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A study on association among dispatching rules in manufacturing scheduling problems using the Rule Mining

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Background and Purpose

In recent years, there exist various manufacturing scheduling works which purpose efficiently product in the industries. However, the present manufacturing scheduling requires a very large computation time that increases exponential rate with respect to the scale and the complex of manufacturing systems. Therefore, as practical manufacturing scheduling methods, there are various algorithms called heuristic rules or dispatching rules, further, those algorithms are widely used.

However, a trial and error approach is only used when the dispatching rules are applied to the manufacturing systems. The reason is that there exist no empirical knowledge for applying various dispatching rule to the each process and/or each processing group of the manufacturing systems, although the empirical knowledge exists at applying single dispatching rule.

In this thesis, our attention is no existence of a guideline to apply those dispatching rules at the manufacturing systems. For giving a guideline, we use “**rule mining**” method. The rule mining approach is based on the data mining with a new concept “**similarity**”. By the rule mining method, we propose a guidance for the selection of the dispatching rules with the satisfaction of the plural performance measure, and the guidance derives a proper solution for the plural performance measure, namely, the serving dispatching rules for each process at the manufacturing systems.

For this purpose, we consider to apply the data mining technique as a method to get a knowledge. Therefore, the guideline to select the dispatching rules is found. The guideline shows us an attempt at measuring validity of effectiveness to select the dispatching rules. Consequently, we achieve a breakthrough both the method such as depending on an experience to select the dispatching rules and a trial and error method for no experience until now. We hope to express measuring validity of effectiveness at each rule.

Rule Minig

The data mining is a field of study on getting a knowledge. As “**mining**”, it means mining some patterns from a large data. In this thesis, the each data are called as the transactions. A set of transactions implies a set of data. A **association rule** defined as $X \implies Y$ is a pattern which is extracted from a set of transactions. X is a condition part, Y is a conclusion part.

The association rule used in this thesis has two measuring method for a standard of value. One is **confidence** and the other is **support**. The confidence is a ratio of transactions with satisfying both a condition part and a conclusion part to transactions with satisfying a condition part. If the ratio is c %, the association rule has confidence c . The support is a ratio of transactions with satisfying both a condition part and a conclusion part to all transactions. If the ratio is s %, the association rule has support s . This method to find association rule using data mining applies to the manufacturing scheduling.

As a way for data mining method, we get a set of transactions for mining. A set of transactions is got from a manufacturing system model by a manufacturing simulation software. We construct a manufacturing system model the simulation, throwing processed goods called **job**, and applying various dispatching rules to each process. This job has various attributes, then a dispatching rule applying by us at a manufacturing process picks up a next job to process with the reference of those attributes.

The output of simulation is some performance measures and dispatching rules applying to each process, and we make a set of transactions for applying data mining to the output. For creating a set of transactions, we import a new concept “**similarity**”. The similarity expresses that a performance of dispatching rule is similar to a performance of another dispatching rule in case of making a set of transactions from the output of simulation.

We call **rule mining** a method to find the association rules between the performance measure and the dispatching rules from a set of transactions imported the similarity, and this rule minig method is a distinctive feature of this thesis.

Summary and prospect

We set the similarity definition among the dispatching rules. We apply a data mining technique using the above definition as a method to get a knowledge from output data by the manufacturing simulation. A above method gives us the association rules between the

performance measure and the dispatching rules from a set of transactions. These results give us effective method although the similarity among the dispatching rules is simple.

A effective performance of the found association rules has showed by a determinate quantity using a support value of an input item at applying the rule mining. In other word, by a determinate quantity, the method to apply the dispatching rules is shifted from a trial and error, and the manufacturing performance may rise using this support value.

The similarity definition for finding the association rules is extended to n performance measures. The above similarity uses n measures to apply a similarity n performance measures, however, it improves the measures to a scale of each performance measure.

This extension to plural performance measure can improve a performance among the sections with each different performance measure, for example, a manufacturing section for the purpose of turning out many manufactured goods, and a production control section for the purpose of reducing manufactured goods with tardiness.

As a prospect, we mention next heading. In case of practice using rule mining on this thesis, originally, two input data consisted of confidence and support is used, however, support value is only used in this thesis. If a utilization of non-use confidence is cleared and used, we will discover more effective method. We will hope for the approach merging the rule mining method into the manufacturing simulation.