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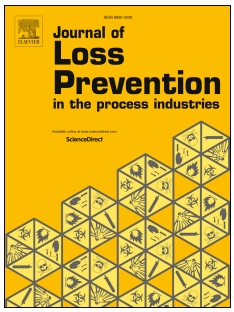

Optimizing emergency rescue and evacuation planning with intelligent obstacle avoidance in a chemical industrial park

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Optimizing Emergency Rescue and Evacuation Planning with Intelligent Obstacle Avoidance in a chemical industrial park

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Abstract: A major chemical accident has the characteristics of being destructive, and potentially provoking a great loss of lives and property damage in any Chemical Industrial Park (CIP). Emergency rescue and evacuation are essential parts of emergency decision-making for enhancing the capacity and effectiveness of emergency handling and reducing the potential loss of accidents. Most of current literature concentrates on one-way route planning of emergency rescue and evacuation, and applies different models, optimization objectives and algorithms. However, when applying the one-way route planning model in a CIP, a road conflict is possible due to the inherent weak traffic capacity. Therefore, a new method of two-way route planning of emergency rescue and emergency evacuation which considers intelligent obstacle avoidance, is proposed in the paper. The method we developed integrates three modeling components: (i) a dynamic grid environment model to simulate the interaction between the road network and the time-varying location of emergency rescue and evacuation. (ii) a two-way route planning model to simultaneously optimize routes of emergency rescue and routes of emergency evacuation. (iii) an intelligent obstacle avoidance model to prevent potential road conflicts. The results illustrate that the proposed model is able to generate a set of two-way optimum routes and overcomes possible road conflicts successfully.

Key words: route planning; dynamic grid method; emergency rescue; emergency evacuation; DNV Phast 7.21; chemical industrial park

1. Introduction

Recent trends that have appeared in the international petrochemical industry put an ever growing focus on clustering, intensiveness, and integration (Reniers et al., 2010). The development of the petrochemical industry has in the past decades resulted in high concentrations of hazardous substances in CIPs. Therefore, CIPs are always in a high-risk state (Chen et al., 2015). On August 12, 2015, a serious fire and explosion occurred in Tianjin Binhai New District (China), which killed 165 people and injured 798. The direct economic loss was $1.1 billion. Emergency decision-making is important for the reduction of numbers of casualties and property losses as