Simulation of Nuclear Accident Evacuation using MASSIVES (a Multi Agent Speedy Simulated Interactive Visual Evacuation System)

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Abstract
We present the continued development and improvement of a hybrid model approach to producing time estimates for evacuation planning using graph adhered multi agent simulation. We are constructing the simulation environment to simulate evacuation, and the potential influence of shadow evacuation in the Tokai-mura PAZ, and UPZ.

Keywords: Evacuation Simulation, Nuclear Accident, Shadow Evacuation, Multi Agent System, OIL

1. Introduction

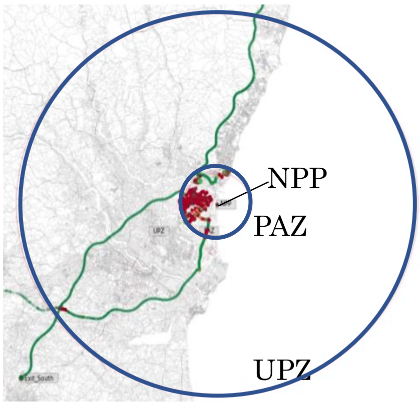
As a lesson learned from the Fukushima Nuclear Power Plant accident, is that it is important to adopt an evacuation time estimate into an evacuation planning. The goal of this project is to develop an evacuation simulation called “MASSIVES” [1].

2. Simulation as an aid in evacuation planning

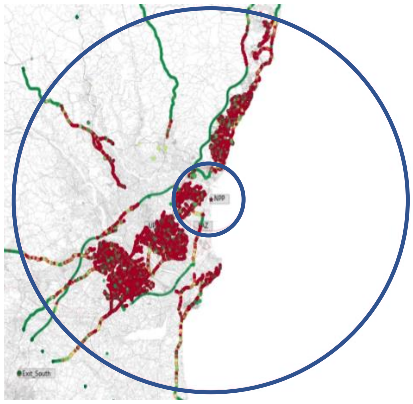
With our system we are developing a **hybrid model** for evacuation simulations. This hybrid model employs multi agent simulation on a graph, rather than simulating the agents as traditional on a Euclidean grid. Moreover, our newly developed original “weighted inverse BFS” is computationally beneficial compared to traditional BFS (Breadth First Search) [1].

3. Use case

In the area surrounding the Tokai-Daini NPP (Nuclear Power Plant) there is a population of about 65,000 people in one village and 4 cities within the PAZ (Precautionary Action Zone), and about 940,000 people in 5 towns and 9 cities in the UPZ (Urgent Protective Action Planning Zone). We made several evacuation scenarios referring publicly opened documents by local authorities [2]. Using MASSIVES, we are examining Tokai evacuation scenarios including; influence of shadow evacuation (certain percentage of people in UPZ start evacuation even though shelter in place is advised and causes delay of PAZ evacuation), influence of detour by tsunami caution, and bottle neck studies (Figure 1) showing increased traffic stagnation due to shadow evacuation (b) vs. (a). We will explain simulation results and findings in the presentation.



(a) Regular scenario



(b) Regular Scenario + Shadow evacuation 40%

Figure 1 Example of bottle neck study

Remark: vehicle speed 4 hours after EAL(AL) event, with green/normal and red/stagnant.

References

[1] Martin Andersson et al. Development of, and Use case for MASSIVES a Multi Agent Speedy Simulated Interactive Visual Evacuation System, 第 23 回「環境放射能」研究会 2022 年 3 月 8 日
[2] For example, 茨城県,原子力災害に備えた茨城県広域避難計画,平成 31 年 3 月改定