ABSTRACT

Control of hybrid AMHS considering dynamic transport load transfers between vehicles

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Motivation

Automated material handling systems (AMHS) are crucial for efficient transport of wafers between production equipment in semiconductor fabs. The design and control of these systems are not only challenging but subject of ongoing research (see Kim et al., 2020). The management of hybrid AMHS which combine transport system components with different characteristics (e.g., automated guided vehicles and overhead hoist transport systems) is currently of particular interest (see Schneider et al., 2018).

Innovation

This contribution discusses a new control concept (compare Boden et al., 2021) that allows transport load exchange in hybrid AMHS. It focuses on vehicles able to perform load exchange dynamically by splitting transport requests into sub-tasks determined ad-hoc depending on the current system status. Unlike conventional control approaches for hybrid AMHS, our dispatching approach does not rely on high-level control rules which statically split transport tasks in advance.

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Description

To perform an exchange, a vehicle deposits its transport load at a transfer location where it is buffered until a vehicle takes it and continues the transport task. This feature allows improved schedules which in the end lead to more efficient automated material handling systems regarding e.g. delivery times or vehicle utilization. However, the generation and evaluation of schedules allowing load exchanges is challenging as the number of possibilities to route vehicles significantly increases. In this connection, we outline different algorithmic approaches to generate appropriate schedules.

Results

The concept of load exchange in principle and approaches are discussed based on a simulation study. The results show on the one hand that load exchanges lead to improvements compared to conventionally operated AMHS and its control approaches, which neglect dynamic transfers. Due to the increased flexibility, effort for driving and handling can be reduced. As a result, positive effects on key performance indicators such as system throughput or delivery time can be achieved. On the other hand, beneficial schedules can be generated in a sufficiently short time. This potentially allows its application in industrial systems.

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Literature

Boden, P., Rank, S., Schmidt, T., 2021. Control of heterogenous AMHS in semiconductor industry under consideration of dynamic transport carrier transfers. 22nd IEEE Int. Conf. Ind. Technol.

Kim, H., Lim, D.-E., Lee, S., 2020. Deep Learning-Based Dynamic Scheduling for Semiconductor Manufacturing With High Uncertainty of Automated Material Handling System Capability. IEEE Trans. Semicond. Manuf. 33, 13–22. https://doi.org/10.1109/TSM.2020.2965293

Schneider, G., Keil, S., Luhn, G., 2018. Opportunities, challenges and use cases of digitization within the semiconductor industry, in: 2018 29th Annual SEMI Advanced Semiconductor Manufacturing Conference (ASMC). pp. 307–312. https://doi.org/10.1109/ASMC.2018.8373173