Modeling Traffic Emissions in Networks with Macroscopic Traffic Models (by Eric Gonzales and Rooholamin Shabihkhani)

Comments by Antonio M. Bento

Cornell University

Summary of the Paper and Importance

- Substantial and successful effort in developing a model that **relies on the macroscopic relationship between average flow and density** known as the Macroscopic Fundamental Diagram (MFD) to **make analytical estimates of the network-wide emissions from traffic**
- The components of driving cycle per vehicle distance traveled are estimated based on:
  - the aggregate flow-density relation
  - the free flow speed in the network
  - the duration of a typical acceleration and deceleration associated with vehicle stop
  - the signal cycle length
- These components are multiplied by emissions factors (developed through a microscopic emissions model)

Remark 1 – Use of MFD is ingenious

- By aggregating, it overcomes major computational hurtles and data limitations – avoids the need to follow the second by second trajectory of each vehicle in the system
- The use of MFD allows for analytical tractability
- Analytical tractability facilitates the calculation of important policy counterfactuals

Comment 1 – How well estimated are the components of the driving cycle?

- Driving cycle depends on:
  - Technical relationships, which the paper does a great job
  - Individual behavior and their preferences for different types of driving (e.g. more or less aggressive)
    - Less relevant at peak periods when there is less discretion, but is likely to be rather important at off-peak
- Potential for improving the analytics even further by considering the microeconomic foundations of individual decision making constrained by:
  - MFD
  - Prices and Income heterogeneity

Alternative attempts by Economists, and a question

- Like the current paper, attempts to get at the relationship in an aggregate way relying on transparent reduced form estimates
- Currie and Walker (AEJ, 2012) – Effect of the EZ-Pass on emissions, by taking advantage of exogenous changes in speed. Emissions are measured directly by monitors (considering monitors closer and further way from freeways)
  - Potential advantages: does not have to estimate the components of the driving cycle; does not rely on emissions factors
- Key questions:
  - How accurate are the final emissions? Can you validate them? (local emissions versus GHG emissions)

Additional comments and suggestions

- With a bit more microeconomics foundations, model has tremendous potential as a policy tool:
  - Incentives to move drivers closer to optimal driving cycle:
    - Increased in fuel prices
    - Varying tolls that secure certain levels of speed
    - Eco-routing – opportunity to measure the trade-offs between time and emissions