UNIVERSITY TRANSPORTATION CENTER

RESEARCH BRIEF

Agent-based Modeling Framework for Wildfire Evacuation in Damaged Transportation Settings

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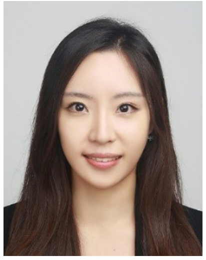
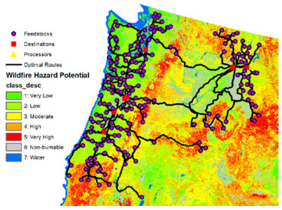


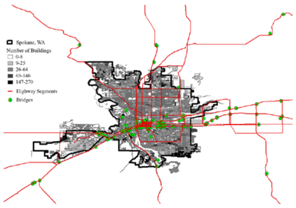
Background

Wildfires pose an increasing threat to residents in the Western United States as more people are moving to the wildland-urban interface. In addition, increasing frequency and magnitude of wildfires induced by climate change will greatly intensify wildfire threat to humans, the built environment, and ecosystems. While many state- and local-level initiatives are underway to mitigate wildfire risks, it is not possible to completely remove such risks due to substantial inherent uncertainties. In this case, evacuation is the most important and effective method of reducing human losses during a wildfire event. While it seems easy to achieve the main goal of evacuation (i.e., moving people at risk to safer places), human behaviors during an evacuation are highly unpredictable, and the elevated travel demand due to simultaneous evacuation may lead to traffic congestion, which endangers human lives. Bridge damage induced by fires and the associated reduction in traffic carrying capacities will further complicate this problem. Thus, wildfire evacuation simulation can be an effective experimental means for emergency management and evacuation planning because it requires low cost and identifies bottlenecks and critical points for traffic congestion during an evacuation.

Research Project

The project develops an agent-based modeling framework for wildfire evacuation in damaged transportation settings aimed at predicting traffic conditions during an evacuation and identifying the critical parts of transportation network for pre-fire risk mitigation actions. To address the gaps identified in existing literature, the framework integrates wildfire simulation and vulnerability assessment with ABM to adequately represent both human behavior during an evacuation and time-dependent network functionality in microscopic traffic simulation. The framework consists of four parts: wildfire simulation, vulnerability assessment, evacuation model, and traffic simulation. All the variables considered in the framework are updated at a fixed time step: bride damage state and its traffic carrying capacity are updated based on fire propagation measured at every time step; each agent updates its state during an evacuation; and microscopic traffic simulation coupled with ABM is performed based on the time-dependent network functionality and the updated locations of all agents. Private vehicles are the primary form of mobility for people living in wildfire prone areas. We therefore focus on capturing vehicle use and vehicular traffic in our modeling without considering pedestrian behaviors. Final results will be time-dependent traffic maps to identify the critical parts of transportation network that are the most vulnerable to wildfires and have great potential for causing traffic congestion during an evacuation. Moreover, the total number of evacuating agents during a given time period will also be obtained as a final result, which could be used to determine the bridges that need to be strengthened in order to minimize human losses during wildfire evacuation.





ABOUT THE AUTHORS

The research team consisted of Ji Yun Lee of Washington State University.

ABOUT THE FUNDERS

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EXPECTED DATE OF COMPLETION

March 2022

FOR MORE INFORMATION

https://depts.washington.edu/pactrans/research/projects/agent-based-modeling-framework-for-wildfire-evacuation-in-damaged-transportation-settings/