A Traffic Simulation Model with Wide-ranged Vehicle Communication

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Abstract:

Traffic is an ever-growing problem as population around the world increases exponentially and with it, the number of drivers. Previously, fluid flow models have been used in an attempt to model traffic, but as has been recently discovered, only agent based models can accurately model a traffic scenario as small perturbations can have a butterfly effect and change the entire system.

Introduction:

I want to create a traffic system that is extremely variable to allow for a great deal of variation and user-specification. The model needs to be tested against simple, proven results before becoming more complex. I need to have an accurate model of driver behavior and an ability for my program to collect data and analyze the traffic situation and congestion well. The system will include varying road systems and the vehicles on the road will have their own properties such as location, speed, acceleration, speed limit, and aggressiveness, some of which will be user-defined. While the simulation is made in an attempt to copy human behavior, like all other standard traffic models in use, it will be collision-free.

Developments Sections:

The World class that my environment is stored in holds an ArrayList of all the Vehicles so that it can access their information and location along with an ArrayList of Intersections. Using these values it will be able to detect traffic jams and react to them by altering conditions. First Iset up a basic simulation to do this, at the moment it is a two-lane system with traffic flowing in two directions moving at user-defined velocity and acceleration and responding to a speed limit, vehicles around them, and stoplights. There is a variable in the program for traffic density that can easily be altered to change the number of cars. Data collected from altering this variable can see how different factors affect traffic congestion. And with the addition of intersections and stoplights, the resultant congestion will show the true traffic health.

Sensing Cars and Intersections

This is a main component of my program as it determines the braking speed of the vehicles in relation to the vehicle in front of them. At first I used a linear model but found it be rather inaccurate, or rather, that with my micro model, I could use more complicated functions because of small set sizes and the ability to visually observe the results. Currently it is a combination of two parabolic functions that vary the speed of the car behind as a function of its current speed and the speed of the car in front of it. This will prevent the car behind from ever running up on the car ahead of it or overrunning it. If no cars are sensed in front of it, a car looks for intersections and judging on their state, accelerate or decelerate

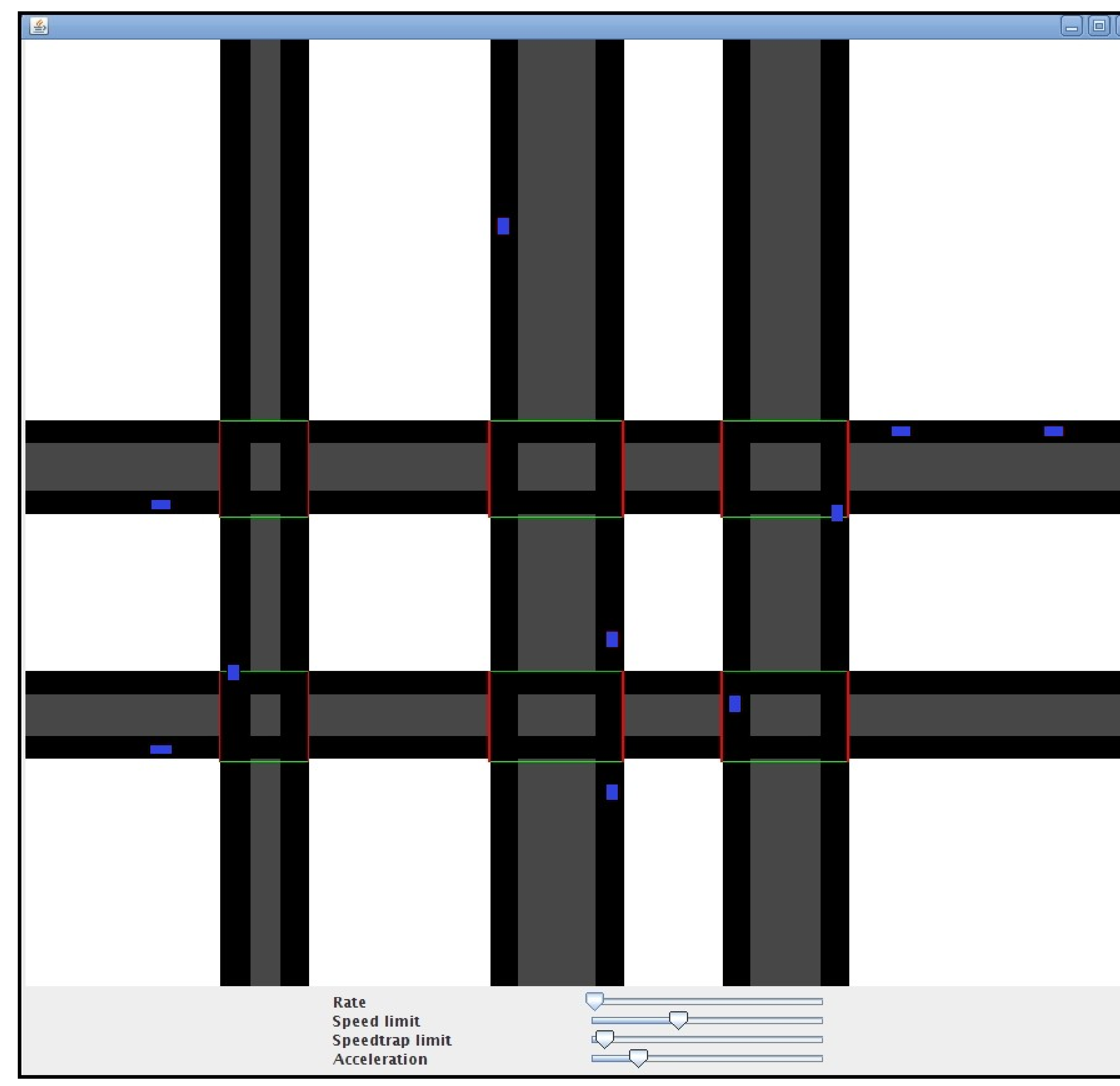
Results and Discussion

My program works in a two-lane traffic simulation with any number of roads. The first version was used as a visual comparison to known behavior to check validity. The behavior that it depicted is a traffic jam moving backwards in traffic. With the speed trap I built in, it was revealed that it is better to have a speed trap earlier on rather than later, as traffic will build up on the road with the speed trap later on, making a slower lane.

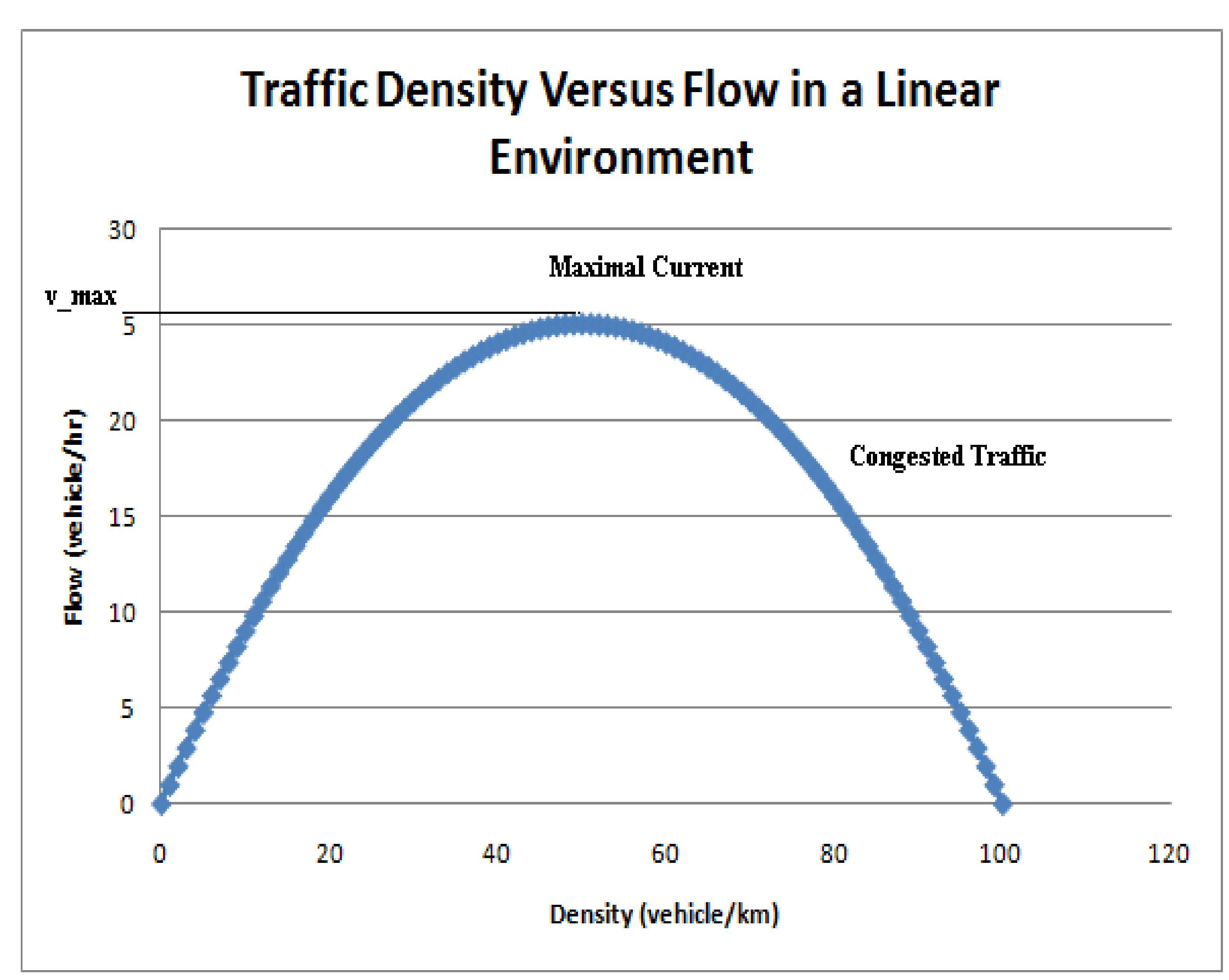
Traffic congestion is used to determine the health and the system and different variables are changed to determine their effect on system health. So comparing the density of the vehicles versus the flow rate would reveal traffic congestion.

With the addition of intersections, the ability for users to define the road environments adds a new level of complexity to the model but also removes some significance from any statistical results because unique environments cannot be compared to a control.

I advise that my model be further developed and used as starting point. Current traffic simulation models are built upon micro models, a large compilation of them. If my code can be optimized and a computer network utilized, my program can be slightly altered to set up a large set of systems adjacent to one another to depict more than just a small road system, perhaps even a whole system.



This is an example user-defined scenario. Such environments can be created in basic image editing software such as Gimp (Figure 1).



This is a graph of the density versus flow characteristic of my linear model exhibiting choking behavior (Figure 2).