Planning layout and transport system simultaneously

Auf einen Blick

- ☑ Automated layout planning
- ☑ Automated selection of means of transport
- ☑ Integrated factory planning
- ☑ Fuzzy logic

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IPH | If companies would select a suitable transport system already during the factory planning stage, they can avoid subsequent adjustments and save a lot of time and costs. IPH is developing a software demonstrator for automated layout and transport system planning.

Integrating the selection of means of transport into factory planning: This is the goal of the research project "AutoLaT - Automated and integrated layout and transport system planning taking logistical and economic targets into account" at the Institut für Integrierte Produktion Hannover (IPH) gGmbH.

Up to now, companies usually first plan a factory layout and then dedicate themselves to the selection of a transport system and route planning. In the future, their effects on the factory layout are to be considered at an early stage. In this way, restricted areas for conveyor belts or other special features can be taken into account in the planning stage when designing transport routes, for example by using automated guided vehicle systems. This can prevent subsequent adjustments, saving companies time and money.

The concept

In essence, the overall concept consists of three parts (Figure 2): the **selection of a transport system**, the layout planning and the final route planning.

By the selection of a transport system, a suitable means of transport for the application case is suggested to the user on the basis of expert knowledge and the use of fuzzy logic. This can be, for example, assembly lines, reach

trucks or even driverless transport systems.

The results of the selection of a transport system are used as input parameters in the rule base for subsequent layout planning and finally for route planning. In **layout planning**, this information is used to better dimension route widths, locate specific transfer points between means of transport, or take blocked areas into account.

Finally, **route planning** is performed for the selected transport system. Special requirements, such as route planning for permanently installed systems (continuous conveyors) or blocking of selected transportation routes, must be taken into account here.

Expert knowledge as a basis

The IPH researchers first developed a so-called morphological box for the selection of a transport system. For this purpose, expert interviews with transport equipment manufacturers serve as a basis for fuzzy logic. In these interviews, five categories (Figure 3) were identified, which can be divided into different sub-categories relevant for the selection of a suitable transport system.

In the software demonstrator that the researchers want to develop, the user should be able to enter the data for his specific application into the morphological box. In the background, the input data are then compared with a database of means of transport. A corresponding degree of fulfilment for the individual categories and the respective means of transport is calculated on the basis of fuzzy logic.

Finally, a spider network diagram (Figure 4) shows the user the degree of fulfilment of different target values for the best three results. This gives the user the possibility to select a suitable means of transport. The system can be used individually. The restrictions resulting from the selection of a transport system are used as input parameters in layout planning in the next step.

Automated layout planning

For the automated creation of a factory layout suitable for the application, various user data are initially fed into the system. On the one hand, the focus is on the objects to be planned, such as machines, warehouse technology or workstations. These are necessary for the rough dimensioning of the areas and the subsequent arrangement of the production objects in the detailed planning. In addition, information on the material flows is required in order to be able to implement a layout that is as efficient as possible in terms of material flow and correspondingly short transport routes.

The processing of the input data, the generation of an initial layout and the optimization of the factory layout with regard to material flow efficiency are carried out by a mathematical optimization model, which is developed on the basis of operational research approaches at IPH. After completion of the layout, the route planning for the initially selected means of transport is carried

out.

Route planning of the means of transport

Various input data on the transportation system, the layout and the transportation process is required for route planning. Means of transport can be of different widths, some are fixed (continuous conveyors). This influences route planning. The transportation process can be used to determine which work stations are to be served by which means of transport. Restricted areas and the position of the transfer points must also be taken into account for an effective layout. The actual route planning is then carried out using a route-finding algorithm (Figure 5), for example, with the A* algorithm.

In the future, this system will enable companies to carry out layout planning and the downstream processes of transport means selection and route planning in a more time- and cost-efficient manner and to achieve a better quality of solution.

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