Joint Math Colloquium

Millersville University and Franklin & Marshall College

Speaker: **Dr. Hanbing Song**
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Franklin & Marshall College

Title: **Modeling Respiratory Rhythm Generating Circuitry: Cellular and Network Modeling Studies**

Date: **April 12, 2018 (Thursday)**

Time: **4:00 pm – 5:00 pm**

Place: **Room 101, Wickersham Hall, Millersville University**

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Abstract:

Breathing in mammals depends on rhythms that originate from the preBötzinger complex (preBötC) of the ventral medulla and a network of brainstem and spinal premotor neurons. The rhythm-generating core of the preBötC, as well as some premotor circuits, consists of interneurons derived from a precursor dubbed Dbx1 but the structure and function of these networks remain incompletely understood. A cell-specific detection and laser ablation system was previously developed to interrogate respiratory network structure and function in a slice model of breathing that retains the preBötC, premotor circuits, and the respiratory-related hypoglossal (XII) motor nucleus such that in spontaneously rhythmic slices, cumulative ablation of Dbx1 preBötC neurons decreased motor output by half after only a few cell deletions, and then decelerated and terminated rhythmic function altogether as the tally increased. In contrast, cumulatively deleting Dbx1 premotor neurons decreased XII motor output linearly, but did not affect frequency nor stop functionality regardless of the ablation tally. In this talk, I will present several network modeling and cellular modeling studies that would further our understanding of how respiratory rhythm is generated and transmitted. First, we propose that cumulative deletions of Dbx1 preBötC neurons preclude rhythm by diminishing the amount of excitatory inward current or disturbing the process of recurrent excitation process rather than structurally breaking down the topological network. Second, we establish a feasible configuration for neural circuits including a random preBötC network and a small-world premotor network with interconnections following an anti-preferential attachment rule, which is the only configuration that produces consistent outcomes with previous experimental benchmarks. Last but not least, since the performance of neuronal network simulations is, to some extent, affected by the nature of the cellular model, we developed a more realistic cellular model based on the one we adopted in previous network studies, which would account for recent experimental findings.