Traffic data collection

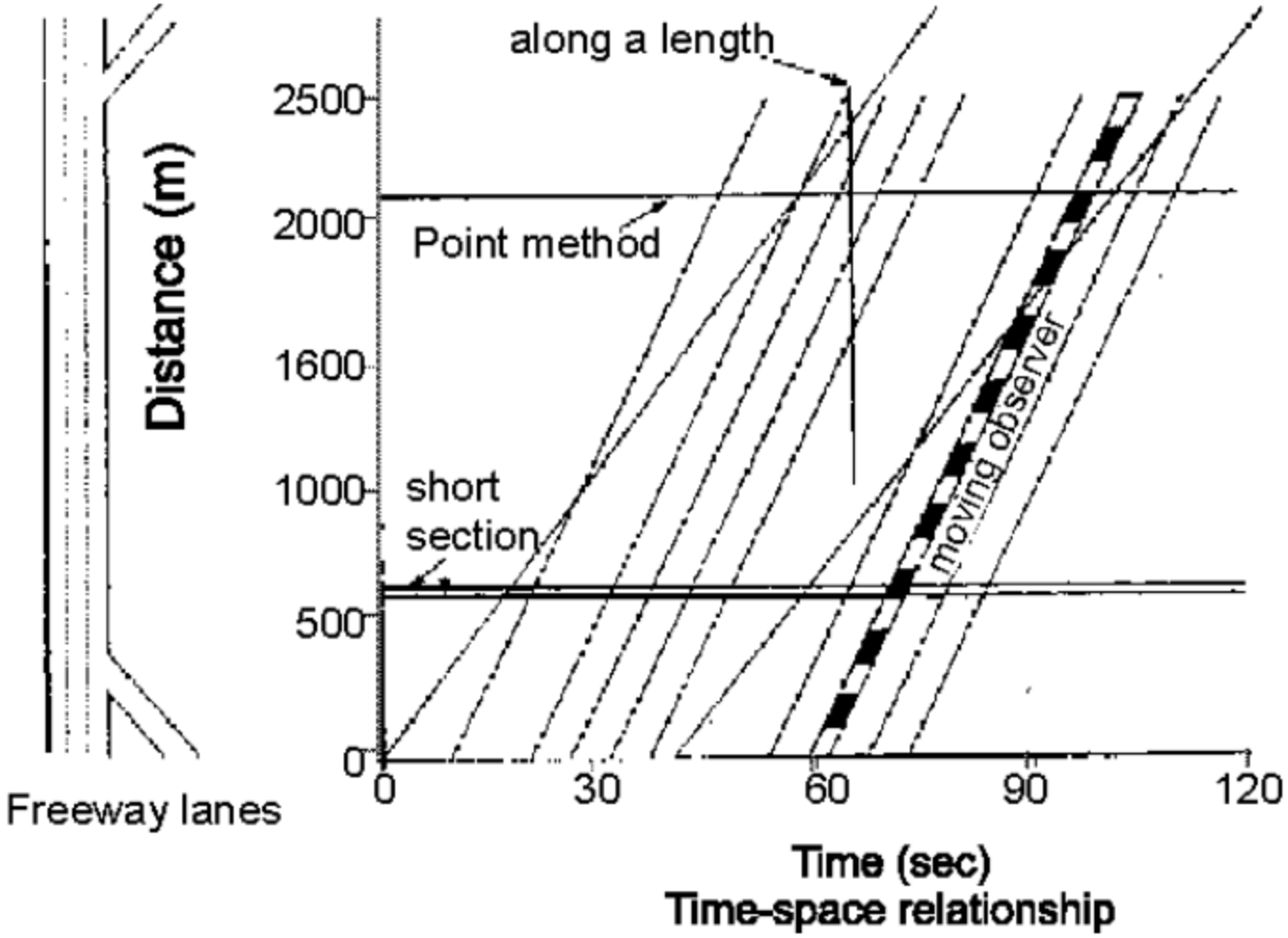
Introduction

- **Outline**
  - Point measurement
  - Measurement over a short stretch
  - Measurement over a long stretch
  - Measurement over an area
  - Moving observer method

Introduction

- **Stream characteristics from field**
  - Flow
  - Speed
  - Density, occupancy
  - Travel time
  - Spacing
  - Headway

Introduction



Measurement Procedures

Traffic stream parameters

- **Measurement Procedures**
  - Measurement at point on the road
  - Measurement over a short section of the road (less than 500 metres)
  - Measurement over a length of the road (more than about 500 metres)
  - Wide area samples obtained from number of locations
  - Use of an observer moving in the traffic stream

Measurements at a point

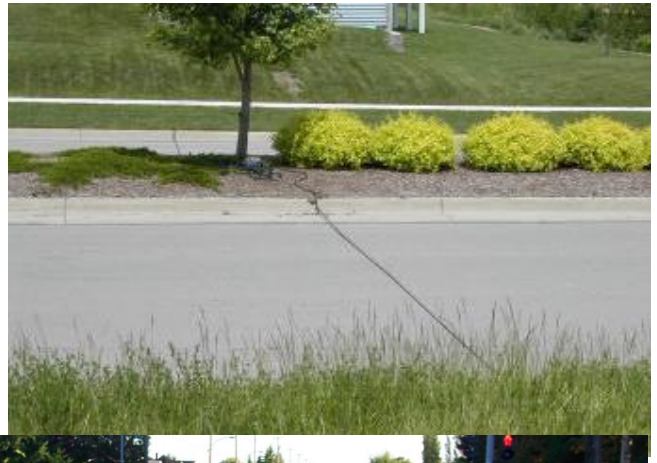
- **Point Measurement**
  - Flow or volume count
  - Manually
    - Observer will stand at the point of interest
    - Count the vehicles with the help of hand tallies.
    - Interval of 5, 10, or 15 minutes

Measurements at a point

- **Point Measurement**
  - Types of vehicles
    - Cars
    - Two wheelers
    - Three wheelers
    - LCV
    - HCV
    - Multi axle trucks
    - Non-motorised vehicles
      - » bullock cart
      - » hand cart

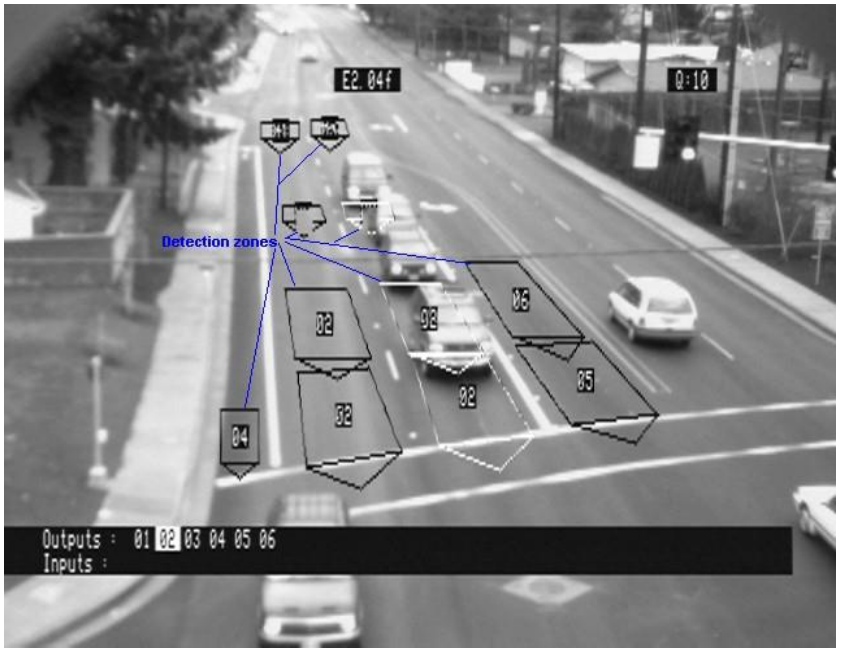
Measurements at a point

- **Point Measurement**
  - Automatic
    - Inductive loop detector
    - Pneumatic tubes
    - Video camera



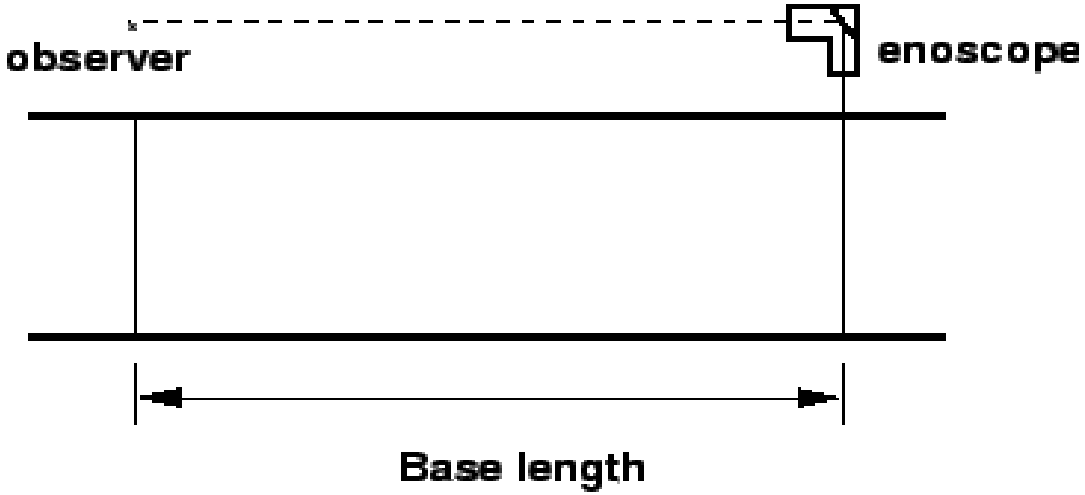
Measurements at a point

- **Video image processing**



Measurements over short section

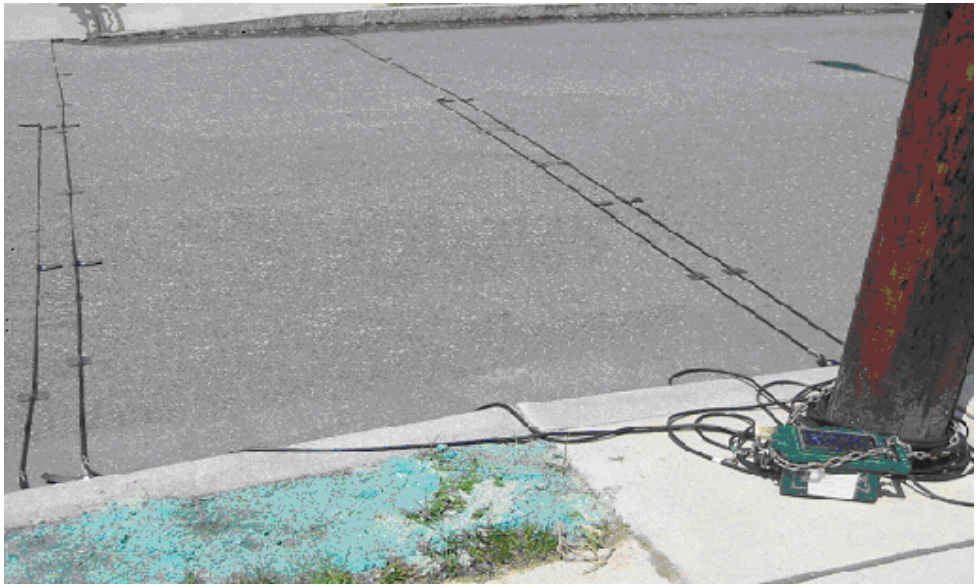
- **Spot speed of vehicles**
  - Manual methods: Enoscope
    - Base length of about 30-90 metres



Working principle of Enoscope

Measurements over short section

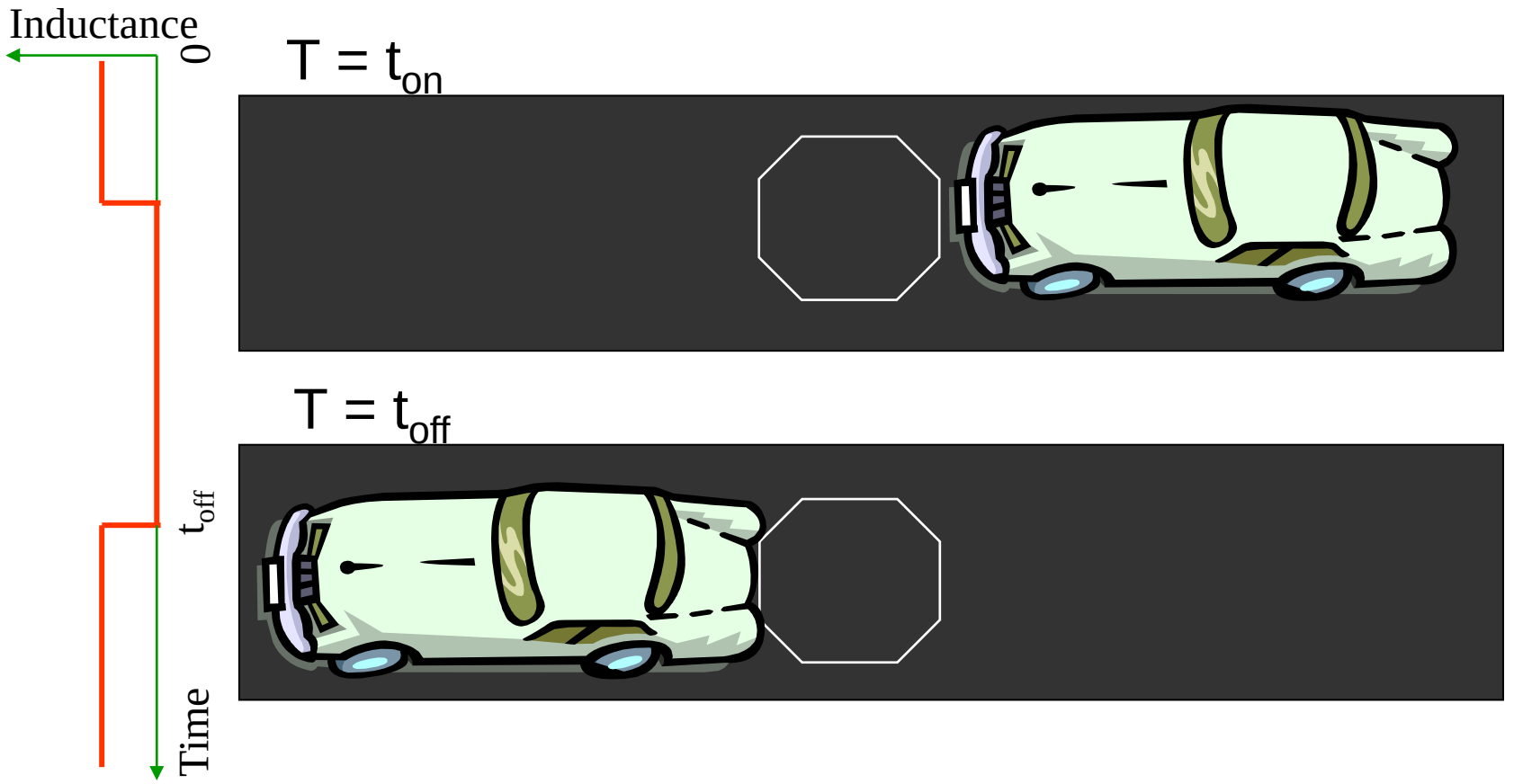
- **Spot speed of vehicles**
  - Pressure contact tube



Measurements over short section

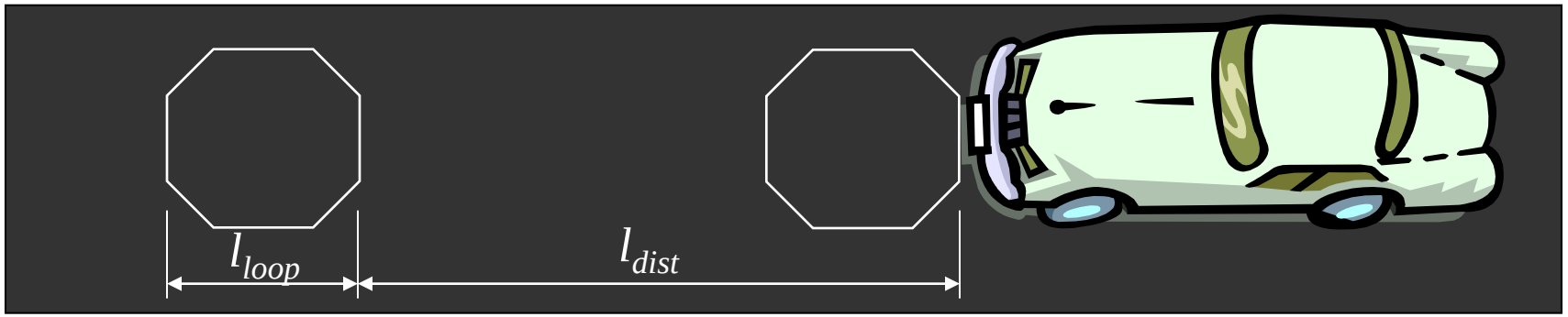
- **Inductive loop detector**
  - Principle of magnetic inductance
  - Metallic content in the vehicle passes over it
  - A signal will be generated and the count of the vehicle can be found automatically
  - Continuous counts
  - Errors due to noise signals generated by heavy vehicle passing adjacent lanes

Single loop detector



- Loop inductance decreases when a car is on top of it.

Dual loop detector



T = t_2

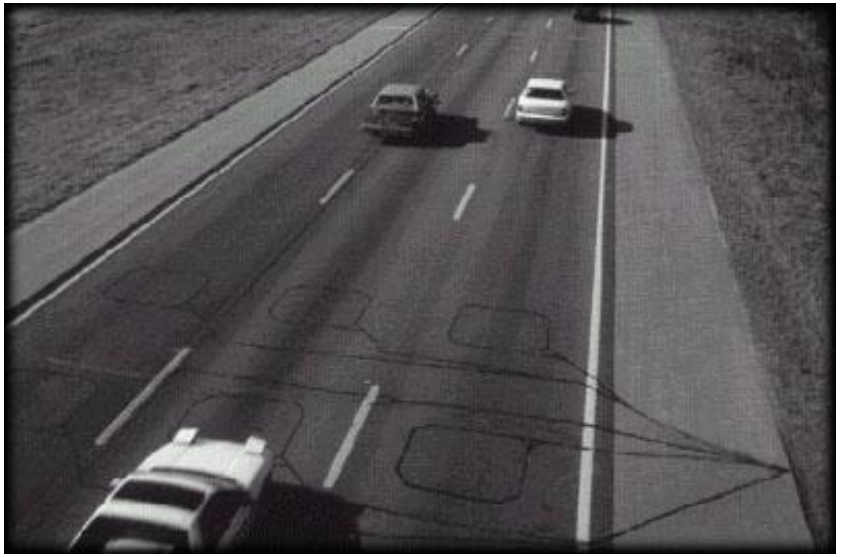
$$Speed = \frac{l_{dist}}{t_2 - t_1}$$

T = t_1

$$L_{vehicle} = \frac{Speed(ot_2 + ot_1)}{2}$$

- **Measured vehicle lengths are used to classify vehicles into different categories**

ot_i = on-time for loop detector i

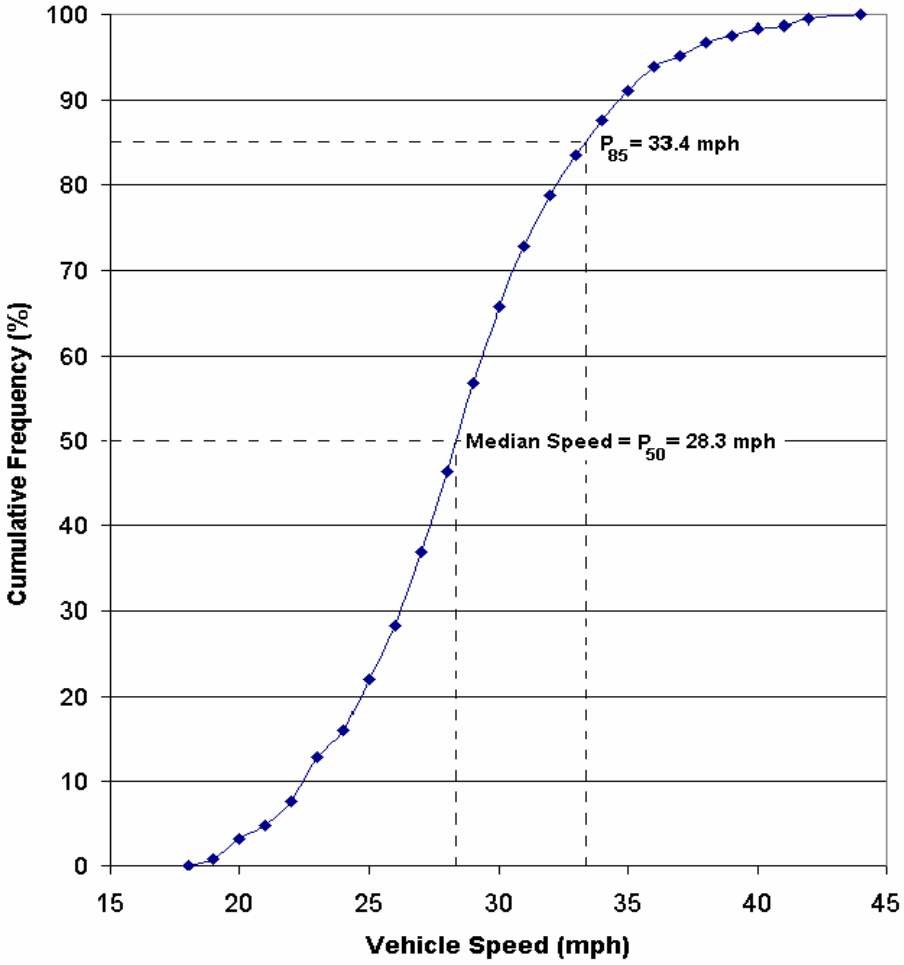


Measurements over short section

- **Speed data analysis**
  - Time and Space Mean Speed
  - 85th Percentile Speed
  - 95th Percentile Speed
  - Median (50th Percentile Speed)
  - Speed Variance: The difference in travel speeds for vehicles on the road.

Measurements over short section

Cumulative Frequency Distribution Plot for Sample Speed Data



Measurements over long section

- **Density**
  - Using aerial photography
  - Single frame give only density
  - Time lapse photography
    - several frames can give speed
    - speeds can be computed from the distance covered between the two frames and time interval

Measurements over long section

- **Density**

Measurements over long section

- **Travel time**
  - Stretch of length more than 500 metres
  - To obtain variations in speed

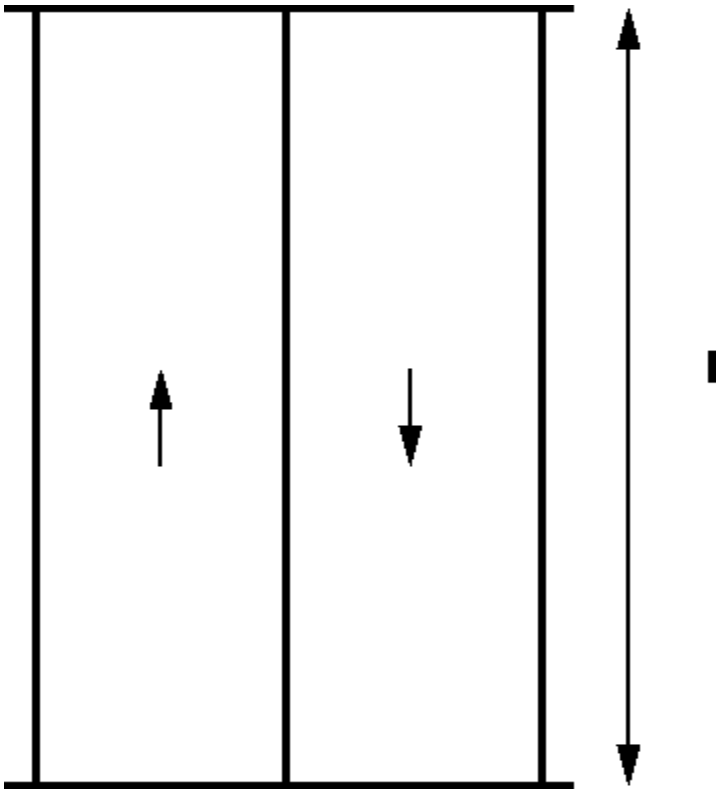
Moving observer method

- **Overview**
  - Obtain relationship between fundamental stream characteristics
  - Observer moves in the traffic stream
  - Derived by Wardrop and Charlesworth (1954)

- **Suitability**
  - Rural traffic, Urban traffic with low volume
  - Driver follows average speed

Moving observer method

- **Derivation**
  - Consider an observer watching a stream of vehicles: two special cases arise:
    - Case 1: Moving stream and stationary observer
    - Case 2: Moving observer and stationary stream



Illustration

Moving observer method

- **Case 1: Moving stream - stationary observer**
  - If n_0 is the number of vehicles overtaking the observer during a period t, then
  - By definition, flow

$$q = n_o/t$$

  - Or

$$n_0 = q \times t$$

Moving observer method

- **Case 2: Moving observer - stationary stream**
  - Let the observer moves with speed v_o
  - Let n_p is number of vehicles overtaken by observer over the length l
  - Density

    $k = n_p/l$
  - Or

$$n_p = k \times l \qquad n_p = k.v_o.t$$

Moving observer method

- **Case 3: Both stream and observer moving**
  - Observer is moving within the stream
    - The general case of Case 1 and Case 2
  - Let m_0 vehicles overtake the observer
  - Let m_p vehicles overtaken by the observer

$$n_0 = q \times t \qquad n_p = k.v_o.t$$

$$m = m_0 - m_p = q\,t - k\,v_o\,t$$

Moving observer method

- **Case 3: Both stream and observer moving**
  - To get both q and v, we need two equations
  - Possible by two trips or a reverse trip

$$
\begin{aligned}
m_w &= q\,t_w - k\,v_w\,t \\
&= q\,t_w - k\,l \\
m_a &= q\,t_a + k\,v_a\,t_a \\
&= q\,t_a + k\,l
\end{aligned}
$$

Moving observer method

- **Case 3: Both stream and observer moving**
  - Solving for q, we get

$$q = \frac{m_w + m_a}{t_w + t_a}$$

Moving observer method

– Solving for v_s, we get

$$\frac{m_w}{t_w} = q - kv_w$$

$$= q - \frac{q}{v} v_w$$

$$= q - \frac{q}{v}\left[\frac{l}{t_w}\right]$$

$$= q\left(1 - \frac{l}{v} \times \frac{1}{t_w}\right)$$

$$= q\left(1 - \frac{t_{avg}}{t_w}\right)$$

$$t_{avg} = \frac{l}{v_s}$$

$$k = \frac{q}{v_s}$$

$$v_s = \frac{l}{t_w - \frac{m_w}{q}}$$

$$\frac{m_w}{q} = t_w\left(1 - \frac{t_{avg}}{t_w}\right) = t_w - t_{avg}$$

$$t_{avg} = t_w - \frac{m_w}{q} = \frac{l}{v},$$

Moving observer method

- **Example 1**
  - Length of the road stretch = 0.5 km
  - Speed of test vehicle = 20 km/hr
  - No of vehicles encountered while moving against the traffic stream = 107
  - No of veh. overtaken the test vehicle =10
  - No of veh. overtaken by the test vehicle = 74
  - Find the flow, density and mean speed

Moving observer method

Solution

Time taken by the test vehicle to reach the other end of the stream while it is moving along with the traffic is $t_w = \frac{0.5}{20}$ = 0.025

hr Time taken by the observer to reach the other end of the stream while it is moving against the traffic is $t_a = t_w$ = 0.025 hr

Flow is given by equation, q = $\frac{107+(10-74)}{0.025+0.025}$ = 860 veh/hr Stream

speed v_s can be found out from equation $v_s = \frac{0.5}{0.025-\frac{10.74}{860}}$ = 5 km/hr

Density can be found out from equation as k = $\frac{i}{\frac{5}{}}$ =

172veh/km

Moving observer method

- **Example 2**
  - Col. 2: no of veh moving against the stream
  - Col. 3: no of veh overtaken the test vehicle
  - Col. 4: no of veh. overtaken by the test vehicle
  - Length = 0.5 km
  - ta = tw = 0.025 hrs

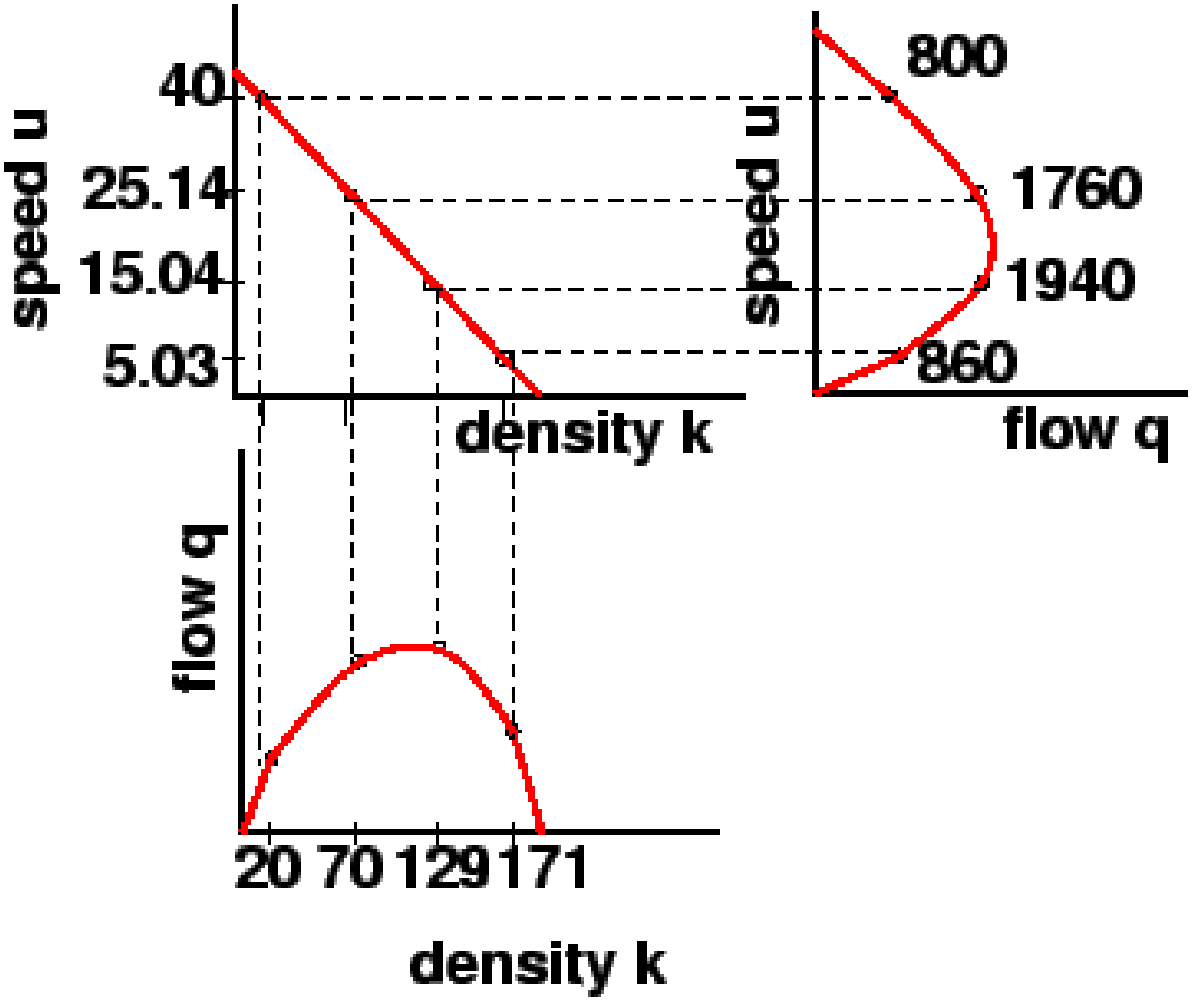
No	1	2	3
1	107	10	74
2	113	25	41
3	30	15	5
4	79	18	9

Moving observer method

Solution

Sample no.	m_a	m_o	m_p	$m(m_o - m_p)$	t_a	t_w	$q = \frac{m_a + m_w}{t_a + t_w}$	$u = \frac{l}{t_w - \frac{m_a}{q}}$	$k = \frac{q}{v}$
1	107	10	74	-64	0.025	0.025	860	5.03	171
2	113	25	41	-16	0.025	0.025	1940	15.04	129
3	30	15	5	10	0.025	0.025	800	40	20
4	79	18	9	9	0.025	0.025	1760	25.14	70

Moving observer method



Moving observer method

- **Limitation**
  - Unsuitable for large traffic
  - Unsuitable if there is major turning traffic
  - Large number of observations required to estimate reliable data
  - Driver bias

Thank You

tomvmathew@gmail.com