Evolution of RF-signal cognition for wheeled mobile robots using pareto multi-objective optimization

Abstract

This article describes a simulation model in which a multi-objective approach is utilized for evolving an artificial neural networks (ANNs) controller for an autonomous mobile robot. A mobile robot is simulated in a 3D, physics-based environment for the RF-localization behavior. The elitist Pareto-frontier Differential Evolution (PDE) algorithm is used to generate the Pareto optimal set of ANNs that could optimize two objectives in a single run; (1) maximize the mobile robot homing behavior whilst (2) minimize the hidden neurons involved in the feed-forward ANN. The generated controllers are evaluated on its performances based on Pareto analysis. Furthermore, the generated controllers are tested with four different environments particularly for robustness assessment. The testing environments are different from the environment in which evolution was conducted. Interestingly however, the testing results showed some of the mobile robots are still robust to the testing environments. The controllers allowed the robots to home in towards the signal source with different movements' behaviors. This study has thus revealed that the PDE-EMO algorithm can be practically used to automatically generate robust controllers for RFlocalization behavior in autonomous mobile robots.