Movement analytics in plant simulation software Tecnomatix

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Abstract: Movement analytics (MA) involves the analysis of moving objects that are each represented by a sequence of spatial locations across time (i.e., a trajectory). Whilst static geospatial data is commonly used in decision making, the spatio-temporal context imparted by the movement of objects (i.e., people, robots, or vehicles) can provide richer insight, albeit with the need for more sophisticated statistical or machine learning based models. For instance, in a manufacturing setting, the analysis of data from real time tracking systems can provide valuable insights into operational efficiency, tool and asset management, logistics, and health and safety.

To develop MA-based methods in a manufacturing system will often require a significant financial investment prior to their validation and can interfere with daily operations. Consequently, digital twins or simulation can be an attractive option to generate the data needed to validate MA methods. Siemens' Tecnomatix Plant Simulation is a discrete event simulation software package that can be used to create a detailed digital twin of a plant or factory. However, Plant Simulation has limitations in generating the diverse trajectories that replicate the real movement of workers, assets, and logistics through a factory. The standard movement behavior of workers is deterministic and limited to follow either the predefined path specified by the developer or to follow the shortest path between the origin and destination. To the best of our knowledge, there has been no previous work to generate diverse, stochastic movement paths in Plant Simulation.

Consequently, we investigated different approaches to generate stochastic trajectories of workers in Plant Simulation. We tested our approaches on a simple tricycle assembly scenario with six workers. Plant Simulation's accompanying scripting language, SimTalk, was used to develop methods of stochastic path and obstacle generation that produced diverse and dynamic trajectories. For stochastic path generation, a predefined path is randomly changed in a multi segmented path immediately before a worker travel on it. For the obstacle generation, multiple obstacles are created a priori in the space to block the shortest path for the worker. These obstacles are periodically and randomly moved. The purpose of this paper is to share our experience and findings with the community by presenting the different options for randomized path generation in Plant Simulation and their pros and cons.

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