creation of a new class of medical devices to address complications resulting from diabetic neuropathy, restore brain function following stroke, and improve elderly balance. I also describe how techniques from nonlinear dynamics and molecular biology can be used to model, design and construct engineered gene networks, leading to the development of the field of synthetic biology. Finally, the implications of synthetic gene networks for biotechnology, biomedicine and biocomputing are discussed.