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COLLEGE OF ENGINEERING

Planning for Disaster Emergency Evacuation: An Evolutionary Algorithm Optimization Model for the Vehicle Routing Problem with Autonomous Buses

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Introduction

- Natural disasters such as hurricanes, tornadoes, earthquakes, and wildfires as well as intentional disasters can result to a lot of human and economic losses
- Challenge: lack of efficient transportation and proper emergency evacuation planning



Hurricane Rita Evacuation
Houston, 2005

- This study conducts an assessment impact of AVs for emergency evacuation particularly for reducing evacuation cost by investigating vehicle routing problem of AVs

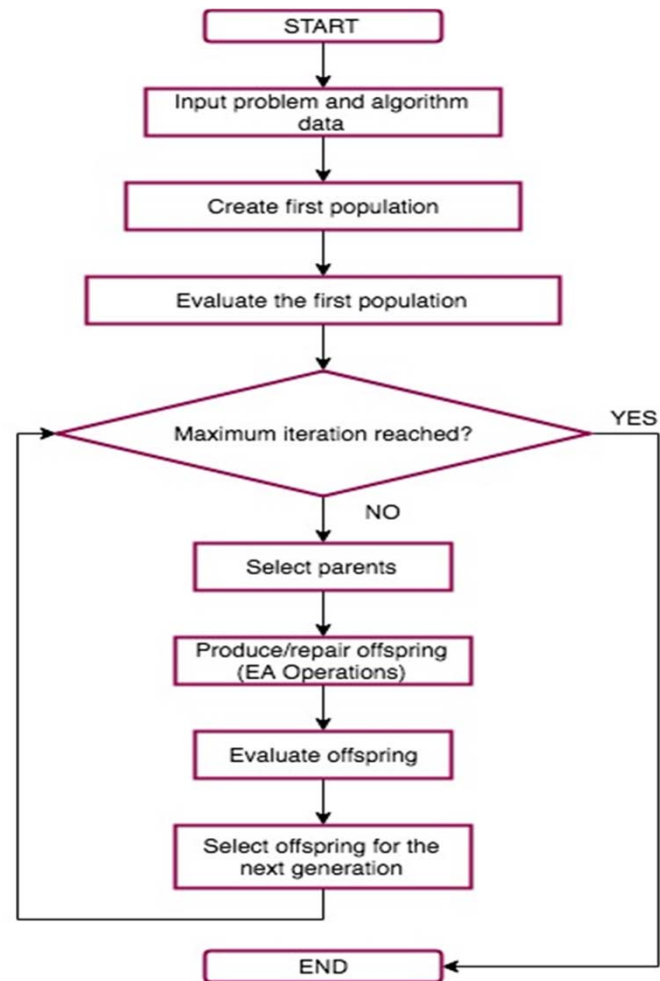


Problem Description

- Determine the routing of autonomous emergency buses (AEB) from the households to shelters using evacuation routes
- Determine the minimum total cost of evacuation process based on travel time cost and accident risk cost
- NP-hard problem

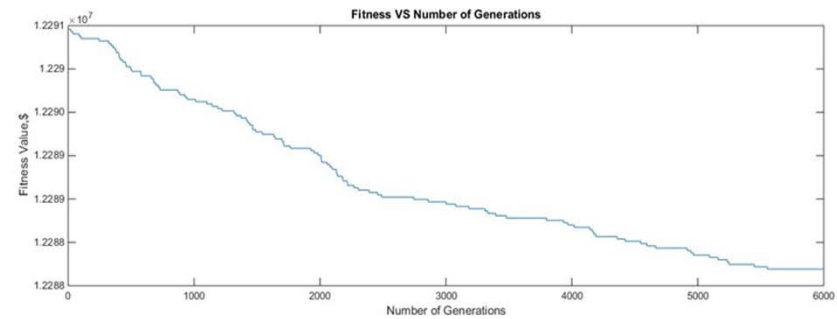
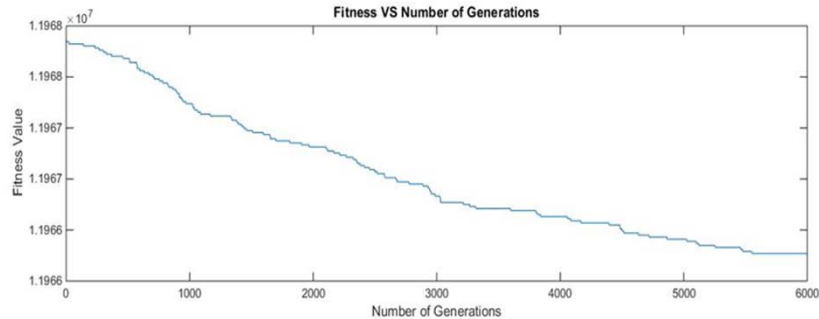
Proposed Solution Algorithm

- This study proposes an Evolutionary Algorithm (EA) to solve the VRP-AEB



Results

- Case Study : Hillsborough County, Florida
- 40 AEB were designated to evacuate 2000 households using 19 possible evacuation routes.
- The use of AEB was observed to lower evacuation cost by 2.6% compared to the existing system. Cost savings are expected to increase for large scale emergency evacuations.



Way Forward

- Use more realistic data and assumptions for autonomous driving to consider evacuation conditions
- Consider large scale emergency evacuation
- Improve the VRP to include other objectives and time window
- Assess the impact of AVs to improve network efficiency and clearance time from evacuation operation perspective

