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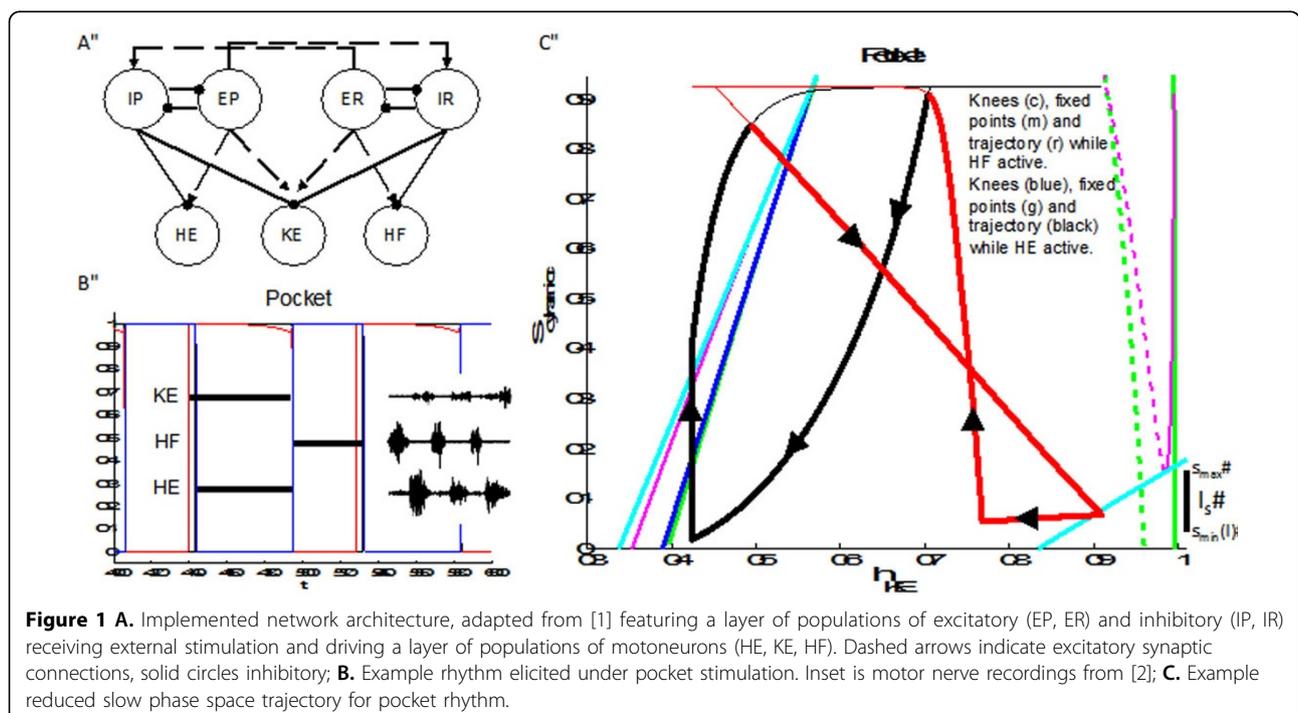
# Multiple rhythms from one network: phase plane and stochastic analyses of rhythmic activity in turtle motor circuits

Abigail Snyder\*, Jonathan Rubin

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A central pattern generator (CPG) is a population of neurons producing rhythmic or repetitive behavior (i.e. scratching, walking) without requiring rhythmic input to the population. Turtles are observed to produce several rhythmic motor patterns in response to stimuli, in particular rostral scratch and pocket scratch (see Figure 1B inset) [1,2]. The rostral scratch and pocket scratch

rhythms are created through the activity of three motoneurons: hip extensor, knee extensor, and hip flexor. A CPG (see Figure 1A) to produce both rhythms has been proposed, featuring a layer of populations of excitatory and inhibitory interneurons projecting to a layer of motoneurons [1]. We implement the CPG as a system of relaxation oscillators. The system successfully repro-



\* Correspondence: [acs73@pitt.edu](mailto:acs73@pitt.edu)  
 Department of Mathematics, University of Pittsburgh, Pittsburgh, PA 15213, USA

duces the desired rhythms by changing inputs to the layer of interneurons (see Figure 1B). We consider a dynamical systems approach to determine the mechanisms underlying rhythm generation. We analyze a proposed central pattern generator's ability to produce differing motor patterns from a single pool of neurons under different tonic drives. A key issue is the knee extensor motoneuron's response to different phasic synaptic inputs. We study the impact of these phasic inputs on motoneuron phase space and on properties of associated trajectories and show how these yield sufficient conditions for reproduction of observed rhythms. A contraction argument leads to existence of a stable solution. We also present preliminary results from stochastic analysis to examine the role of strong synaptic conductances.

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