Analyzing Traffic Flow Data using Sensors at Signalized Intersections

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Introduction

Inductive loop sensors ⇢ Were originally designed to be used for traffic signal control

- Most used type of sensors
- Used for over 60 years
- Wide range of applications
- Real-time traffic data

- Sheer number of sensors in the road network
- High-resolution data (1/10 s)

⇩

High potential to measure traffic flow characteristics

Goals

1. To find which relevant traffic flow parameters can be derived from traffic signal sensors.
2. To analyze quality aspects of the data and traffic flow parameters derived from it.

Data and test methods

- Data from four intersections of Frankfurt on Main
- Total of 79 sensors (77 inductive loops and two video)

Plausibility checks ➡	Can a sensor be used?
Malfunction checks ➡	Is a sensor currently malfunctioning?
Incorrect response checks ➡	Are there systematic errors?

Results of the analysis

Data analysis showed that over half of detections made by given sensors were implausible. As a summary, all the investigated types of errors were grouped into two kinds of classifications.

Severity of errors

Critical	High	Moderate	Low
⇩	⇩	⇩	⇩
Unsolvable; replace sensor	Solvable; high priority	Not serious; easy to correct	Do not need corrections
• Continuous occupancy • Missed detections • All types of strong oscillation	• Not strong oscillations • Incorrect responses • Bad layout of sensors	• Incorrect mapping • Bad calibration of sensors • Errors by two-wheelers	• Driving by red light • Phantom detections

Frequency of errors (in terms of number of sensors affected)

High	Moderate	Low
⇩	⇩	⇩
Over 7% of sensors affected	3-7% of sensors affected	Less than 3% of sensors affected
• Spontaneous oscillation (15) • Erroneous occupancy (9) • Incorrect responses (7)	• Errors by changing lanes (5) • Errors by two-wheelers (5) • Errors by mapping (3)	• Driving by red light (2) • Bad calibration of sensors (1) • Phantom detections (1)

Conclusion

Derived traffic flow parameters

Traffic volume ➡	Obtained directly from sensors
Occupancy ➡	Obtained directly from sensors
Traffic state ➡	Estimated based on occupancies
Queue length ➡	Estimated based on occupancies

Considered quality aspects

Comparability ➡	Not always possible; no redundancy on some lanes
Validity ➡	38% of valid detections among all sensors
Accuracy ➡	Not evaluated; no standard data available
Continuity ➡	Not achieved; a lot of implausible data

Recommendations

1. More data to get statistically reliable results
2. Video recordings or live observations to find the reasons for sensors’ errors
3. Redundant detectors to check the comparability and then the plausibility of detections
4. Standard data to find the degree of accuracy of detections
5. Data from another type of sensors for evaluation of the data quality

References

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