**Traffic Flow In A Single Dimension**

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ABSTRACT

**1 Introduction**

Hyperbolic partial differential equations, like the one were analyzing, form initial value problems. They require both the limits of the test space and are dependent on time. The biggest issue for solving these types of equations is stability. We only focused on one spatial dimension. For this, we used the method of lines, which considers a linear combination of coupled points on the space along with already improved values and mitigates the computationally expensive process of matrix inversion. It converts a set of partial differential equations into coupled ordinary differential equations by discretizing the in the x-direction only, allowing to create equations that only need to be evaluated for a specific time. Additionally, we added a factor of numerical viscosity, which helps prevent discontinuities so that the function can be analytically evaluated.

We applied this method to a simple traffic flow model moving only in the x-direction that was only dependent on density and the car speed *u*. We then tested **[insert what we tested here] [we used this data to determine the importance of what factors in terms of what?] [we found this was relevant and this wasn’t]**

In Section 2, we describe the nature of the traffic flow model we are trying to analyze. Section 3 gives a more detailed description of how method of lines and couples ordinary differential equations are used to solve this problem. We then discuss our experimental methodology in Section 4 and our findings (and analysis thereof) in Section 5. In Section 6, we discuss possible future research.

**2 Traffic Flow**

We are modeling cars on a road that travel only in the x-direction with a speed *u*. They have a density, , of cars per mile. This density satisfies the continuity equation:

**[1]**

To simplify the model, we made *u* a function of , where speed only depends on the density of the car. The simplest model is the linear relation:

where is the speed limit and is indicative of bumper-to-bumper traffic. Equation **[1]** then becomes:

**[2]**

with

**[2]** is non-linear, and in general there is no analytical solution. However, it is in the standard form of a flux-conservative problem.

Cars travel with a speed *u*, but perturbations in the flow travel with a “characteristic speed”, *v*. This is found by considering the perturbation , where is constant and . In this case,

[**still need to discuss shocks**]

Problem Solving Techniques

Experimental Methodology

Results

Further Work

Conclusion