Multi-objective Particle Swarm for Performance Optimization of General Single-server Finite Queueing Networks *

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Abstract

The performance optimization of general finite single-server acyclic queueing networks is the subject of several studies. The present study considers the minimization of the total capacity and the overall service rates in the network simultaneously with the maximization of its throughput. It is easy to verify that these are conflicting objectives. This fact leads to a multi-objective approach. The literature has already proposed some algorithms but the discussion of new efficient proposals is still relevant. A multi-objective particle swarm optimization approach was developed and applied to optimize the throughput of an acyclic, general single-server finite queueing network. This algorithm was specifically tailored to address the problem, which involves mixed-integer variables and constraints dependent on the current solution, as service rates cannot fall below arrival rates. Optimization problems in similar queueing network contexts can benefit from the strategies described here. The proposed approach simultaneously decreases both the total capacity allocation and the overall service rate. Consequently, our method yields a suboptimal Pareto set for these conflicting objectives. We performed a comprehensive computational experimental set to determine the efficacy and efficiency of the proposed approach. In addition, we present a comparison with previously proposed solutions. The insights obtained from this analysis can improve the design of general single-service finite queueing networks.

Keywords: Capacity allocation; queueing networks; conflicting objectives; multi-objective particle swarm optimization.

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