22M:096:001
Traffic Flow Module–Mini-project Suggestions

For each of these projects, we'll take $\frac{\partial q}{\partial \rho}$ to be the derivative obtained from our 2-second model. That is, take

$$\frac{\partial q}{\partial \rho} = \begin{cases} u_{max} & \text{if } \rho \leq \rho^* \\ -\frac{\Delta x}{\Delta t} & \text{if } \rho > \rho^* \end{cases}$$

Project 1

Consider the PDE

$$\rho_t + \frac{\partial q}{\partial \rho}\rho_x = 0$$

with initial conditions

$$\rho(x,0) = \begin{cases} 0 & \text{if } x < 0 \\ 1 & \text{if } 0 < x < 1 \\ 0 & \text{if } x > 1 \end{cases}$$

Solve this system using method of characteristics. Discuss what happens when characteristics intersect, and interpret the meaning in terms of traffic flow. Is your interpretation physically realistic? Write MATLAB code to calculate data.

Project 2

Consider the PDE

$$\rho_t + \frac{\partial q}{\partial \rho}\rho_x = 0$$

on a closed loop of length L. What initial conditions would you need in order to apply the method of characteristics? How could you model the loop constraint? Using your method, write MATLAB code to calculate your data. Discuss what happens under various initial conditions. Is your interpretation physically realistic?

Project 3

Consider the following traffic situation:

Cars are stopped at a long red light. The light turns green, allowing cars to pass through for 20 seconds. The light turns red again. Using the traffic flow model PDE

$$\rho_t + \frac{\partial q}{\partial \rho}\rho_x = 0,$$

and method of characteristics, set up a model for this situation and solve it. (You may assume that no other cars enter or exit the roadway except through the light...kind of like the lights outside the Old Capitol Mall to the ped-mall).