

## **Multi-objective multi-verse optimiser for integrated two-sided assembly sequence planning and line balancing**

*Mohd Fadzil Faisae Ab Rashid, Nik Mohd Zuki Nik Mohamed & Ahmad Nasser Mohd Rose*

<sup>a</sup> College of Engineering, Universiti Malaysia Pahang, Pahang, Pekan, 26600, Malaysia

### **ABSTRACT**

Research in assembly optimisation is presently inclined towards integrative measures. Several benefits of simultaneously optimised Assembly Sequence Planning (ASP) and Assembly Line Balancing (ALB) have been highlighted by researchers to have better solution quality, shorter time-to-market, and minimalised error during planning. Recently, several efforts have been made to realise integrated assembly optimisation. However, none of the published research considered the two-sided assembly line problem. This paper presents an integrated ASP and ALB optimisation in a two-sided assembly environment (2S-ASPLB), which is mainly adopted in automotive assembly process. In this study, the 2S-ASPLB problem was formulated and optimised using Multi-Objective Multi-Verser Optimiser (MOMVO) by considering line efficiency, reorientation penalty, and tool change as the optimisation objectives. The computational experiments were conducted in a few stages, beginning with the identification of the best decoding approach for 2S-ASPLB. Next, the best MOMVO coefficient was studied, followed by comparing MOMVO performance with well-established multi-objective optimisation algorithms. Finally, a case study problem was presented to demonstrate applicability of the proposed model and algorithm in real-life problem. The results indicated that the priority factor (PF) decoding approach had better performance compared with others. Meanwhile, in comparison with well-established algorithms, MOMVO performed better in convergence and solution distribution. The case study results indicated the applicability of proposed 2S-ASPLB model and algorithm to improve line efficiency in assembly line. The main contribution of the research is a new 2S-ASPLB model and optimisation scheme, which can assist manufacturer in designing better assembly layout.

### **KEYWORDS**

Manufacturing systems; Assembly optimization; Assembly sequence planning; Assembly line balancing; Multi-verse optimiser

## **ACKNOWLEDGEMENTS**

The authors would like to acknowledge the Ministry of Education Malaysia and Universiti Malaysia Pahang for funding this research under the FRGS Grant RDU1901108 (FRGS/1/2019/TK03/UMP/02/3).