CSE6730/CX4230
Literature Review - Group 11
Tusheet Goli, Matthew Dacey-Koo, Tushna Eduljee, Aarun Srinivas

Project Overview: Our team is planning on working on a project that is trying to simulate road behaviors like traffic, merging, etc. For this literature review, we wanted to keep our literature search broader by expanding this to other services like trains, metro systems, bus services, etc. Our goal through this modeling and visualization is to better understand the usage patterns of such services and aim to optimize these networks based on the models we create.

1. The paper titled “Trends in Real-time Traffic Simulation” discusses the various types of software tools that are being used to model traffic. Specifically, the paper analyzes 17 different traffic simulation software tools to determine the shortcomings and strengths of traffic simulation software as a whole. From its analysis, the paper comes to the conclusion that traffic simulation software still is unable to simulate the conditions present on complex heterogeneous road requirements due to the fact that it cannot identify patterns when presented with a small amount of real-time data. From this paper, we have identified several tools that could aid us in the development of our application. Specifically, the traffic simulation software tools Quadstone Paramics and SITRA-B+ might serve as good sources of inspiration for our project.

2. Another paper that offers some insights that could be utilized in our project is titled “Traffic Simulation Modeling of Rural Roads and Driver Assistance Systems.” It discusses how microscopic traffic simulations can be used to analyze different road systems. Specifically, the paper attempts to utilize this simulation technique to analyze traffic present in rural roads and how driver assistance systems can affect traffic. The primary contribution this paper makes to the field of traffic simulation modeling is a simulation called RuTSim which stands for Rural Traffic Simulator. In particular, the paper utilizes RuTSim to simulate traffic present on a Swedish two-lane rural road and on a Dutch two-land rural road. In the chance that we would like to construct a model to describe a phenomenon that does not have much data, the ideas proposed in this paper could be very beneficial in that they can help serve as a starting point.

3. Unlike other papers which have worked to simulate traffic in the 2D space, the paper titled “Continuum Traffic Simulation” attempts to simulate traffic in the 3D space. Specifically, it attempts to provide a more accurate simulation of traffic in the real world in a fast and efficient way by describing the movement of several vehicles in a single computational cell. The paper further proved that its approach was much more efficient than state-of-the-art 3D simulation methods. This paper provides us with an idea as to how to go about tackling 3D simulations in a fast and efficient way. Thus, the main idea presented in this algorithm which is approximating real traffic by describing the movement of several vehicles in a single computational cell could serve as a good starting point when constructing our own model of how traffic behaves.

4. The paper titled “Population-based simulation optimization for urban mass rapid transit networks” can help us in our simulation model for our project. Depending on whether we decide to look into metro rail-based transportation or road traffic, we can incorporate some hypothetical future population-based work into our simulation. This could be helpful if we are motivated to focus on the city of Atlanta for our simulation. We could propose a way to create more efficient rail, bus, or roadways for our city based upon some of the ideas for population-based simulation optimization discussed in this paper.

5. Wang et al. create multiple different models and compares them to data collected in China over a 10-month span. The researchers created the following models: Linear Regression, Spatial Lag, Spatial Error, and Time-Fixed Effects Error. To create these models, they consider both spatial and temporal features, creating equally-sized traffic analysis zones (rectangles for grouping data for analysis). The researchers found that the time-fixed effects error model, one that considers both spatial and temporal effects to be superior. From this, our group has identified a few models that we can pursue in our own research of traffic, along with possible inspiration for methodology.

6. This link is a grouping of various resources used for a class on transportation at the University of Lisbon. Similarly, it provides many examples of models used to analyze various forms of transportation, for which our team can take inspiration to apply to our own individual topic. The methods and models listed are as follows: Multiple Linear Regression, Factor Analysis, Cluster Analysis, Generalized Linear Models, Panel and Spatial Regression Models, Discrete Choice Models, Ordered Models, Hazard-Based Duration Models.

7. Andrade-Michael et al. take a look at the bus vehicle and reliable driver scheduling problem. It attempts to take two NP-Hard problems - the Vehicle Scheduling Problem and Crew Scheduling Problem, and proposes an exact constraint programming model that is claimed to greatly improve efficiency when considering the reliability of drivers. This paper could be very useful if our team ends up pursuing research on local transportation systems like those of Marta or Georgia Tech. It’d be useful to utilize the proposed model and apply it to our local systems to determine where improvement could be made.

8. The paper titled “Modeling and simulation of highway traffic using a cellular automaton approach”. If we do in fact aim to solve a traffic flow-related problem with our simulation, then we can utilize this paper to understand how cellular automata can be applied to simulate a traffic flow-related problem. Something like this can be helpful for us in describing the influence of a car accident in single-lane vs double-lane traffic flow models. Although this research project implemented the code in Matlab, we may use similar ideas to understand how to structure our inquiry in the space.

References

Andrade-Michel, A., Ríos-Solís, Y. A., & Boyer, V. (2021). Vehicle and reliable driver scheduling for public bus transportation systems. Transportation Research Part B: Methodological, 145, 290–301. https://doi.org/10.1016/j.trb.2021.01.011

Ding, D. (2011). Modeling and simulation of highway traffic using a cellular automaton approach.

Modelação da Procura de Transportes. Tecnico Lisboa. https://fenix.tecnico.ulisboa.pt/disciplinas/MPTra/2020-2021/1-semestre/materiais-de-apoio

Pell, Andreas & Meingast, Andreas & Schauer, Oliver. (2017). Trends in Real-time Traffic Simulation. Transportation Research Procedia. 25. 1477-1484. 10.1016/j.trpro.2017.05.175.

Schmaranzer, David & Braune, Roland & Doerner, Karl. (2020). Population-based simulation optimization for urban mass rapid transit networks. Flexible Services and Manufacturing Journal. 32. 10.1007/s10696-019-09352-9.

Sewall, J., Wilkie, D., Merrell, P., & Lin, M. C. (2010, May). Continuum traffic simulation. In *Computer Graphics Forum* (Vol. 29, No. 2, pp. 439-448). Oxford, UK: Blackwell Publishing Ltd.

Tapani, A. (2008). Traffic Simulation Modelling of Rural Roads and Driver Assistance Systems (PhD dissertation, Linköping University Electronic Press). Retrieved from http://urn.kb.se/resolve?urn=urn:nbn:se:liu:diva-12428

Wang, W., Yuan, Z., Yang, Y., Yang, X., & Liu, Y. (2019). Factors influencing traffic accident frequencies on urban roads: A spatial panel time-fixed effects error model. PLOS ONE, 14(4). https://doi.org/10.1371/journal.pone.0214539