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Reading Assignment 3

This article lays out several key points in the introduction. Primarily, the authors reject the ability of second-order Payne-Whitham (PW) models of traffic flow. In particular, the authors demonstrate that the PW model fails to predict realistic driver behavior under certain conditions. Consider a situation in which a driver encounters a dense collection of cars all moving at a high speed in front of them. Under the PW model, the driver is predicted to apply the brake. However, this does not reflect the real-world case, in which the driver would clearly speed up in order to match the velocity of the cars in front of them. In addition, the PW model predicts that in some cases, the driver would not only stop completely, but could potentially reverse, which is clearly ridiculous. Finally, the PW model has characteristic speeds which are unrealistic, as these characteristic speeds suggest that information "always travels faster than the velocity v of cars," which is impossible.

An aspect I have not thought deeply about before is the concept of information travel and the velocity at which this information may propagate. I have seen videos on the Internet of traffic shocks as they travel backwards on a highway, so I was previously aware of this phenomenon and even was able to observe it as I was driving. However, the speed at which these could propagate backwards is something I had never considered. It makes sense that this wave couldn't travel faster than a car. After all, the "information" of the wave existing can only be transmitted when one car encounters another close enough to have an effect. Thus, it does not make sense that a car could transmit the "information" of traffic faster than a car could move. This is a pretty clear issue with the aforementioned PW model, and I'm not curious as to why that model was developed in the first place in light of its obvious issues.

In all honesty, there are many aspects of this paper I don't understand. Pretty much everything under the sub-section titled "Principles" is confusing to me, as I don't understand what many of the terms mean. For example, I'm familiar with what a linear system of equations means, but a hyperbolic system is entirely foreign to me. Clearly, a system cannot be linear if it is hyperbolic, but as to the consequences of this I am entirely unsure. Furthermore, I am unfamiliar with the term "Riemann data" as used in the same section and, somewhat related, what a "Riemann problem" is and how this differs from a non-Riemann problem. Both of these concepts seem to be important in the formulation of the new second-order traffic flow model.