Path planning algorithm for levitating planar motion system

Department of Control, Lund University
Henry Nilsson & Johan Ternerot

This thesis aims to examine the possibility of incorporating a path planning algorithm into the Beckhoff levitating transporter system Xplanar, with focus on static scenarios such as the start-up of the system.

Production-line transportation has long been done by integrating more traditional machinery, such as one-dimensional conveyor belts, mono-rail carts and transfer machines. However, during later years these old-fashioned systems have been continuously replaced and re-modelled to new more sophisticated technologies, such as multi-agent transporter robots. One of these systems is the new Beckhoff XPlanar system, using magnetized ground-tiles to move robots or so called movers within production lines with the help of their PC-based control software TwinCAT3.

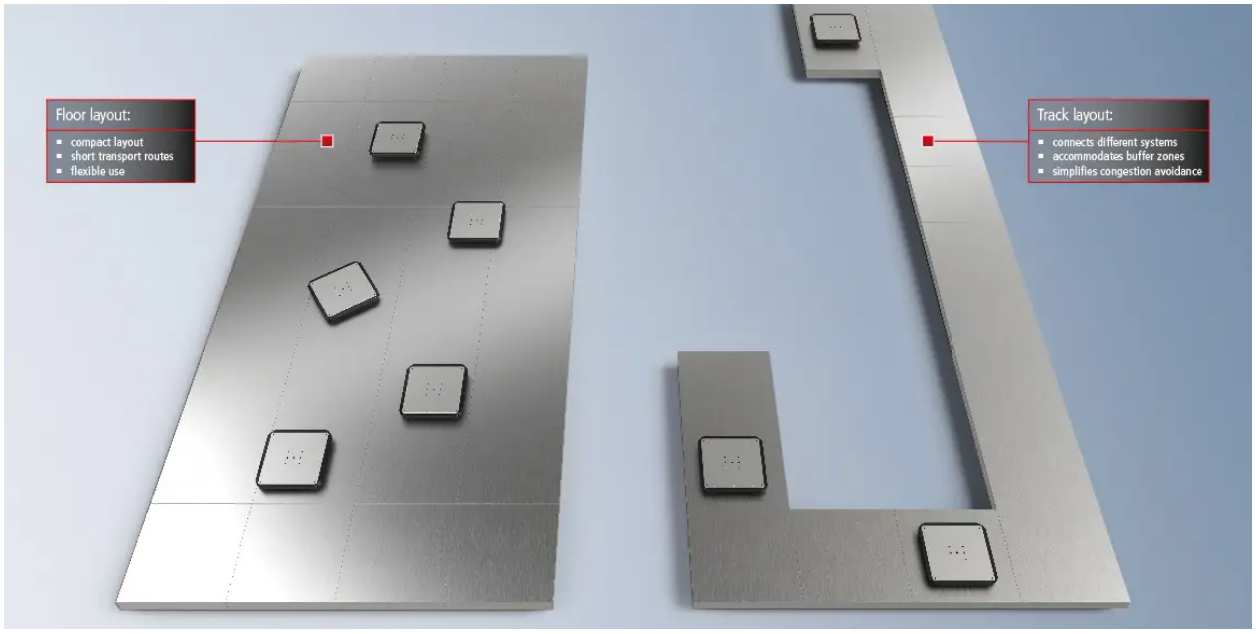

Figure 1: An overview of the XPlanar system, showing movers, and the tiles beneath them [1].

Introducing these kinds of new systems ensues a myriad of challenges. A particularly interesting one is rebooting the system from an unexpected intermission. In a case such as this, the system must be able to return to a predetermined state in order to assure that the quality of the carried product won't be compromised.

This master thesis discusses and evaluates the use of a multi-agent pathfinding algorithm as a reset function to align movers on a predetermined track after a sudden halt in the Beckhoff Xplanar system. To achieve moving multiple transporters simultaneously in a collision-free manner, a single-agent pathfinding algorithm named A* was used in conjunction with a high-level search algorithm named Conflict-Based Search. The solution proved that the algorithms were applicable in a real world system with the help of supporting functionalities to allow complete integration. The thesis also concludes that the A* and CBS algorithms provide very good solvability for these kinds of problems, solving more complex multi-agent pathfinding problems under 10 seconds.

The video below displays how the algorithm performs on the real XPlanar system:
https://youtube.com/shorts/ev-40qVbQBM

References:

[1] Beckhoff. XPlanar | Planar motor system. Url:
https://www.beckhoff.com/sv-se/products/motion/xplanar-planar-motor-system/ (visited on 12/06/22).