License Plate Recognition Technology’s Potential Benefits to ITS: 
an ‘Arterial Travel Time’ Case Study

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Introduction

• Travel Time:
  - The most important performance measures
  - Not only average travel time, but more importantly, travel time reliability.

• Travel Time Estimation vs. Measurement:
  - Estimation: Averages speeds and transforms to average link travel time.
  - Inaccurate for congested traffic
  - Not considering signal control delays
  - Measurement: Tempo-spatial vehicle tracking, actual travel time, also Origin Destination studies

• Vehicle Tracking/Re-identification Devices:
  - On-Board-Unit: GPS, Bluetooth, cellphone, toll tag reader (<30%)
  - No On-Board-Unit: Inductive/Magnetic Signatures, License Plate Tracking (<100%)

LPR vs. other Vehicle Re-identification ITS Technologies

• Bluetooth, GPS, Cellphone, Toll Tag Identification
  - Good travel time estimators
  - Market penetration: Bluetooth/GPS 5%
  - Toll Tag Identification System limited to the toll roads only
  - Inductive Loop Detector and Magnetic sensor signatures
  - No board unit, high market penetration
  - Re-identification rate about 30-50%
  - Re-identification rate drastically decreases by increasing detectors distance (<1-1.5 mi)
  - Useless for OD studies

• License Plate Recognition
  - High market penetration (~100%)
  - required by law to have a visible license plate
  - High re-identification accuracy (>90%)
  - Perfect for Dynamic OD studies
  - Plates are identical
  - Accuracy is not sensitive to detectors distance
  - OD studies are the most expensive surveys

Case Study and Results

• Arterial Segment
  - 1 mile
  - five lane two-way
  - 4 signalized
  - 7 un-signalized (Fig 2)

• Data Collection
  - Two Standard HD cameras
  - One hour an A and 67 minutes at B
  - Each camera covers two lane

• Ground Truth
  - 781 vehicles, A
  - 725 vehicles, B
  - 206 vehicles passed both A and B

• Re-identification Accuracy:
  - 188 correct out of 206 (91.3%)
  - 9 by matching texts on vehicles
  - 5 wrong matches (2.4% error)

• Arterial Travel Time
  - Negative travel times, first passed B then A (Fig 4)
  - Extremely large positive, intermediate stops
  - Extracting Outliers, using Tukey Filter (Fig 5)

• Reading the texts on vehicles’ body as plate number
  - Benefit : Larger re-identification rate.
  - Drawback: duplicates. Solution is filtering out repetitive travel times with same captured times.

Figure 2. Arterial Segment

Figure 3. LPR Re-identification Accuracy

Figure 4. Individual’s Travel Times.

Figure 5. Final Individual’s Travel Times.

Figure 6. Average, Minimum and Maximum Travel Times in 5 minutes intervals.

Figure 7. Example of Texts on a Bus Body (Vision Components, ANPR Demo Software).

LPR’s Potentials

• Parking Spaces Management and Toll Collection
  - Actual Travel Time Measurement
  - temp-spatial vehicles re-identification
  - LPR considers the control delays

• Real Time Signal Coordination
  - Individuals’ actual travel time, instead of average

• Dynamic Origin-Destination Trip Matrix Estimation
  - In contrast to other methods, LPR’s accuracy, barely sensitive to distance.
  - Higher market penetration
  - Larger successful re-identification rate
  - The most expensive study

• Incident Detection
  - Drastic increases in travel time incident
  - Flexibility of manual video monitoring to find incident

• Route Choice Determination
  - Different path travel times (Fig1) for each OD useful to:
    - Inform drivers about the shortest path
    - Dynamic traffic assignment.

Summary

• Market penetration
  - >90%
  - All vehicles are required by law to have

• Accuracy
  - 91.3% re-identification, using two HD cameras
  - Other LPR studies mostly less than 60%

References: 10-20% (1), 18% (2), 35% (3), 50% (4), 60% (5), 65% (6).

• LPR Applications
  - Travel Time Measurement instead of Estimation
  - The segment travel time could be improve up to 40 seconds (30% improvement)
  - Accuracy is not sensitive to distance
  - Perfect for OD studies (Most expensive surveys in transportation)

References

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