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Lorenzo Tiacci

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Simultaneous balancing and buffer allocation decisions for the design of mixed-model assembly lines with parallel workstations and stochastic task times

Lorenzo Tiacci*

Università degli Studi di Perugia - Dipartimento di Ingegneria, Via Duranti, 93 – 06125 – Perugia, Italy

Abstract

The buffer allocation problem (BAP) and the assembly line balancing problem (ALBP) are amongst the most studied problems in the literature on production systems. However they have been separately so far approached, although they are closely interrelated. This paper for the first time considers these two problems simultaneously. An innovative approach, consisting in coupling the most recent advances of simulation techniques with a genetic algorithm approach, is presented to solve a very complex problem: the Mixed Model Assembly Line Balancing Problem (MALBP) with stochastic task times, parallel workstations, and buffers between workstations. An opportune chromosomal representation allows the solutions space to be explored very efficiently, varying simultaneously task assignments and buffer capacities among workstations. A parametric simulator has been used to calculate the objective function of each individual, evaluating at the same time the effect of task assignment and buffer allocation decisions on the line throughput. The results of extensive experimentation demonstrate that using buffers can improve line efficiency. Even when considering a cost per unit buffer space, it is often possible to find solutions that provide higher throughput than for the case without buffers, and at the same time have a lower design cost.

Keywords: mixed-model assembly line; unpaced lines; asynchronous lines; buffer allocation; balancing; stochastic task times; paralleling; genetic algorithm; discrete event simulation.

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* Corresponding Author: Tel.: +39-075-5853743
E-mail address: lorenzo.tiacci@unipg.it
Web-site: www.impianti.dii.unipg.it/tiacci

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