Sensing and Direction in Locomotion Learning with a Random Morphology Robot

Karl Hedman David Persson Per Skoglund Dan Wiklund Krister Wolff Peter Nordin
Complex Systems Group, Department of Physical Resource Theory
Chalmers University of Technology
SE-412 96 Göteborg, Sweden
E-mail: {wolff, nordin}@fy.chalmers.se

We describe the first instance in sensing and direction with a learning Random Morphology robot. Using GP, it learns to locomote itself in different directions and by letting different solutions master the robot in different situations it can thus follow an arbitrary path.

The Random Morphology robot [Dittrich et al, 1998] is composed of seven standard off-the-shelf R/C servo motors that are interconnected arbitrarily in a two dimensional plane. The robot also has a proximity sensor onboard. To control the servo motors and process sensory data, we use the EyeBot MK3[1] 32-bit micro controller board. The learning method is a conventional steady-state linear GP algorithm with tournament selection, running onboard. The operators work on the three registers and each individual consists of a string of integers, where every integer corresponds to a predefined instruction. The decoding of an integer into instruction is handled by a register machine.

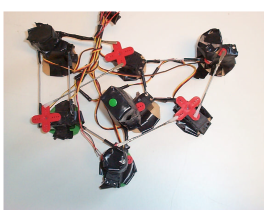

Figure 1: The Random Morphology robot.

Four different individuals are randomly picked from the population and get to compete against each other in pairs. Crossover is in this case two-point and can be done in two ways, homologous and non-homologous, with equal probability. Mutation randomly takes a point in one of the children and inserts a randomly selected instruction there.

The robot is positioned in an enclosed arena with the goal to locomote towards a wall as straight forward and fast as possible. The objective was to find individuals able to move in different directions. The fitness function is the difference between the measured distance before and after each individual. To promote movement, the individual achieves a bonus each time it sets a servo to a different value than it was previously set to.

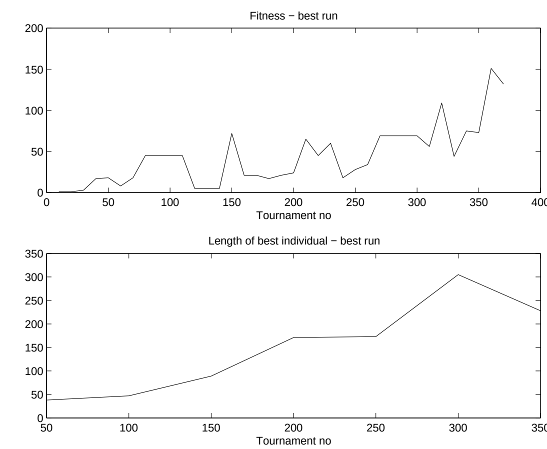

Figure 2: The fitness of the best run (top). Best individual length of the best run (bottom).

The overall result of the experiment is that the GP algorithm is able to produce individuals that can locomote the robot in different directions. Figure 2, selected as representative, show how fitness is getting better and better as evolution proceed. Note: a full version of this paper is also available[2].

References

P. Dittrich, A. Burgel and W. Banzhaf (1998). Learning to move a robot with random morphology. In Phil Husbands and Jean Arcady Meyer, editors, *First European Workshop on Evolutionary Robotics* (pp. 165-178). Berlin: Springer-Verlag.

[1] http://www.ee.uwa.edu.au/∼braunl/eyebot/

[2] http://fy.chalmers.se/∼wolff/publications.html