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DEVS-BASED SEMICONDUCTOR PROCESS SCHEDULING USING THE MULTIFACETTED SYSTEM MODELLING AND DISCRETE EVENT SIMULATION

Minkyu Ji[1], Youngshin Han[2] and Chilgee Lee[1]

[1]Semiconductor engineering, Sungkyunkwan University
Seobu-ro, Jangan-gu,Suwon-si,Gyeonggi-do, 440-746, Koera
[2]Dept. of Computer Engineering, Sungkyul University
Anyang-si,Gyeonggi-do,430-742, Korea
hanys@sungkyul.ac.kr

ABSTRACT

Short cycle time prediction is a well-documented problem in complex-process manufacturing such as semiconductor manufacturing. In general, the amount of production in wafer fabrication is dependent on bottleneck facilities. In this paper, we compare scheduling methods to increase the production of the wafer fabrication. We model the process based on DEVS (Discrete Event System)/SES (System Entity Structure) and estimate our methods whose models are created from the SES through pruning processes.

1 INTRODUCTION

A Bottleneck Facility (BF) is a production facility that constricts the smooth flow of production on the production line. The facility can be identified by inspecting queue length, machine utilizations, or loading level. In the wafer fabrication process, many devices are connected to a BF and they require a setup time, workload and WIP (Working in Progress). Since a BF selects a job from the devices by considering these factors, scheduling problems occur. To express a BF system including above mentioned methods, System Entity Structure (SES), which constructs a system with specialization, aspect, and multi-aspect properties, is used [1]. To generate a specific system from the general system, a pruning process, which selects an entity from specialization and defines the number of entities from multi-aspect, is applied. In this paper, based on the workload that is proposed by Y.D. Kim [2], we compare the performance of FCFS, same setup and loop heuristic methods.

2 DEVS BASED MODELING & SYSTEM ENTITY STRUCTURE OF THE BOTTLENECK SYSTEM

We exploit DEVS to model the target system and observe the system behaviors for each scheduling rule. Fig. 1 shows the overall models' view of Bottleneck Facility. A top level coupled model consists of an Experiment Frame model (EFForBottleNeck) and a BottleNeckSystem model which is made of seven coupled models. The PreProc and the PostProc models with same number handle the same Lot type. The BottleNeck model has a QueueSystem model with three different rules such as FCFS, same set up, and loop heuristic methods.

BottleNeck System can be expressed with System Entity Structure (SES) which contains all possible models' structure. As seen in Fig. 3, a top coupled model can be decomposed to PreProcs, BottleNeck, and PostProcs models. One vertical line (|) between the bottleNeckSystem and PreProcs (BottleNeck or PostProcs) means aspect relationship. The PreProcs and PostProcs coupled models has three vertical lines (|||) which means multi-aspect relationship. Sub models (PreProc or PostProc) in the PreProcs or PostProcs can be generated from 0 to infinity through the pruning processing of the SES. In the BNInputQueue model, there is two vertical lines (|| |) which displays specialization relationship between BNInputQueue and FCFSQueue(SameSetUpQueue, or LoopHeuristicQueue). The BNInputQueue can be an FCFSQueue, SameSetUpQueue, or LoopHeuristicQueue through the SES pruning processing. Figure 4

shows pruning SES of the bottleNeckSystem SES. To generate a bottleNeckSystem with a FCFS Queue model, we assign a multi-aspect for PreProcs to three instances and a multi-aspect for PostProcs to three instances. Those assignments result in generating three PreProc coupled models and three PostProc coupled models in the BottleNeckSystem coupled model.

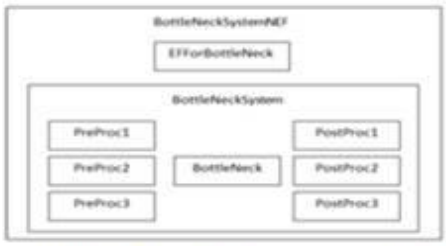

Figure 1 Overall Models' View for the bottleneck facility

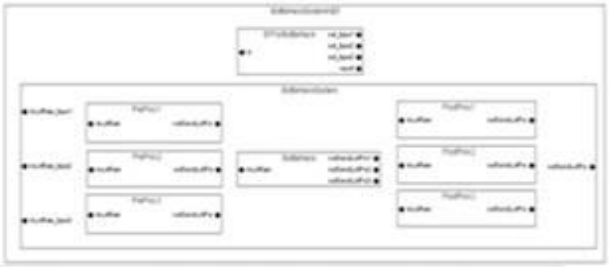

Figure 2.Overall Models' View for the bottleneck facility

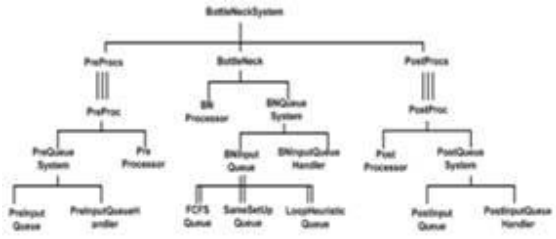

Figure 3 SES view of the BottleNeckSystem

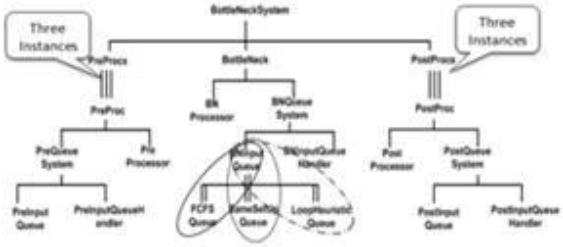

Figure 4 Pruning SES of the BottleNeckSystem

For a specialization, we can select an FCFS Queue entity for a BNInputQueue entity. That selection makes a BNQueueSystem coupled model have an FCFSQueue atomic model as a BNInputQueue (left ellipse in Figure 4). For a bottleNeckSystem with SameSetUpQueue, we can select a SameSetUpQueue as a BNInputQueue (middle ellipse in Figure 4). For a bottleNeckSystem with LoopHeuristicQueue, we choose LoopHeuristicQueue entity as a BNInputQueue (right ellipse in Figure 4).

3 CONCLUSION

We described a bottleneck system as a multifaceted system using SES. From the multifaceted system, we can generate a specific coupled model through pruning process which assigns the number of instances for multi-aspect relationship and selects one entity from the multiple sub-entities for a specialization relationship. According to the simulation results in this study, heuristic rule is superior to FCFS rule in terms of the average cycle time but it is agreed that the same setup rule is the best. FCFS takes longer than 10 times than other alternatives. This is because its setup is more complicated and time-consuming.

4 ACKNOWLEDGEMENTS

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