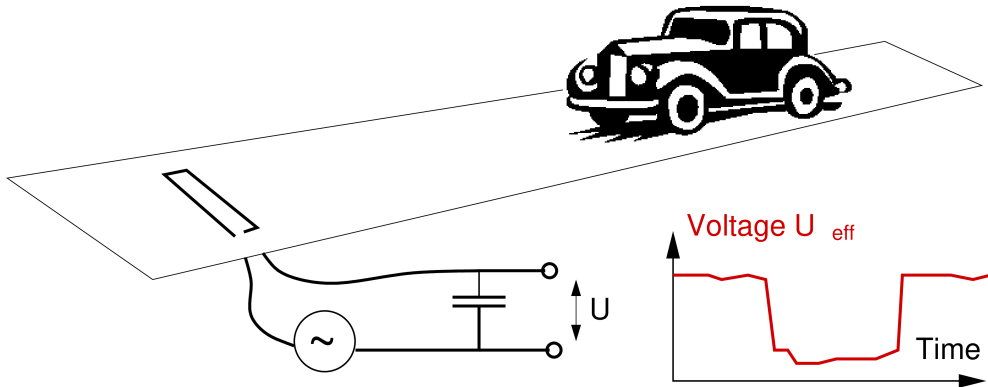


Lecture 2: Stationary Detector Data

- ▶ 2.1. Stationary Detector Data (SDD) and How to Obtain Them
- ▶ 2.2. Single-Vehicle Data
- ▶ 2.3. Aggregated Data

2.1. Stationary Detector Data (SDD) and How to Obtain Them

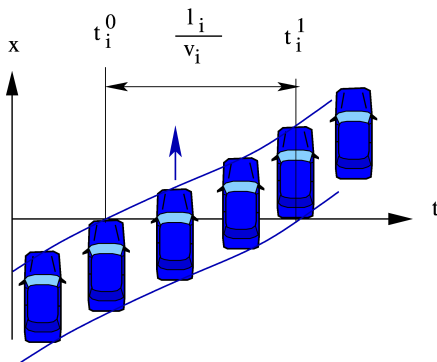


- ▶ Vehicle drives over a loop detector \Rightarrow inductance of the loop increased upon driving over it \Rightarrow circuit gets out of tune.
- ▶ Other means: pneumatic tubes, IR light barriers, radar/lidar
- ? Discuss the advantages/disadvantages of induction loop detectors wrt. other sensors.

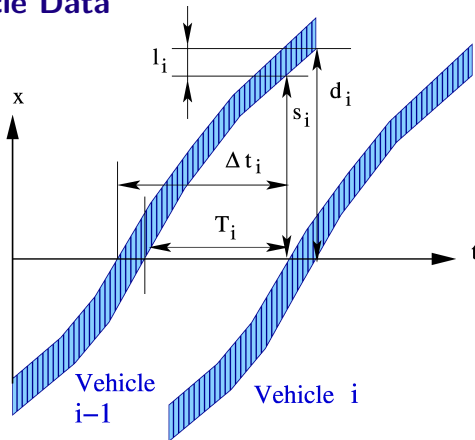
Loop/double loop detectors are everywhere ...



2.2. Single-Vehicle Data

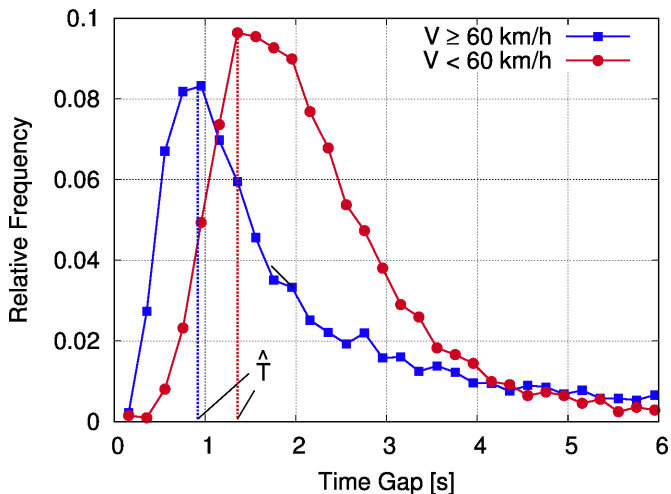


- ▶ **Occupancy time:** $t_i^1 - t_i^0$ (single loops OK)
- ▶ **(Time) headway:** $\Delta t_i = t_i^0 - t_{i-1}^0$ (single loops OK)
- ▶ **Time gap:** $T_i = t_i^0 - t_{i-1}^1 = \Delta t_i - \frac{v_{i-1}}{l_{i-1}}$ (single loops OK)



- ▶ **Vehicle speed:** $v_i = \frac{(t_i^0)_{\text{loop2}} - (t_i^0)_{\text{loop1}}}{\Delta x_{\text{loops}}}$
- ▶ **Vehicle length:** $l_i = v_i(t_i^1 - t_i^0) \Rightarrow$ vehicle type
- ▶ **Distance headway:** $d_i = v_{i-1} \Delta t_i$
- ▶ **(Distance) gap:** $s_i = d_i - l_{i-1}$

Application: Density functions of time gap distributions



? Compare with the German driving rule “keep a gap of at least half the speedometer reading”

? Compare with the US rule “keep an additional vehicle length distance per 5 mph”

Distance rules

Keep a gap of at least half the speedometer reading:

Units: Germany → gap in meter, speedometer reading in km/h

$$\begin{aligned}\frac{s}{1 \text{ m}} &\geq \frac{1}{2} \frac{v}{\text{km/h}} \\ T = \frac{s}{v} &= \frac{1}{2} \frac{\text{m}}{\text{km/h}} \\ &= \frac{1}{2} \frac{\text{m}}{\frac{1}{3.6} \text{m/s}} \\ &= \underline{\underline{1.8 \text{ s}}}\end{aligned}$$

Keep an additional vehicle length distance per 5 mph:

Assume a vehicle length of 5 m (US vehicles are big!):

$$\begin{aligned}T &= \frac{\Delta s}{\Delta v} \\ &= \frac{5 \text{ m}}{5 \text{ mph}} \\ &= \frac{1 \text{ m}}{\frac{1.6}{3.6} \text{m/s}} \\ &= \underline{\underline{2.25 \text{ s}}}\end{aligned}$$

2.3. Aggregated Data

Most detectors stations *aggregate* the single-vehicle information over fixed **aggregation time intervals** Δt and transmit only the aggregated **macroscopic** data to the traffic control center.

▶ **Flow** $Q(x, t) = \frac{\Delta N}{\Delta t} = 1/E(\Delta t_i)$

where the **expectation** $E(\cdot)$ is just the arithmetic mean over the microscopic data y_i : $E(y_i) = \frac{1}{\Delta t} \sum_{i=i_0}^{i_0+\Delta N-1} y_i$

▶ **Occupancy** $O(x, t) = \frac{\Delta N}{\Delta t} E(t_i^1 - t_i^0) = Q(x, t) E(t_i^1 - t_i^0)$

▶ **(Arithmetic mean) Speed** $V(x, t) = E(v_i)$ (double loops)

Useful but generally not known:

▶ **Harmonic mean speed** $V_H(x, t) = 1/E(1/v_i)$

▶ **Harmonic flow** $Q^*(x, t) = E(1/\Delta t_i)$