AN EFFICIENT RANKING ANALYSIS IN MULTI-CRITERIA DECISION MAKING

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Nomenclature

A_i	Alternative i
Y_j	Criterion j
Y_{ij}	Performance of alternative i in terms of criterion j
w_j	Weight of criterion j
w^*	New weight
$w^{'}$	Normalized weight
m	Number of criteria/objective functions
q	Number of alternatives/Pareto solutions
I^+	Ideal solution
I^-	Anti-ideal solution
A_k^*	k-th extreme solution
$\sim$	Uncertain parameter
σ_Y^2	Variance of variable Y
n	number of parameters which vary
$\eth$	Value of change in the current weight
mp	Possibilistic mean
K	Number of Decision Makers
DM	Decision Maker
MCDM	Multi-criteria decision making
AHP	Analytic Hierarchy Process
ANP	Analytic Network Process
MAUT	Multi-Attribute Utility Theory

ELECTRE	Elimination and Choice Expressing Reality
PROMETHEE	Preference Ranking Organization Method for Enrichment Evaluations
GA	Genetic algorithm
PSO	Partial swarm optimization
DSD	Directed Search Domain
TOPSIS	Technique for order preference by similarity to ideal solution
VIKOR	Vise Kriterijumska Optimizacija I Kompromisno Resenje

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Abstract

This study is conducted with the aims to develop a new ranking method for multi-criteria decision making problem with conflicting criteria. Such a problem has a set of Pareto solutions, where the act of improving a value of one solution will result in depreciating some of the others. Thus, in this type of problem, there is no unique solution. However, out of many available options, the Decision Maker eventually has to choose only one solution. With this problem as the motivation, the current study develops a compromise ranking algorithm, namely a trade-off ranking method. The trade-off ranking method able to give a trade-off solution with the least compromise compared to other choices as the best solution. The properties of the algorithm are studied in the thesis on several test cases. The proposed method is compared against several multi-criteria decision making methods with ranking based on the distance measure, which are the TOPSIS, relative distance and VIKOR. The sensitivity analysis and uncertainty test are carried out to examine the methods robustness. A critical criteria analysis is also done to test for the most critical criterion in a multi-criteria problem. The decision making method is considered further in a fuzzy environment problem where the fuzzy trade-off ranking is developed and compared against existing fuzzy decision making methods.

Keywords: Trade-off, ranking, multi-objective optimization, multi-criteria decision making, Pareto optimal solution, directed search domain algorithm