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Design of real-time locomotion generator with map-based neuronal models NIKOLAI RULKOV, UCSD, JOSEPH AYERS, NEU, MARK HUNT, Ariel Inc. — We are developing an electronic nervous system for a biomimetic robot based on an established neurobiological model system, the Sea Lamprey. Undulatory locomotion of the lamprey is coordinated by a concatenated network of over 100 segmental central pattern generators (CPGs). To achieve real time operation in a DSP chip, we are using simple phenomenological models of neurons and synapses based on the dynamics of nonlinear maps. CPG networks based on known neuronal circuitry have replicated main properties of the dynamical behavior of the animal model. The results of numerical studies of the neuronal activity coordinating various swimming patterns in the reduced model of the CPG are considered. Both ascending and descending connections between segmental CPGs can mediate both forward and backward propagating flexion waves based on anterior or posterior bias by descending premotor commands. Bilaterally asymmetric biases of descending commands can mediate turning. The CPG outputs control 5 shape memory alloy actuators on each side to generate coordinated undulations. Two dorsal and ventral pitch actuators control the angle between the hull and undulator to control dive and climb. Descending commands are modulated by an analog compass, inclinometers, accelerometers and a short baseline sonar array to mediate homing by the vehicle on a sonar beacon.

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