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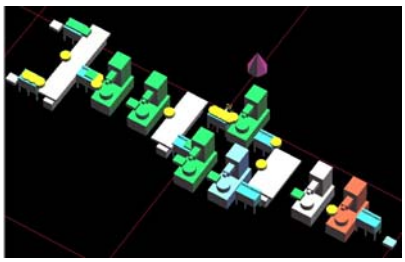
特集：生産システムシミュレーション技術

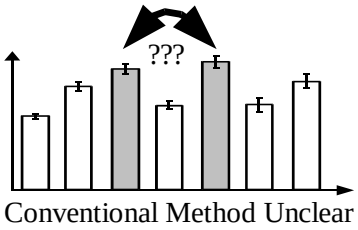
(2) Automatic Real Time Bottleneck Detection

1. Introduction



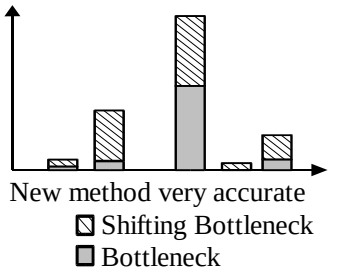
All production systems are constrained by a bottleneck. Improving the bottleneck machine improves the whole production system. In addition, the bottleneck is usually not static but changes between different machines, creating one main bottleneck and a number of less important secondary bottlenecks. The presented method is able to detect and monitor the shifting bottleneck and to detect the main and secondary bottlenecks. Additionally, the accuracy of the results can be measured using only one simulation, allowing the automatic termination of a simulation after reaching a required precision.

2. Conventional Methods



Bottlenecks are usually found using human expertise. However, this requires detailed knowledge of the production system, which is not always available. Shifting bottlenecks are usually not detected, and secondary bottlenecks are ignored. The accuracy of the results is not known, and the method is difficult to use for simulations. Other methods as for example the queue length or the utilization have similar problems.

3. Automatic Bottleneck Detection



The bottleneck is detected by measuring the time a machine is working without interruption. At any given time, the machine with the longest working time is the bottleneck. This allows for the detection of the bottleneck at any given time, and for the averaging of long-term primary and secondary bottlenecks. The accuracy of the results can be determined with only a singe simulation by calculating confidence intervals using the delta method. Furthermore, this accuracy can be used to automatically terminate a simulation if a required accuracy is reached.

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4. Conclusion

The presented method is a simple but reliable method to detect the primary and secondary bottlenecks in a production system.

Conventional Method	**Automatic Bottleneck Detection**
✖Multiple Simulations required	⭘One Simulation only
✖Inaccurate	⭘Very accurate Detection
✖Results vary	⭘ Robust Results
✖No Real Time Bottlenecks	⭘ Real Time Bottlenecks
✖Simulation Length unknown	⭘Automatic Simulation Termination
✖Requires Human Experience	⭘Automatic Bottleneck Detection
✖No Confidence Intervals	⭘Automatic Confidence Intervals

5. Future Work

The bottleneck detection method may also be used to improve the scheduling of the production system in order to avoid congestions due to unfortunate scheduling. Furthermore, research is in progress to optimize the production system based on the bottleneck information obtained by the bottleneck detection method. This allows the ranking of the effect of the production system variables on the performance of the production system.

責任者：中野 冠

担当者：○Roser Christoph(ｿﾌﾄｳｪｱ研究室)、田中 稔(ｿﾌﾄｳｪｱ研究室)