

# **Single- versus multiobjective optimization for evolution of neural controllers in Ms. Pac-Man**

## **Abstract**

The objective of this study is to focus on the automatic generation of game artificial intelligence (AI) controllers for Ms. Pac-Man agent by using artificial neural network (ANN) and multiobjective artificial evolution. The Pareto Archived Evolution Strategy (PAES) is used to generate a Pareto optimal set of ANNs that optimize the conflicting objectives of maximizing Ms. Pac-Man scores (screen-capture mode) and minimizing neural network complexity. This proposed algorithm is called Pareto Archived Evolution Strategy Neural Network or PAESNet. Three different architectures of PAESNet were investigated, namely, PAESNet with fixed number of hidden neurons (PAESNet\_F), PAESNet with varied number of hidden neurons (PAESNet\_V), and the PAESNet with multiobjective techniques (PAESNet\_M). A comparison between the single- versus multiobjective optimization is conducted in both training and testing processes. In general, therefore, it seems that PAESNet\_F yielded better results in training phase. But the PAESNet\_M successfully reduces the runtime operation and complexity of ANN by minimizing the number of hidden neurons needed in hidden layer and also it provides better generalization capability for controlling the game agent in a nondeterministic and dynamic environment.