Summer Showcase

Sadman Ahmed Shanto

Work-Lab

Project: *Traffic Control with Connected and Autonomous Vehicles*

Principal Investigator: Daniel Work, PhD

Mentor: George Gunter, (future PhD)

Timeline

- **Week 1:** Papers, papers, some more papers + getting familiar with Flow
- **Week 2:** I-24 network into Flow, #ShutDownSTEM day, simulated RDS data
- **Week 3:** Sensitivity analysis of the Intelligent Driver Model (IDM)
- **Week 4:** More sensitivity analysis (analytical) + started testing Optimization routines
- **Week 5:** Head first dive into the bizarre world of Optimization and the epic quest to find an efficient routine
- **Week 6:** Nelder-Mead to the rescue + beginning of attempt at a decent calibration
- **Week 7:** A week of head scratching (poor calibration results)
- **Week 8:** Pivot point and invaluable insights from mentor and PI + BIG DATA!
- **Week 9:** Race for TRB paper *(Challenges of Microsimulation Calibration with Traffic Waves using Aggregate Measurements)*
- **Week 10:** Professional Development + Grad School Tips

High Level Summary of Paper

FIGURE 2 : A graphic representing the road geometry combined with a single radar sensor generating aggregate speed measurements.

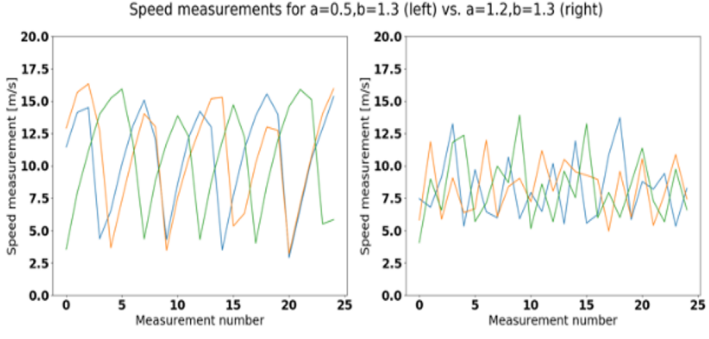

FIGURE 6 : Illustration of the time series measurements recorded for the three simulations under $(a, b) = (0.5, 1.3)$ (left) and $(a, b) = (1.2, 1.3)$ (right).

$$\dot{v}_\alpha = \frac{\mathrm{d}v_\alpha}{\mathrm{d}t} = a\left(1 - \left(\frac{v_\alpha}{v_0}\right)^{\delta} - \left(\frac{s^*(v_\alpha, \Delta v_\alpha)}{s_\alpha}\right)^2\right)$$

$$\text{with } s^*(v_\alpha, \Delta v_\alpha) = s_0 + v_\alpha T + \frac{v_\alpha \Delta v_\alpha}{2\sqrt{a\,b}}$$

$$\underset{\boldsymbol{\theta}}{\text{minimize}} \;\; L(Y_{\text{real}}, Y_{\text{sim}}(\theta, \lambda))$$

Loss Function	Average % Failure	Average Divergence in a	Average Divergence in b
ME:	49.1	0.40	0.25
MNE:	49.0	0.40	0.25
RMSNE:	47.5	0.39	0.24
MANE:	47.1	0.37	0.24
SSE:	44.4	0.28	0.20
RMSE:	43.5	0.26	0.17
MAE:	42.1	0.24	0.19
U:	31.4	0.19	0.18

TABLE 2 : Reporting of three different error metrics on each candidate loss function. All loss functions are found to have similar and high degrees of error in their performance.

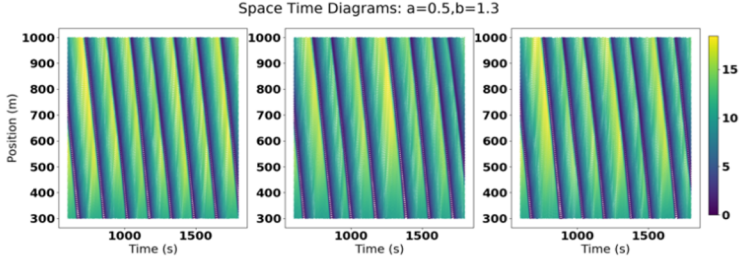

FIGURE 4 : Three time space diagrams colored by speed in (m/s) produced from identical simulations except for the random seed, with $(a, b) = (0.5, 1.3)$. Waves are present and small variations occur in the phase and amplitude of the waves.

Great Lessons

- Traffic is MUCH more complicated than I EVER imagined
- Math is just awesome!
- I really enjoy programming
- Need to work on taking initiatives
- Communication is key
- Passion leads to perseverance
- Leading by example

Notable Moments

- Accidently deleted data from 5 hours of simulation on my local machine...
- Started dreaming about optimization from Week 5....
- Actually got a viable solution from one of those dreams....