# Distributed Flow Shop Scheduling Problem Global versus Local Optimization*

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IIIA, Emile-Argand 11,
CH-2007 Neuchâtel

Because of its highly combinatorial aspect, its dynamic nature and its practical interest for manufacturing systems, the scheduling problem has been widely studied in the literature by various methods: heuristics, constraint propagation techniques, Constraint Satisfaction Problem formalism, simulated annealing, Taboo search, genetic algorithms, neural networks, etc.

This paper deals with the Flow Shop Scheduling Problem (FSSP) by a Multi-Agent_Simulated Annealing Model (MASAM). FSSP consists, according to a certain number of criteria, in finding the best possible allocation of n jobs on m resources, so that operations of every job must be processed on all resources in a unique order. MASM involves two types of agents: jobs and resources. Each job requests the resources by sending its operations one by one, according to the precedence relations existing between these operations (process plan). When a resource is requested by a job *J*, its behavior, based on simulated annealing (SA), consists of two phases: generating a new state comprising necessarily the new operation just received and deciding on whether to accept this new state or not. The generation phase comprises the following subphases: determining a position to *J*, computing the start and finish dates of *J*, satisfying the deadline of *J* and reacting to side effects. The objective (cost function) is to minimized setup durations between successive operations on the same resource and to maximize the slack time of each job.

It is well known that the convergence of simulated annealing requires an infinite run-time. Consequently, we propose two alternatives to put simulated annealing in practice. The first one consists in implementing a unique centralized SA whilst the second one (Distributed SA) consists in assigning to each resource on the one hand a local cost function representing locally the above objective and on the other hand a simulated annealing whose parameters are locally controlled. The obtained experimental results show that the distributed aspect outperforms the centralized one in terms of quality (cost function) and complexity (run-time). Despite the first promising experimental results, stronger experiments have to be performed, and further comparisons with other known methods have to be done.

*This work is supported by the Swiss National Founds of the Scientific Research under contract # SPPIF5003-034319