Comparison among four calibrated meta-heuristic algorithms for solving a type-2 fuzzy cell formation problem considering economic and environmental criteria

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ABSTRACT

In this paper, a mathematical model is proposed using economic and environmental criteria for a type-2 fuzzy (T2F) cell formation (CF) problem emphasizing the effect of the man-machine relationship aspect. This model aims to show the use of this aspect in CF to minimize the costs of processing, material movement, energy loss, and tooling. For this purpose, a two-stage defuzzification procedure is used to convert the T2F variable into a crisp value. Due to NP-hardness of the model and problem, a genetic algorithm (GA) is used to derive the appropriate solutions. Furthermore, because there is no any existing benchmark to validate the performance of the proposed model, three tuned meta-heuristic algorithms, namely, differential evolution (DE), harmony search (HS) and particle swarm optimization (PSO), are proposed and used. The present research uses the Taguchi method to adjust the parameters in the four proposed algorithms. Furthermore, 15 examples are used to validate the presented model. The results show that PSO is the most appropriate algorithm for solving the model.

Keywords: Cell formation; Environmental factor; Genetic algorithm; Particle swarm optimization; Harmony search; Differential evolution

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