Embodiment Effects in Evolutionary Robotics

Nicholas Livingston
Vassar College

Anton Bernatskiy
University of Vermont

Kenneth Livingston
Vassar College

Marc Smith
Vassar College

Jodi Schwarz
Vassar College

Joshua Bongard
University of Vermont

David Wallach
Vassar College

Evan Altiero
Vassar College

John Long
Vassar College

Abstract: We evolve simple neural network controllers in swimming robots in order to test the hypothesis that, given distinct dimensions of control for the tail structure, evolution will favor the emergence of modular neural networks as most likely to enhance fitness (successful light harvesting). Evolution does lead to improved fitness, but this does not appear to result from increases in modularity. However, an unexpected result highlights the importance of embodiment for the evolution of the agent. The output of the neural network controller is high frequency with many extreme excursions, but the actual movements of the tail are damped by the physics of the body as it interacts with the aquatic environment. Subsequent simulations establish the role of these physical parameters in dampening noisy network controller output. Thus, morphology can increase evolvability by acting as a low pass filter of high-frequency controller dynamics.