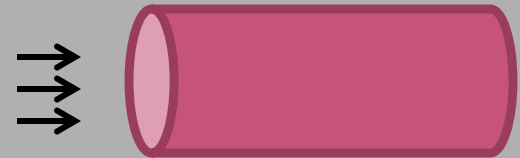


Future of Traffic Flow Theory?

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In the past (last fifty years) traffic flow theory has concentrated on:

- **Drivers are homogeneous active particles (with human behavior) flowing through a pipe** – Works of Pipes, Newell, LWR, Daganzo, Fundamental Diagram, and others
- **Extensions** –
 - Physical characteristics of pipes (links)
 - Point queues to spatial queues
 - Heterogeneous drivers and vehicles -> stochastic models
 - Car following, lane changing, cooperative behaviors issues and models. Discharge rates at stops, ...
 - Applications of TFT to traffic management, traveler information, safety improvements, ITS applications, ... which require estimation and prediction from data



As we continue on this pathway, what is missing?

While some of the things below have been in fact discussed a little here at this meeting, I will mention three directions that I feel are important:

1. Mixed Traffic*: Besides trucks, we now should consider **connected vehicles**, and **automated vehicles** (recall remarks of Gartner, Zhang, Talebpour/Mahmassani, ...)

* Excluding bicycles, peds, three wheelers, bullock carts, ...

Need new models for “driver” behaviors and vehicle dynamics.

Traffic Management for Freeways and Arterials with mixed traffic

Scheduling of vehicles for system optimal (lessons from air-traffic control)?

And new “theory”?

2. **Lane level models***: Can imagine that we will have managed lanes for (a) automated vehicles, and (b) connected vehicles, and other categories, (we have already have HOT/HOV lanes)

* E.g., Recently Daganzo, Laval and Daganzo and yesterday Shiomi/Kozono



Managed lanes means we need ways to measure, estimate, and predict for actually managing these lanes, including congestion pricing/rewarding and safety reductions – in real time

While some of the things below have been in fact discussed a little here at this meeting, I will mention three directions that I feel are important:

- 3. Education for research***: Besides the current background in needed for learning traffic flow theory, need now to have heavy dose of **optimization, control theory**, and **data sciences** to understand, measure, analyze, estimate, predict, and optimize decisions on traffic management and traveler information.

* Already directions at several research institutions