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Agent-based simulation of network evacuation problem with dynamic shelter allocation

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Catastrophes threaten the entire population of the devastated areas and put them in highly risked situations. In order to avoid life losses caused by these disasters, the best way is to evacuate people from areas considered as risky zones to safe areas with resilient transports. This study proposed a new framework to solve the network evacuation problem, considering a dynamic allocation of evacuees to shelters. Although many studies have been performed on this problem with static settings [2], there are few studies in the literature that address this problem in a dynamic context. The proposed framework couples and solves the dynamic traffic assignment (DTA) [1] and dynamic shelter allocation problem (SAP) [3] using agent-based dynamic simulation.

In order to solve the evacuation problem dynamically, we have solved the problem in multiple departure time intervals by considering the system optimum principle for the SAP and the user equilibrium principle for the DTA problem. For calculation of the vehicle evacuation time, we have considered an agent-based dynamic simulator that provides us the travel information every second. We apply our methodology to the real network of Luxembourg and compare it with a model using fixed shelters based on [4]. The results show that the proposed model outperforms the model with fixed shelter by more than 30% reduction in network clearance time. It means that using dynamic allocation can improve the evacuation process because it gives us an opportunity to provide the optimal evacuation plan considering the dynamics of the network. Besides, the analysis on the computation time proves that solving the online SAP needs tiny computational resources, while it significantly reduces the duration of the evacuation process.

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