

Cellular Automaton Model for Mixed Traffic of Self-driving Cars and Human-driving Cars

Zuzhao Ye, Qian Xie

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1 Objectives

Our project will be based on the validation and the extension of the paper *Realistic Multi Lane Traffic Rules for Cellular Automata*.

We will start from rebuilding their model and reproduce their results, which will then be compared with NaSch model, a cellular automaton model for single-lane traffic. Beyond this point, as the intelligent self-driving system is being declared as a potential next-generation transportation solution, we are particularly interested in how autonomous vehicles will improve the traffic efficiency when they cooperate with other vehicles (V2V) and infrastructures (V2I).

Here is a brief list of what we plan to address in our model:

- Cooperation between vehicles, include distance keeping, lane changing, and emergency warning.
- Information sharing between vehicles and traffic lights.
- Effects of vehicles entering and exiting intersections.

In addition to the model, there are also two important scenarios to be included in the study:

This project proposal is for TR-GY 7363 Data Mobility Modeling and Simulation. The instructor is professor Kann Ozbay.

Z. Ye and Q. Xie are first year PhD students in Transportation Planning and Engineering. (email: zy1451@nyu.edu, qianxie@nyu.edu)

- The mix of self-driving vehicles and human-driving vehicles. As one can imagine, the adoption of self-driving vehicles will be a gradual process, it will be important to understand the system behavior and performance with different percentages of the self-driving vehicles.
- The impacts of accidents. Accidents are very common in everyday transportation, we want know how it affects the performance of V2V/V2I system.

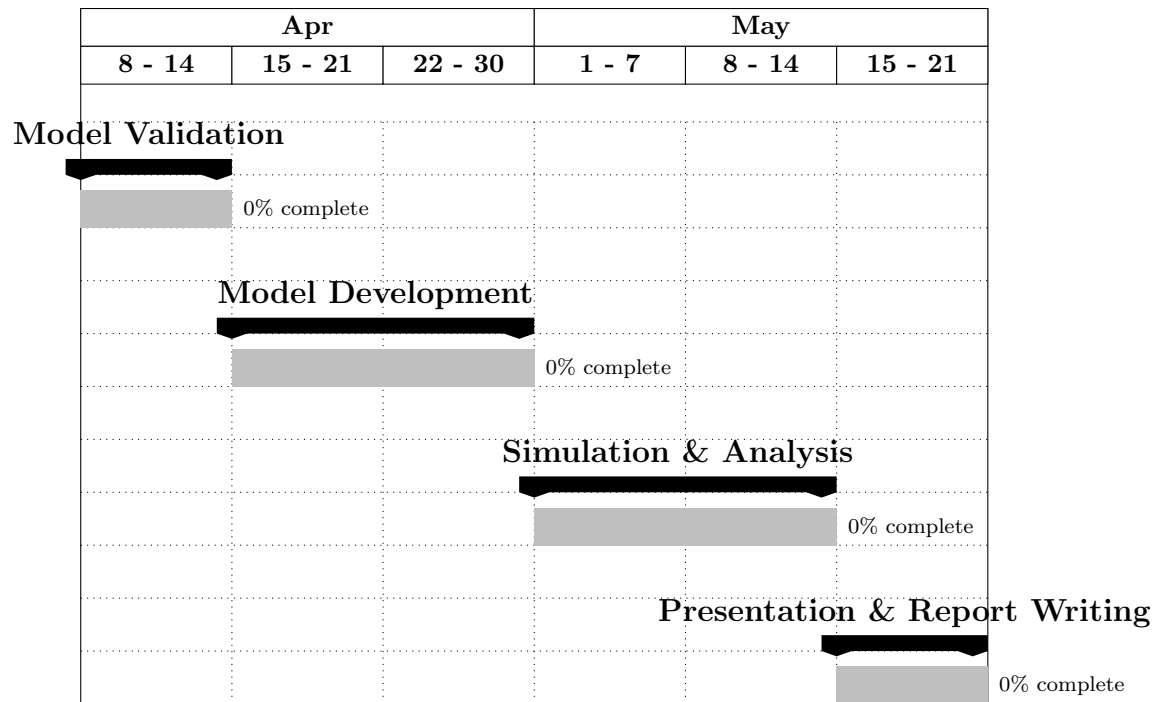
2 Tools and Data

Here are a few candidates that we consider to fit our purpose. We will choose one from them along the project:

- Front-end (for displaying): NetLogo or PTV Vissim
- Back-end (for coding): Python or Matlab

The U.S. Route 1 is one of the major routes connecting New Jersey and NYC, it serves a large amount of traffic flows everyday. We believe it will be a good benchmark system in this study. The travel information of U.S. Route 1 (New Jersey section) can be found at <https://www.njtms.org/map/>.

3 Schedule



Notes

- **Reference Model Validation:** This includes establishing a duplicated model as the paper proposed and validate this model with NaSch microscopic traffic model. This step is also important for us to become familiar with the toolsets.
- **V2V/V2I Model Development:** This includes implementing detailed rules for V2V and V2I communication. A literature survey will be performed before any coding. If applicable, existing rules will be adjusted to fit our model.
- **Simulation and Analysis:** This includes varying the percentage of self-driving vehicles as well as introducing traffic accidents to test and evaluate the performance of the system.

References

- [1] Wagner, Peter, Kai Nagel, and Dietrich E. Wolf. "Realistic multi-lane traffic rules for cellular automata." *Physica A: Statistical Mechanics and its Applications* 234.3-4 (1997): 687-698.
- [2] Nagel, Kai, and Michael Schreckenberg. "A cellular automaton model for freeway traffic." *Journal de physique I* 2.12 (1992): 2221-2229.