

UNIVERSITY OF TARTU
Institute of Computer Science
Computer Science Curriculum

Hendrik Parik

Metaheuristics for Sustainable Supply Chains

Bachelor's Thesis (9 ECTS)

Supervisor: Dr. Stefania Tomasiello

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Metaheuristics for Sustainable Supply Chains

Abstract:

Optimizing models of sustainable supply chains is a high-dimensional multi-objective optimization problem. The primary focus of this optimization is minimizing different kinds of costs. Costs can generally be grouped into economic, environmental, and social costs. Metaheuristics can be used for tackling this kind of task efficiently.

In this thesis, a realistic model of a supply chain is implemented. Different metaheuristics are implemented or adapted for optimizing the above-mentioned model. The results are then compared. It was found that genetic algorithms performed the best out of the three compared stand-alone metaheuristics which also included simulated annealing and particle swarm optimization. The results obtained by the genetic algorithms were feasible solutions to the problem. Other stand-alone metaheuristics did not provide solutions of sufficient quality. Two hybrid methods were also used. The first one is a combination of the genetic algorithm and the particle swarm optimization. The second one is a combination of the genetic algorithm and simulated annealing. The simulated annealing hybrid did not improve on the initial solution provided by the genetic algorithm in the simulated annealing phase. It was found that the particle swarm hybrid improved the result of the genetic algorithm in the particle swarm phase. Based on the experiments in this thesis the implementation of the hybrid genetic algorithm combined with particle swarm optimization outperformed the implementation of the stand-alone genetic algorithm.

Keywords:

Metaheuristics, genetic algorithms, evolutionary techniques, particle swarm optimization, simulated annealing, optimization

CERCS: P170 Computer science, numerical analysis, systems, control

Metaheuristilised meetodid jätkusuutlike tarneahelate optimeerimiseks

Lühikokkuvõte:

Jätkusuutlike tarneahelate mudelite optimeerimine on kõrgdimensiooniline mitme-eesmärgiline optimeerimisülesanne. Tarneahela optimeerimise põhieesmärgiks on vähendada erinevaid kulusid. Jätkusuutlike tarneahelate kulud võib jaotada majanduslikeks, keskkonnaalasteks ja sotsiaalseteks kuludeks. Taoliste ülesannete lahendamiseks saab kasutada metaheuristilisi meetodeid.

Töös kirjeldatakse ja kasutatakse ehtsal tarneahelal põhinevat mudelit. Seejärel kohandatakse erinevad metaheuristilised meetodid mudeli optimeerimiseks ning tuuakse välja optimeerimise tulemused. Töö käigus selgus, et geneetilised algoritmid saavad eraldiseisvatest meetoditest tarneahela optimeerimisega kõige paremini hakkama. Teisteks eraldiseisvateks metaheuristilisteks meetoditeks olid simuleeritud lõõmutamine ja osakeste parve optimeerimine. Geneetilise algoritmi teostus andis eraldiseisva meetodina ainukesena sobivaid lahendusi. Teised eraldiseisvad meetodid ei andnud piisava kvaliteediga tulemusi. Eraldiseisvaid metaheuristilisi meetodeid kombineeriti ka hübriidmeetoditeks. Esimeseks hübriidmeetodiks oli geneetilise algoritmi ja osakeste parve optimeerimise kooslus. Teiseks hübriidmeetodiks oli geneetilise algoritmi ja simuleeritud lõõmutamise kooslus. Simuleeritud lõõmutamisega hübriidmeetod ei suutnud ületada geneetilise algoritmi faasis saavutatud tulemust. Leiti, et osakeste parve optimeerimise meetod suutis parandada hübriidi esimeses faasis geneetilise algoritmi poolt saadud tulemust. Katsete käigus selgus, et geneetilise algoritmi ja osakeste parve optimeerimise hübriidmeetod saavutas keskmiselt paremaid tulemusi, kui eraldiseisev geneetiline algoritm.

Võtmesõnad:

Metaheuristika, geneetilised algoritmid, evolutsioonilised meetodid, osakeste parve optimeerimine, simuleeritud lõõmutamine, optimeerimine

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