Cooperation between Human and Machine for Shop Scheduling Under Uncertainties

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Abstract

We are interested in jobs scheduling in flexible manufacturing systems. We try to combine predictive methods which guarantee optimal or good results but are not very robust to perturbations and reactive methods which take into account the real state of the system. For this, we use a method called the group sequencing method.

Group sequencing was first introduced in [3]. The goal of this method is to provide a sequential flexibility during the execution of the schedule and to guarantee a minimal quality corresponding to the worst case. This method has been developed in the last twenty years, in particular in [3, 2, 1]. For a theoretical description of the method, see [1].

This method enables the description of a set of schedules in an implicit manner (*i.e.* without enumerating the schedules) and guarantees a minimal performance. Actually, as it proposes a group of permutable operations, one can choose inside a group the operation that best fits the real state of the system. Furthermore, the flexibility added to the schedule should permit to handle uncertainties.

ORABAID method used in the ORDO software [4] use this method for managing the shop floor. Before the execution of the schedule, a group sequence that respect due dates in every case is generated. Then, during the schedule, a decision support system helps the operator to choose the operation to execute according to the group sequence. This decision support system is based on the free sequential margin, which is a kind of free margin adapted for group sequencing. Thanks to this decision support system, the human can manage the flexibility provided by group sequencing.

But this decision support system has a drawback: because it provides only the free sequential margin as an indicator to choose the operation to execute, the human will not analyze the situation, but will only choose the operation with the biggest margin. That is why we propose a new decision support system.

This new decision support system will propose to the operator different indicators that describe the knowledge of the machine to the operator. The different indicators proposed are indicators based on the group sequence structure (the free sequential margin, the quality of the group sequence in the worst case, the quality of the group sequence in the best case) and indicators based on the problem (processing times of the operations, due dates, *etc.*).

This way, the cooperation between the human and the machine is effective, because the advantages of the machine (calculating) and the advantages of the operator (compromising, negotiating) are combined.

To validate this proposition, experiments must be done. These experiments will study different aspects: the implication of the operator in the decision, the effectiveness of the new decision support system in comparison with the other, and the usage of the indicators by the operator.

References

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