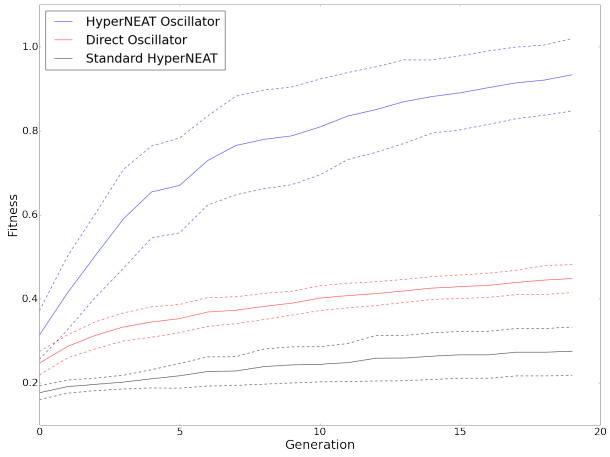

Figure 2: Comparison between evolving with standard HyperNEAT, HyperNEAT for oscillator neurons, and directly encoded oscillator neurons.

displacement task using the RoboGen simulator and HyperNEAT [8][3]. The controllers evolved using a population size of 100 for 20 generations yielding 2000 fitness evaluations, which can run in a few minutes time. As compared to using either a simple direct encoding of oscillator parameters or evolving standard neural networks with HyperNEAT, the ultra rapid approach used here is able to find significantly more fit solutions (see Fig. 2) for a variety of robots (such as the one depicted in Fig. 1). Additionally several of the gaits evolved using this technique were transfered onto a real robot (see 1 bottom) and showed a strong correspondence between simulated and evolved behaviors. Videos of this robot behavior both in simulation and reality can be seen at http://youtu.be/cIUlCMEtly0 and http://youtu.be/gaibm3RazXA, respectively.

While the robot behaviors evolved here clearly lack the complexity of some state-of-the-art ER results, and will not be directly usable in more complex tasks requiring reactive control or memory, the ability to rapidly evolve successful robot gaits will be instrumental in attracting students, hobbyists and others to Evolutionary Robotics. This ability will also be crucial if one wants to bring Evolutionary Robotics to the web [5] to attract a wider and more diverse audience to the field, and to incorporate real-time user feedback in the optimization process [11]. Work towards building a web based platform for RoboGen is currently underway.

Additionally, it is possible to extend the neural system to allow for more complex control by allowing oscillator neurons to be modulated by sensors or other neurons. In doing so, one can first rapidly evolve an open loop controller as is done here, so that users see real-time progress, and then gradually increase the controller sophistication for more complex tasks. Future work will extend the current system in this direction.

[3]Using a modified version of Peter Chervenski's open-source MultiNEAT implementation: http://multineat.com/.

2. ACKNOWLEDGEMENTS

This project has received funding from the European Union's Seventh Framework Programme for research, technological development and demonstration under grant agreement no 308943.

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