Article

Solution for Convergence Problem in DEMATEL Method: DEMATEL of Finite Sum of Influences

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Abstract: Decision-making trial and evaluation laboratory (DEMATEL) is one of the multicriteria decision-making methods based on asymmetric linguistic comparison matrices that has received a great deal of attention, and it is a widely used method in various fields. One of the drawbacks of DEMATEL is a convergence problem that may occur when the infinite sum of normalized influences does not converge. Based on the observations of some examples, the new concept of DEMATEL, the DEMATEL of a finite sum of influences (FSI DEMATEL), is proposed. Instead of an infinite sum, a finite sum of influences is used in FSI DEMATEL so that the convergence problem is avoided. The advantage is that FSI DEMATEL can handle more decision-making problems than the DEMATEL. It can also be used for fuzzy evaluations. FSI DEMATEL can be used as the multicriteria decision-making method to evaluate the relationships between the factors in many different fields.

Keywords: multicriteria decision-making; DEMATEL of a finite sum of influences; fuzzy numbers; defuzzification; convergence problem

1. Introduction

Nowadays, decision-making in many intelligent systems is a very important process that is complicated due to uncertainty, vagueness, limited knowledge, sources, and time [1]. Multicriteria decision-making (MCDM) is the collective term for mathematical methods for solving decision problems with multiple conflicting criteria [2], which differ in their properties and problem types that they are best suited for solving. A subset of MCDM methods are subjective methods, where experts evaluate objects based on their knowledge and experience [3]. Most of them are weighting methods with the goal of assigning weights to objects. Many methods use pairwise comparisons between objects, of which AHP (analytic hierarchy process) is the most popular [4], while BWM (best–worst method) [5] has also gained popularity in the last decade. Full consistency method (FUCOM) and level-based weight assessment (LBWA) [6] are two of the newer methods based on pairwise comparisons that have been introduced in recent years. TOPSIS (technique for order performance by similarity to ideal solutions) and VIKOR (vise kriterijumska Optimizacija i kompromisno resenje) are two of the best known methods where alternatives are directly evaluated with respect to multiple criteria [4], while CILOS [7] (method of the criterion impact loss) is one such method developed in recent years. The most known outranking methods are PROMETHEE (preference ranking organization method for enrichment evaluation) and ELECTRE (elimination et choix traduisant la relalite) [4]. Methods that focus on evaluating the interdependencies among criteria are DEMATEL (decision–making trial and evaluation laboratory) [8], ANP (analytic network process), and the more recent method WINGS (weighted influence nonlinear gauge system [9]).

This paper focuses on DEMATEL (decision–making trial and evaluation laboratory) [4], one of the most widely used MCDM methods [10], which is the seventh most frequently used MCDM method in applications. It was first developed by the Geneva Research Centre of the Battelle Memorial Institute to visualize the structure of complex causal

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