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Information transfer from medullary central pattern generators to analog microcircuits

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Abstract:
Biological central pattern generators provide the rhythms and motor patterns that are essential to life. In mammals, central patterns generators located at the base of the brain regulate respiration and modulate heart rate over the respiratory cycle to save the heart energy [1] and prevent the onset of heart failure.
This talk shall describe methods we have implemented to transfer information from electrophysiological recordings of in-vivo and in-vitro medullary central pattern generators to mathematical models and ultimately to analog neuromorphic central pattern generators. We shall also report of the emergence of neural synchronization observed in small experimental networks of mutually inhibitory neurons which underpin the generation of biological rhythms. Experimental maps of network dynamics - which is chaotic - will be reported as a function of inhibition delay, the docking/undocking times of neurotransmitters and the strength of synaptic connections. We obtain the exact and asymptotic laws giving the number of stable oscillations as a function of network size. In particular we find that inhibition delay increases the capacity of a N-neuron network by a factor of $(\ln 2)^{-N}$ [2,3]. These results form a basis for adaptive analog neuromorphics.

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