Abstract

Many real-world optimization problems consist of several conflicting objectives, the solutions of which is a set of trade-offs called the Pareto-optimal set. During the last decade, Evolutionary Algorithms (EAs) have been utilized to find an approximation of the Pareto-optimal set. However, the approximation set must possess solutions with high convergence towards the Pareto-optimal set and hold a good diversity in order to demonstrate a good approximation.

The subject of this thesis is to improve the existing Multi-Objective Evolutionary Algorithms (MOEAs) and to develop new techniques in order to achieve approximated sets with high convergence and diversity in low computational time.

Reducing the computational time has been attained by incorporating various data structures and archiving techniques in the storage of the approximated solutions. A desirable convergence of solutions has been accomplished by applying a controllable search strategy to MOEAs in a hybrid MOEA.

Since 1995, the search strategy of EAs has been modified by a new optimization technique called Particle Swarm Optimization (PSO), inspired by the simulation of social behavior of bird flocking. In this thesis, a novel approach in Multi-Objective Particle Swarm Optimization (MOPSO) has been developed which leads to a better convergence and diversity of solutions than MOEAs. This has been demonstrated by several test problems and two real-world applications in antenna design and molecular force field parameterization in computational chemistry. Furthermore, a new quantitative metric for measuring the diversity of the approximated set has been developed and applied to the obtained solutions.