

Abstract

The management of major emergencies is a well-established area of research that aims to minimize loss of life and maximize human well-being, also reducing loss of property and economic damage. Examples of such emergencies, which unfortunately occur frequently, include the summer fires around the Mediterranean that require a rapid response to avoid the loss of dwellings and agricultural property, or the annual hurricane season events in the United States, which can require the evacuation of millions of people. Within this broad scope, this doctoral dissertation focuses on accidents with cruise ships that carry large numbers of passengers. In these emergencies, physical space is highly constrained, and one needs to have pre-defined methods for evacuating the passengers and crew members within delays that have been defined by specialized international standards agencies. Facing this challenge requires the use of special-purpose decision aids, including Internet of Things (IoT) infrastructure that can sense the location of evacuees within the ship and help them reach the evacuation exits rapidly with the help of sophisticated routing algorithms and algorithmic methods. A key issue in this area is to understand the performance of the methods that are used to address such emergencies, such as the actual exit times for evacuees who may have different physical capabilities based on age or health condition. After reviewing the main technical challenges in this area, this document summarizes our doctoral dissertation and the related publications, which focus on the evacuation of Cruise Ships, and develop simulation and analytical methods to optimize the evacuation through routing techniques that may apply to each individual evacuee. Our simulations and analytical models show that the IoT can substantially assist in accelerating the evacuation process and reducing the evacuation delays to meet the safety standards in this area.