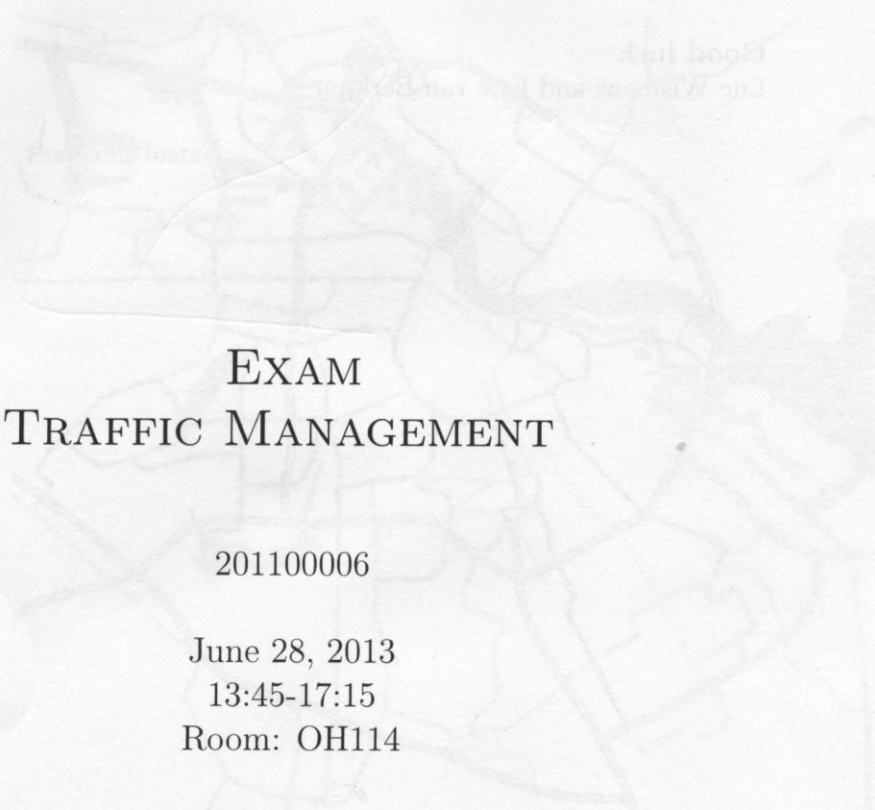




EXAM

TRAFFIC MANAGEMENT

201100006

June 28, 2013

13:45-17:15

Room: OH114

Consider the main network around Amsterdam as depicted in figure 1. All highways (depicted in red) are equipped with the STM system. This means that for all locations x , for time interval t , speed v_x , flow q_x , and occupancy ρ_x are measured. All main urban streets are depicted in black and yellow. The figure also shows the location of the first ramp meter in the Netherlands just upstream the Coentunnel.

Figure 1: Amsterdam network



Consider the main network around Amsterdam as depicted in figure 1. All highways (depicted in red) are equipped with the MTM system. This means that for all locations x_j for time interval t_i speed v_{ij} , flow q_{ij} and occupancy o_{ij} are measured. All main urban arterials are depicted in black and yellow. The figure also shows the location of the first ramp meter in the Netherlands just upstream the Coentunnel.

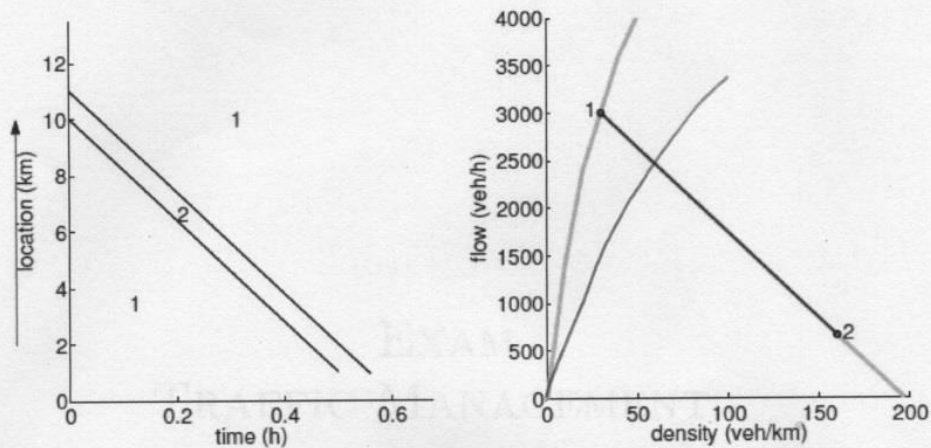
1. (20 points) A plan for a large traffic management program for this network is under development. One of the measures that are being considered is coordinated ramp metering using the HERO algorithm in combination with ALINEA.
 - (a) (5 points) Explain the rationale behind ramp metering and use the fundamental diagram to indicate why this is in principle a good traffic management measure.
 - (b) (5 points) Give a description of the ALINEA algorithm, and describe in detail which measurements as described above and which additional measurements are necessary to feed this algorithm. Why is ALINEA called a feedback control algorithm?
 - (c) (10 points) Describe HERO, again using the measurements as described above and provide potential reasons why local road authorities prefer coordinated ramp metering over local ramp metering.

2. (30 points) You are asked to perform an evaluation study on local and coordinated ramp metering for Amsterdam. Performance indicators include travel time and delay. Specifically road authorities are interested in equity issues.

- (a) (5 points) How do you expect equity in travel times/delays to alter as a result of the introduction of local and coordinated ramp metering. Explain your answer.
- (b) (5 points) Describe how equity in travel times/delays can be quantified using the measurements as mentioned above?
- (c) (10 points) How could traffic information influence the effectiveness of ramp metering (local and coordinated)
- (d) (10 points) Any form of ramp metering may result in a spatial shift of traffic problems from the highway to the urban network. Design an altered form of the HERO algorithm that is able to deal with this potential problem.

3. (20 points) As a result of some severe cuts in the budget for traffic management, road authorities have decided to reduce the number of locations where double induction loops are located by a factor 2. This reduction may have some severe implications. For instance the Automated Incident Detection (AID) feature of the MTM system is likely to operate less good and also the reduction may lead to a worse spatiotemporal description of the traffic states on the network.
- (a) (10 points) List and quantify the effects of this reduction on the operation of AID by providing a numerical example.
 - (b) (10 points) One way to overcome the problem of a worse spatiotemporal description of traffic states is to include Floating Car Data. Describe how exactly loop detector data and FCD can be combined (*data fusion*) to determine a spatiotemporal description of traffic states.

Figure 2: Reference situation without *Specialist*



4. (30 points) Another measure that is considered is the implementation of the *Specialist* algorithm, where dynamic speed limits are used to resolve shock waves on highways.
 - (a) (10 points) Explain how the *Specialist* approach operates using shock wave theory.
 - (b) (10 points) As part of this explanation draw (and explain) the various states and propagation of the fronts in a space-time diagram and fundamental diagram of the phases you distinguish. Use Figure 2 as a reference situation of a shockwave which would propagate upstream if *Specialist* would not have been applied and draw the situation that occurs when *Specialist* would be activated.
 - (c) (10 points) Explain to what extent the *Specialist* approach could be effective on the ringroad of Amsterdam.