

# An approach for scheduling a bi-objective flexible flow shop

Miguel Rojas-Santiago, María Hulett, Shanthi Muthuswamy, Fabricio Niebles

## Abstract

This work considers a hybrid flow shop scheduling problem, a well-known production systems problem. It has been largely studied in the literature as a single objective optimization problem. We analyze a flow shop with two stages and  $m_s$  identical and unrelated parallel machines at each stage  $s$ . Given a set of jobs with their process times, the objective is to schedule the jobs such that both the makespan and the maximum tardiness are minimized. Each job is to be processed on one of the first-stage parallel machines, and then on the second-stage parallel machines. The problem under study is NP-hard and it can be represented as  $FF2(Pm_1, Pm_2 | |w * C_{max} + (1-w) * T_{max})$ . When  $m_1 = m_2 = 1$  and the objective is only minimize the makespan, our problem reduces to  $F2 | |C_{max}$ . A particle swarm optimization (PSO) approach is proposed to solve the problem. In the experimental phase, instances of 5, 10, 20, 50 and 100 jobs were run. The solution quality and run time of PSO is compared with a commercial solver used to solve the mathematical formulation. Experimental study clearly highlights the advantages, in terms of solution quality and run time, of using PSO to solve large-scale problems.

## Keywords

Bi-Objective scheduling,  $C_{max}$ , Flexible flow shop, PSO,  $T_{max}$