Soft Computing • 2023

Document type
Article

Source type
Journal

ISSN
14327643

DOI
10.1007/s00500-023-08342-2

View more

An optimization algorithm for the multi-objective flexible fuzzy job shop environment with partial flexibility based on adaptive teaching–learning considering fuzzy processing times

Jiménez Tovar, Mary[a] ; Acevedo-Chedid, Jaime[a] ; Ospina-Mateus, Holman[a] ; Salas-Navarro, Katherinne[b] ; Sana, Shib Sankar[c]
Save all to author list

[a] Department of Industrial Engineering, Universidad Tecnológica de Bolívar, Cartagena, Colombia
[b] Department of Productivity and Innovation, Universidad de la Costa, Barranquilla, Colombia
[c] Department of Mathematics, Kishore Bharati Bhagini Nivedita College, Behala, Kolkata, 700060, India

Abstract

Production scheduling is a critical factor to enhancing productivity in manufacturing engineering and combinatorial optimization research. The complexity and dynamic nature of production systems necessitates innovative solutions. The Job Shop Flexible Programming Problem (FJSP) provides a realistic environment for production, where processing times are variable and uncertain, and multiple objectives need optimization. To solve the Multi-Objective Flexible Fuzzy Job Shop problem with partial flexibility (P-MOFfJSP), this paper proposes a hybrid metaheuristic approach that combines the Teaching–Learning-based Optimization (TLBO) algorithm with a Genetic Algorithm. The proposed algorithm of Adaptive TLBO (TLBO-A) uses two genetic operators (mutation and crossover) with an adaptive population reconfiguration strategy, ensuring solution space exploration and preventing premature convergence. We have evaluated the TLBO-A algorithm's performance on benchmark instances commonly used in programming problems with fuzzy variables. The experimental analysis indicates significant results, demonstrating that the adaptive strategy improves the search for suitable solutions. The proposed algorithm (TLBO-A) exhibits low variations (around 11%) compared to the best mono-objective heuristic for the fuzzy makespan problem, indicating its robustness. Moreover, compared with other heuristics like traditional TLBO, the variations decrease to around 1%. However, TLBO-A stands out as it aims to solve a multi-objective problem, improving the fuzzy makespan, and identifying good results on the Pareto frontier for the fuzzy average flow time, all within this low variation margin. Our contribution addresses the challenges of production scheduling in fuzzy time environments and proposes a practical hybrid metaheuristic approach. The TLBO-A algorithm shows promising results in solving the P-MOFfJSP, highlighting the potential of our proposed methodology for solving real-world production scheduling problems.

Author keywords

Flexible job-shop; Fuzzy processing times; Hybrid algorithm; Teaching–learning-based optimization

Indexed keywords

Sustainable Development Goals 2023 New

SciVal Topics

Topic name
Job Shop Scheduling Problem; Makespan; Genetic Algorithm

Prominence percentile
98.199

Metrics

References (106)

View in search results format >

All

Export Print E-mail Save to PDF Create bibliography

1 Abdullah, S., Abdolrazzagh-Nezhad, M.
Fuzzy job-shop scheduling problems: A review

(2014) *Information Sciences*, 278, pp. 380-407. Cited 78 times.
doi: 10.1016/j.ins.2014.03.060

View at Publisher