

ABSTRACT

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Optimized Multi-Criteria Decision Analysis

Through Median Ranking and Analytical Hierarchy Process.

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The present thesis addresses the consensus ranking problem, also known as the median ranking problem, the social choice problem, the Kemeny problem or the rank aggregation problem, which tackles the challenge of finding a ranking that best represents the preferences of a set of individuals. It is an intractable problem that has become increasingly relevant in recent years, despite it being a very old problem that has been perceived by researchers across multiple domains. Several algorithmic proposals have been successful in handling it, each with its own trade-offs. These include, among others, QUICK, FAST, Emond And Mason's Branch And Bound, and a Differential Evolution algorithm named DECoR. The main goal of the thesis is to add to that work by proposing the application of another metaheuristic under Kemeny's axiomatic framework. More specifically, the application of a modified version of Particle Swarm Optimization equipped with a restarting strategy and its comparison with a proposed variant of DECoR that exploits the same restarting strategy. The Particle Swarm Optimization variant follows the same fundamental adaptations that were used to develop DECoR. The rank aggregation problem is also closely tied to decision making procedures, therefore it is also proposed that the input rankings are the result of an indirect criteria based methodology that employs the Analytic Hierarchy Process. Simulation results indicate that the modified Particle Swarm Optimization implementation performs similarly to DECoR and can be considered a viable alternative for the case of full rankings. It is also concluded that the criteria-based methodology for ranking creation in conjunction with a metaheuristic approach for

finding solutions to the median ranking problem can serve as a useful framework for structuring and confronting similar problems in various decision making contexts.

Keywords: Consensus Ranking, Median Ranking, Rank Aggregation, Social Choice, Differential Evolution, Particle Swarm Optimization, Analytic Hierarchy Process, Kemeny Distance, Kendall's Tau, Kemeny And Snell Axioms