Potential for Learning and Memory in Evolutionary Robotics

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Research presented here addresses the potential to use the principles of evolutionary robotics to design a controller able to learn within the lifetime of the robot. Test groups of robots are asked to evolve the capacity to habituate to stimulus spikes ("kicks"), with and without an implementation of recursive memory. Unlike prior research, the bots here must continue to execute a four-legged walking task requiring precise neural adaptation, so ability to habituate cannot come at the expense of other requirements on the neural network. Evolved populations are compared in three areas: evolutionary progress, fitness on test environments, and velocity and memory states through the test environments. Evolution and test environment fitness data shows a statistically significant increase in fitness as measured by walking ability for the groups with recursive memory, but no statistically significant advantage for the groups evolved with kicks. Thus, there is no evidence for habituation with this memory implementation. However, further investigation of the movement of individual bots within the test environments shows cyclical patterns in gait and memory function, pointing towards the importance of recurring cycles in efficient networks. These results show this implementation of recursive memory unable to produce habituation, but point towards a promising new research direction focusing on the neural network cycles exploited by the evolutionary algorithm.