APEM journal

Advances in Production Engineering & Management
Volume 19 | Number 1 | March 2024 | pp 31–45
https://doi.org/10.14743/apem2024.1.491

ISSN 1854-6250
Journal home: apem-journal.org
Original scientific paper

Human-robot collaboration assembly line balancing considering cross-station tasks and the carbon emissions

Li, Y.C.[a,*], **Wang, X.**[b]

[a]School of Economics and Management, Beijing University of Technology, P.R. China
[b]School of Economics and Management, Beijing University of Technology, P.R. China

ABSTRACT

With the growth of industrialization, the global manufacturing industry is continually evolving and reforming in the direction of intelligence and green production. Industrial robots have replaced human workers because of the benefit of production efficiency. However, the large-scale application of robots requires a large amount of energy consumption and generates a large amount of CO_2, which will lead to energy waste and environmental pollution. In addition, in term of performing some particular tasks, current robot technology cannot achieve the same level of intelligence as human. Therefore, the design trend of assembly lines in industry has shifted from traditional configuration to human-robot collaboration to achieve higher productivity and flexibility. This paper investigates the human-robot collaboration (HRC) assembly line balancing problem, taking cycle time and carbon emission as primary and secondary objectives. A new mixed-integer programming model that features a cross-station design is formulated. A particle swarm algorithm (PSO) with two improvement rules is designed to solve the problems. The comparative experiments on ten benchmark datasets are conducted to assess the performance of the proposed algorithm. The experimental results indicate that the improved particle swarm algorithm is superior to the other two heuristics: simulated annealing (SA) and the late acceptance hill-climbing heuristic (LAHC).

ARTICLE INFO

Keywords:
Assembly line balancing problem;
Human-robot collaboration;
Cross-station tasks;
Carbon emissions;
Collaborative robot (cobot);
Particle swarm algorithm (PSO)

**Corresponding author:*
15831029622@163.com
(Li, Y.C.)

Article history:
Received 26 February 2024
Revised 17 April 2024
Accepted 19 April 2024

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