THE GEORGE WASHINGTON UNIVERSITY
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The GW Chapter of the Pi Mu Epsilon Mathematics Honor Society Lecture Series

A friendly introduction to slow-fast systems and their importance in mathematical neuroscience

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Friday, April 6, 4-5 p.m.
Monroe Hall, Room B32

ABSTRACT

A variety of differential equations models for physical systems exhibit the so-called separation of time scales, where phase space trajectories are not traversed uniformly, but rather at (at least two) vastly different speeds. Such models are prevalent in mathematical neuroscience where the dynamics of neural depolarization-polarization cycles suggest a rapid discharge followed by a gradual recovery period. Since the late 1960s, a growing body of work in dynamical systems known as geometric singular perturbation theory has yielded a framework for understanding systems featuring time scale separation, the simplest variety of which is colloquially called slow-fast systems.

This talk will feature an illustration of some basic phenomenology of slow-fast systems through two simple examples, the classical van der Pol model and the FitzHugh-Nagumo model for neural dynamics. We will restrict attention to ODEs in both instances. We will note first the similarities between these systems, which place them in a context where the results of the theory are applicable. We will then discuss a major difference between the two, namely, the equilibrium featured in the latter model and its importance for capturing neural excitability. The talk will finish with a brief mention of our current research on signal propagation in networks of FitzHugh-Nagumo neurons.

Dr. Mintchev is Associate Professor of Mathematics at The Cooper Union in New York. He received his B.S. in Mathematics and Physics from GWU in 2002, and his Ph.D. from the Courant Institute at NYU in 2008. His research interests lie in applied dynamical systems and relations to mathematical physics, biology, and neuroscience.

This talk is open to everyone. Mathematics majors and minors are especially encouraged to attend.