Proceedings of the 2010 Winter Simulation Conference
B. Johansson, S. Jain, J. Montoya-Torres, J. Hugan, and E. Yücesan, eds.

AUTOMATED 3D-MOTION PLANNING FOR RAMPS AND STAIRS IN INTRA-LOGISTICS MATERIAL FLOW SIMULATIONS

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ABSTRACT

Commercial software of material flow simulations has the ability to layout the simulated models. Arranged equipment, such as conveyors or machines, includes the need to model and determine motion paths for moving objects like forklifts or automatically guided vehicles, so that the simulation framework is able to navigate all vehicles across those motion paths. After analyzing first scenarios, the user often carries out layout changes in the simulation model, e.g. moving, adding or deleting equipment. However, those changes cause time consuming, additional modeling of the motion paths for the user. Our motion planning algorithm reduces these changes by automatically determining the motion paths for moving objects, depending on an actual model layout without colliding with other objects. The algorithm works on the basis of the virtual scene's 3D-data used for the simulation model's visualization. We demonstrate the technique with a multi-floor building example.

1 INTRODUCTION

In the global competition "change simply happens" and therefore sustainable planning and flexible adaptation of all processes close to production poses a continuous challenge for companies. Innovative products as well as their corresponding manufacturing processes are to be reviewed at regular intervals in order to improve their efficiency and productivity. One well established method in the area of designing and safeguarding those production processes is the material flow simulation, where multiple scenarios can be modeled, simulated and evaluated before the factory's actual construction. During the last years, in this area, the trend increasingly followed the idea of a "digital factory" (VDI 2006), which covers among other disciplines the simulation and 3D-visualization of the designed processes (Dangelmaier and Laroque 2007). More often, in this research focus, multiple disciplines and methods close to the "basic" simulation, which are also used for the design of production or logistic processes, are connected and combined to simulation systems, in order to improve the gain of knowledge for a specific domain problem. In the area of the material flow simulation, these enhancements might cover modeling and simulation of multiple production systems in a supply chain (Gan et al. 2000; Holweg and Bicheno 2002) or the simulation of special logistic cells, e.g. in the construction industry (Rossmann et al. 2009).

Since the results of a special simulation scenario should lead to a higher understanding of the underlying system behavior, the generated experience of simulation results leads to improved system layouts and parameterizations of the simulation model as well as the designed production processes. Nowadays, in all