An Empirical Analysis of Macroscopic Fundamental Diagrams for Sendai Road Networks

仙台道路ネットワークにおける Macroscopic Fundamental Diagram の実証分析

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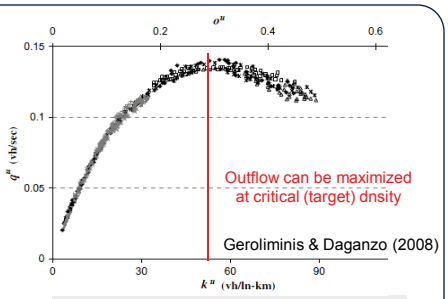
What is the Macroscopic Fundamental Diagram?

Macroscopic Fundamental Diagram (MFD) describes the relation between the **number of vehicles** in the network and the **output flow** of the network.

The MFD has a potential to be a good performance index of traffic management and control polies for reducing traffic congestion and improving accessibility.

We investigated the issue “what kind of conditions are needed to observed the well-defined MFD in the real world?” by using long term data (one year).

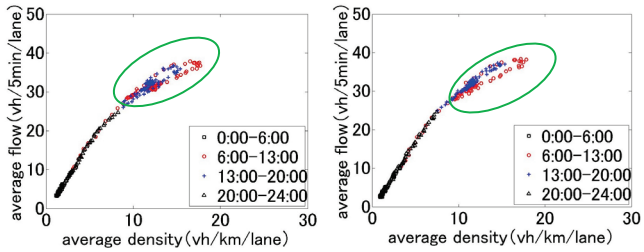


Well-defined MFD empirically observed in Yokohama area

Observation Data

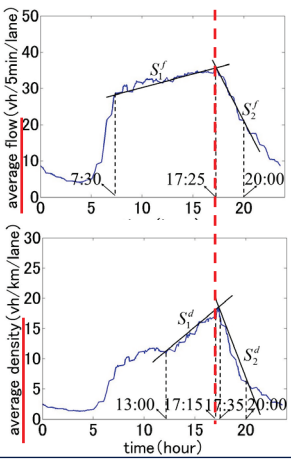
- Long-term data (365 days) observed by fixed detectors in Sendai road net-work was used
- Traffic flow and speed values were recoded in 288 periods/day with 5-minute period/each
- 1,756 detectors were used in 878 road links
- 4 areas with different sizes are considered

MFD features under standard conditions



- A hysteresis loop always exits under standard conditions (weekday & sunny)
- The shape of the MFD is invariant throughout the entire year

Hysteresis loop formation process



Average flow decrease rapidly with the congestion spread.

In the MFD:

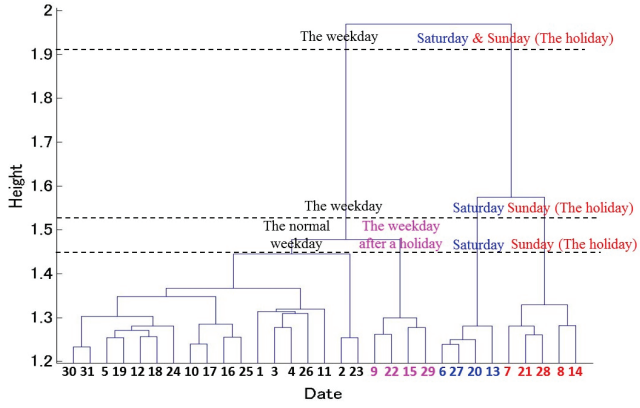
(the decreasing slope) S_2^f/S_2^d > S_1^f/S_1^d (the increasing slope)

The state changes clockwise along the upper curve when increasing and along the lower curve (hysteresis loop) when decreasing

Effects of traffic demand conditions, weather conditions and area setting

The shape of MFD is changed when there are differences in several conditions:

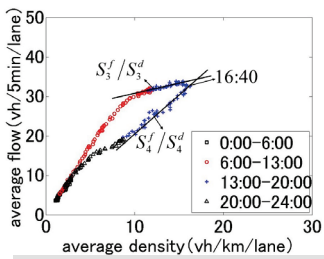
- Demand-side conditions
- Supply-side (weather) conditions
- Area settings (omitted here)



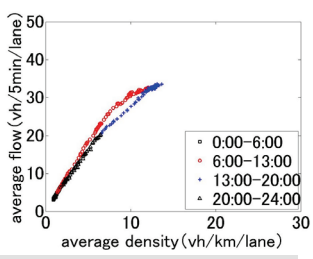
MFD shapes can be classified based on demand conditions:

- Weekday vs. Saturday & Sunday (holiday)
- In weekday:
  Normal weekday vs. Weekday after holiday
- In Saturday & Sunday (holiday):
  Saturday vs. Sunday (holiday)

Snow-Sunday



Rain-Sunday



MFD shape is affected by weather condition: Hysteresis loop become larger.