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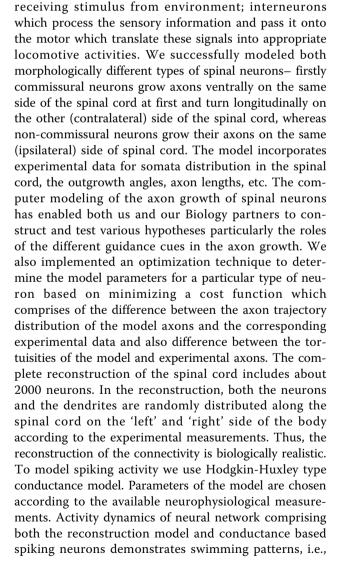
Gradient based spinal cord axogenesis and locomotor connectome of the hatchling *Xenopus* tadpole

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Understanding the mechanisms underlying the selfassembly and organization of functional neuronal networks is a crucial problem confronting both experimental and theoretical neuroscience alike. Early in development, functional neuronal networks self-assemble with astonishing rapidity. It is, therefore, imperative to investigate and understand how far simple basic mechanisms can allow primary functioning neuronal circuits to develop. To address this 'structure-function' issue, we model anatomy and electrophysiology of young hatchling Xenopus tadpole's spinal cord [1-3]. Our bottom-up approach to modeling of neuronal connectivity is based on developmental process of axon growth - we develop a gradient-based mathematical model for axon growth. It is known that in the developing vertebrate spinal cord, neurons arise from progenitor cells in the neural tube and thereafter the axons grow under influence of chemical morphogenes released from the dorsal roof plate ('BMP'), ventral floor plate ('shh') and hindbrain regions ('Wnt'). Distribution of these guidance molecules along the spinal cord set up a gradient field which steer the axons in appropriate locations and thus ensure formation of proper connections. We grow axons of spinal neurons and generate synaptic connections similar to biological developmental process based on the data from Professor Alan Roberts Lab at University of Bristol [4]. Using the gradient-based model we were able to grow axons for all seven types of spinal neurons which are believed to be involved in swimming and struggling behavior of tadpole. These spinal neurons include sensory neurons which are responsible for

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anti-phase oscillations on opposite sides of the body and metachronal wave in longitudinal direction in a wide range of model parameters.

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