The 2001-2004 Atlanta Instrumented Vehicle Intensive

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1000 Tickets are written each year in Atlanta for speeding over 100 MPH.

17,000 Vehicles monitored on I-285 in the commute: 1% complied with the speed limit.
Background: Three City Study

- Instrumented vehicle studies
  - Atlanta, Baltimore, and Spokane (and Los Angeles)
  - Date, time, engine start, rpm, map, throttle position
- Observed driving patterns were significantly different
  - Can match any vehicle-day of driving to the appropriate city 95% of the time
- Could not explain the reasons for the differences
  - No data to compare across driver characteristics
  - No data to compare across vehicle characteristics
  - No route data to compare infrastructure effects
  - No interaction analyses possible
Atlanta Instrumented Vehicle Studies

• Two major multi-year research efforts are now underway in Atlanta
  – National Highway Transportation and Safety Administration Study (1100 Vehicles)
  – Federal Highway Administration Value Pricing Study (500 Vehicles)
  – FHWA Congestion Pricing Study (50 Vehicles)
• All projects employ instrumented vehicles to collect a wide variety of driving pattern, driver behavior, and engine operating parameters
NHTSA Study

• Goal: Develop an understanding of the relationships between driver behavior, onroad driving patterns, and crash risk across various demographic, environmental, and physical conditions

• Examine factors affecting crash occurrence
  – Driver demographics/socio-economic factors, driver skill factors, vehicle factors, environmental factors, and transportation system operating characteristics

• Principle Investigators at Georgia Tech:
  – Jennifer Ogle and Simon Washington
NHTSA Project Scope

• Instrument 1100 vehicles from 600 representative households in Atlanta and monitor activity for 2 years

• Activity monitoring and crash detection equipment:
  – Onboard computer, tri-axial accelerometer, GPS, digital cellular modem

• Collect and upload details on tripmaking and onroad operating characteristics to a central data warehouse

• Collect data for the 100+ crash events (>5% annual crash rate/vehicle) and correlate the crash occurrence to high-risk driving patterns (speed/acceleration, congestion, near misses, etc.)
NHTSA Timeline

- Equipment acceptance testing by April 2001
- Infrastructure set-up and testing by May 2001
- Installation and data collection begins June 2001
  - Staggered deployment over 3 month period
  - Continuous data collection for 2 years (all vehicles)
NHTSA Participants

• Subjects will be selected in conjunction with the Year 2000 SMARTRAQ Travel Survey recruitment
  – Strategies for Metropolitan Atlanta’s Regional Transportation and Air Quality (SMARTRAQ)
• SMARTRAQ is based on 8,000 household travel survey to address land use, travel behavior, air quality, safety as well as other critical issues in the Atlanta region
• Random Sample of Households based on:
  – Income (4-5 strata)
  – Household Size (4-5 strata)
  – Land Use – Residential Density (4-5 strata)
Participant Data

• Household demographics
  – Household and individual survey data
    • Demographics and routine destination data
  – Standard travel diary survey(s)
  – Attitudinal data from periodic surveys

• Vehicle data
  – Vehicle Identification Number (VIN)
  – Engine and performance data
  – Safety systems
  – Fuel delivery and emissions control systems
NHTSA Onroad Data Collection

• Driving characteristics (every trip)
  – High resolution activity data
  – Date, time, latitude, longitude, speed, acceleration, heading, DGPS status, # Satellites, PDOP, HDOP
  – GPS data at 0.2 Hz, speed/acceleration at 1 Hz
  – OBD-capable system
• Aggressive driving characteristics and near-miss data
• Crash detection and notification
  – Crash details via accelerometers
  – Field surveys of crash and prevailing conditions
NHTSA Trip Data

• Trip origin
  – Date, time, location
  – Soak time (time since last trip end)

• Trip destination
  – Date, time, location
  – Trip duration (time)
  – Travel distance

• Driving characteristics
  – Speeds, accelerations, aggressive maneuvers

• Route choice
Value Pricing Project Scope

- Instrument 500 vehicles from 273 representative households in Atlanta and monitor activity for 3 years
  - Onboard computer, GPS, OBD scanner, digital cellular modem
- Collect tripmaking and onroad operating data
- Implement pay-as-you-drive insurance strategies in second and third years and monitor consumer response
  - Per-mile charge for insurance in year 2
  - Per-mile rates adjusted for risk factors (time-of-day, congestion levels, routes, etc.) in year 3
Value Pricing Implementation

- Coordinate initial deployment with NHTSA project
- Same sampling framework as NHTSA project
- Same basic demographic and monitored tripmaking data will be collected in both projects
- Annual travel diaries collected (summer as well)
- Employer interviews conducted each year to identify employer workplace incentives (ensure that changes in commute behavior result from insurance treatment)
- OBD data stream provides continuity between experiments (100 NHTSA vehicles similarly equipped)
All Trips (GT Participant #28)
GIS Mapping Detail

US Postal Service Facility
Angier Springs Rd NE
Data Transfer

• Data transfer by cellular phone
• Data are transferred periodically (e.g., when storage reaches threshold or bi-weekly) during off-peak hours
• System can be remotely configured by cell phone
  – Each unit can be set 0.2 Hz to 1 Hz or at trip-level frequencies throughout the study period
• NHTSA Crash notification messages sent immediately upon detection, uploading the data preceding the crash
• Daily system integrity checks verify that units are communicating properly
Urgh!
Vehicle Speed Thematic
OBD II Capabilities

• System will monitor the OBDII data stream
  – Separate black box unit
  – Low-power scanning (hardware) and code conversion (software) system

• All standard OBDII parameters will be collected and transferred to the data center:
  – vehicle speed, engine speed, manifold pressure, throttle position, coolant temperature, oxygen sensor, engine misfire, fuel injection, evaporative purge, exhaust gas recirculation, air injection, etc.
Vehicle RPM Thematic

14th Street

State St.

OTC Data 7-3-98

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<tr>
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<td>Yellow</td>
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<td>807 to 989</td>
<td>Purple</td>
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<td>990 to 1233</td>
<td>Blue</td>
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<td>1875 to 4000</td>
<td>Orange</td>
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<tr>
<td>Other</td>
<td>Black</td>
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Miles

0 0.050 0.100 0.15
Histogram of Engine RPM

July 1, 1998 Demonstration Run
Throttle Position Thematic
Histogram of Throttle Position (volts)

1-3 volt range ➔
0-100% TP

July 1, 1998 Demonstration Run
ATMS Monitoring System
Travel Demand and Emissions Modeling Benefits

• GPS provides trip origin, destination, and route choice
  – Improved spatial and temporal resolution
  – Calibration of traffic flow and simulation models
• Second-by-second operating speeds and acceleration
• Engine start and soak distributions (by purpose)
  – Operating profiles after engine start
• Identify probable enrichment/enleanment locations
• Grade effects on operating conditions (GIS-grade)
• Congestion effects on operating conditions (ATMS)
• Identification of driver behavior interaction effects
Enhanced Engine Start and Onroad Emissions Modeling

Engine Start CO Emissions
7-8 AM, 1 KM Cells
(Zone-based, 33% of total)

Running Exhaust CO Emissions
7-8 AM, 1 KM Cells
(Road-based, 67% of total)

Total CO Emissions
CO 7-8 AM