SYMBIT
(Synchronization Model for Belgian Inland Transport)

Key Characteristics
- Scalable and transferable
- Stochastic and dynamic interactions
- Detailed spatial and temporal awareness of moving and stationary assets
- Decentralized agent behaviour to test current practices and new autonomous systems and structures
- Ability to simulate and evaluate movements of physical assets based on firing rules and triggering events

Motivation & Objectives
The objective of our paper is to introduce a model which integrates information flows with physical movement of assets. Our SYMBIT (Synchronization Model for Belgian Inland Transport) has the ability to simulate and evaluate movements of physical assets based on firing rules and triggering events such as newly incoming order requests, insertion of extra service points, altered delivery times caused by route deviations etc. The SYMBIT architecture, tested herein for city distribution, can be connected to inter-regional flows to assess one of the first synchronous door-to-door deliveries. The main motivation behind SYMBIT’s development is the fragmentation of various freight transport applications which present challenges in terms of knowledge transferability and solution scalability. This is due to the ad-hoc nature of current models which focus on specific scales and geographical regions. The freight transport sector lacks a uniform standard evaluation tool that is capable of measuring freight transport performance, its resilience and consequent impact from a holistic perspective. A model that would take such a holistic perspective and allow, through its design, for a combination of inter-regional and local flows, has not been fully develop yet.

The supply chain collaboration concept introduced in the European Horizon 2020 Citylab project, presents a good opportunity to test the reactive and decentralized behavior of SYMBIT’s agents. This city case was chosen to demonstrate SYMBIT’s scalability and transferability; in other words, the author’s intention is to show that the model’s approach can be up-scaled to a European level, but also down-scaled to a city level, without using a different model structure, software or approach. The case application in this paper concerns only the ‘ad hoc part of SYMBIT due to the scope of the study area.

Methodology

Ports and Terminals
Navigable waterways, railways and main roads
Detailed urban infrastructure (case specific)

Case application and results

Disruption management

Research Outlook

More work is needed in terms of geographical clustering and speed parameter variability since all moving agents roam the environment at 50 km/h. The agent calibration and geographical order clustering are subject to ongoing research. The goal is to demonstrate the decentralized agent behaviors, their movements, data collection and information exchange. Furthermore the aim is also to showcase how time measuring processes in discrete event blocks can be linked to a more detailed (white box) logic of moving agents and consequently recomputed back to the discrete event logic within stationary agents (as demonstrated with Pedlos and Distributor DC). The case application in this paper concerns only the ‘ad hoc part of SYMBIT (see figure in methodology) given the scope of the study area, timing and page limit. Future work will thus showcase a complete assessment which will include city/urban distribution as well as inter-regional flows. In terms of model improvement, agent movement calibration will be carried out by incorporating real-time data feeds from commercial sources.

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