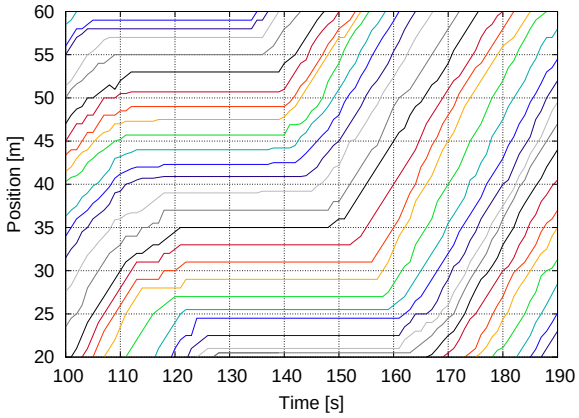
# Traffic Flow Dynamics and Simulation

Summer semester, Tutorial 3, page 1

## Problem 3.1: Bicycle Trajectory Data

The diagram below shows a clipping of a bicycle-following experiment. The trajectory of every $10^{\text{th}}$ cyclist has the same color.




(a) Determine, based on the overall characteristics, whether free or congested bicycle traffic flow is shown.

(b) Determine the density, flow, and local speed both in the „stop" and in the „go" regions.

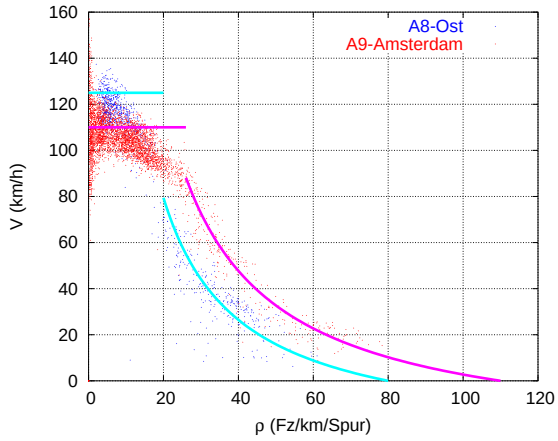
(c) Show that, in the region of complete standstill $[130\,\text{s}, 150\,\text{s}] \times [20\,\text{m}, 30\,\text{m}]$, Edie's definition of the density gives the same value as the standard way of bicycle counting.

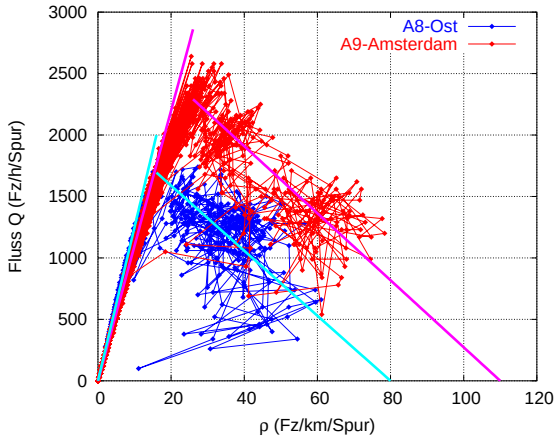
(d) Estimate the propagation velocity $w$ of the traffic wave.

(e) Calculate the typical time gap $T = (\Delta x_i - l_{\text{eff}})/v_i$ a cyclist keeps in the „go" regions.

## Problem 3.2: Fundamental diagram estimated from stationary detector data

Given are speed-density and flow-density scatter plots obtained from stationary detector data aggregated as arithmetic averages over one minute of the German freeway A8-East (near Munich) and the Dutch A9 (near Amsterdam):




These data should be approximated by triangular fundamental diagrams of the general form

$$Q_e(\rho) = \begin{cases} V_0 \rho & \rho \le \rho_c \\ \frac{1}{T}\left[1 - \frac{\rho}{\rho_{\max}}\right] & \rho > \rho_c \end{cases} .$$

(a) Determine for both freeways the parameters $V_0$, $T$ und $\rho_{\max} = 1/(s_0 + l)$ as obtained from the drawn fit curves. Also estimate the *capacity drop* as the flow difference between the intersection of the free and congested traffic fit lines, and the end of the free branch (not considering the few outliers). Is it possible to imply from these data some general statements about the collective behaviour of the drivers on these freeways?

(b) Do you expect biases in the estimation of $T$, $\rho_{\max}$, and the capacity drop as obtained from the fit lines? If so, in which direction?

(c) Is there a way to improve the estimate by using several detector sites (all of them only provide arithmetic time means)?

(d) Give a substantiated statement whether it is possible to detect a complete standstill ($\rho = \rho_{\max}$) using stationary detectors, only