



Traffic Flow Prediction:

An Expansion of the Cell Transmission Model

ABSTRACT

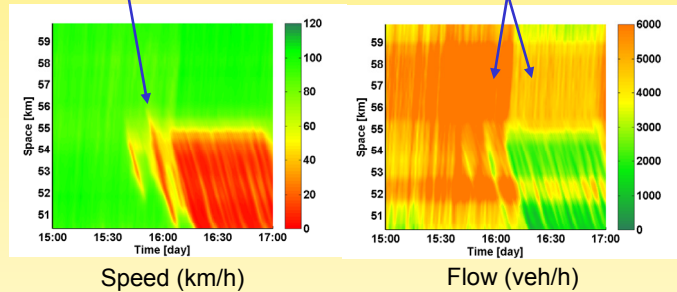
Dynamic Traffic Management (DTM) is used to reduce congestion on highways and to react quickly to incidents. Thereby, a traffic flow model predicts the traffic over a short period of time. Most importantly, such a model must reproduce traffic phenomena, such as the **capacity drop**, or the **boomerang effect**.

The widely-used basic Cell-Transmission Model (CTM) covers neither of these phenomena, since it uses a triangular flow-density fundamental diagram. Here, the CTM is expanded to model both phenomena, while reproducing numerically stable results.

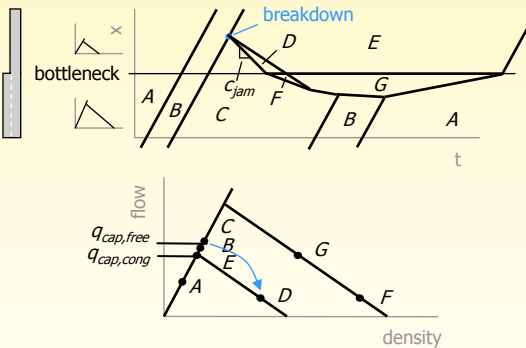
Empirical Data

Boomerang effect:
congestion starts
downstream of bottleneck

Capacity drop: capacity
before congestion higher
than during congestion



Analytical Solution: Kinematic Wave Theory



Numerical Solution: Expand CTM

Capacity Drop

- Apply Fundamental Diagram with two capacities: $q_{cap,free}$ before breakdown, $q_{cap,cong}$ after breakdown
- At **breakdown** (C → D), ensure that propagation speed c_{jam} is at realistic value

Boomerang Effect

- In bottleneck, slightly decrease capacity $q_{cap,free}$ over space

Conclusion

The following traffic phenomena are reproduced:

- Onset and dissolution of congestion
- NEW: capacity drop
- NEW: boomerang effect

The expanded Cell Transmission Model can be applied to:

- Online forecasting of traffic flow
- Modelling of bottlenecks
- Travel time prediction

The quality of Dynamic Traffic Management using an online traffic flow model is therefore improved.

Simulation

