# Artificial Neural Controller Synthesis in Autonomous Mobile Cognition

## Abstract

This paper describes a new approach in using multi-objective evolutionary algorithms in evolving the neural network that acts as a controller for the phototaxis and radio frequency localization behaviors of a virtual Khepera robot simulated in a 3D, physics-based environment. The Pareto-frontier Differential Evolution (PDE) algorithm is utilized to generate the Pareto optimal sets through a 3-layer feed-forward artificial neural network that optimize the conflicting objectives of robot behavior and network complexity, where the two different types of robot behaviors are phototaxis and RF-localization, respectively. Thus, there are two fitness functions proposed in this study. The testing results showed the robot was able to track the light source and also home-in towards the RF-signal source successfully. Furthermore, three additional testing results have been incorporated from the robustness perspective: different robot localizations, inclusion of two obstacles, and moving signal source experiments, respectively. The testing results also showed that the robot was robust to these different environments used during the testing phases. Hence, the results demonstrated that the utilization of the evolutionary multi-objective approach in evolutionary robotics can be practically used to generate controllers for phototaxis and RF-localization behaviors in autonomous mobile robots