Visuomotor Coordination in a Neuromechanical Salmander Simulation

Jeffrey R. Begley, Auke Jan Ijspeert & Michael A. Arbib

University of Southern California

How do neural computations transform sensory inputs into muscle-driven action? With arguably the simplest vertebrate nervous system, the salamander is a model organism used to study basic issues in vertebrate neuroscience. We are using a neuromechanical simulation program to investigate behaviorial consequences of salamander visual system organization using a neuromechanical simulation program. The system's central pattern generators (CPGs) produce biologically plausible spinal waveforms, thus producing characteristic walking and swimming movement. The simulation has been used to investigate prey approach behavior with a realistic mechanical simulation and a simplified visual system model. We are extending the simulation program to include more realistic models of the retina and optic tectum, including a retinal disparity map and connections to brainstem locomotor control regions.

These extensions will allow us to investigate the the potential role played by the various neural pathways from the optic tecta to the brainstem in generating orienting head movements, prey approach behavior, and snapping. Possible functions of projections from the nuclei isthmii to the tecta will investigated using the behavioral simulation. Hypotheses will be evaluated according to their effectiveness in generating the salamander's behavior and according to the capacity of the neural network to learn an effective configuration.

The simulation is physically and biologically realistic, and is thus an excellent model for investigations into dynamic interactions between the salamander and the environment, mediated by the salamander's brain using sensory and motor systems.