Motorcycle Rider Naturalistic Driving Study

Feasibility Study of Instrumentation to Collect Behavior Data to Identify On-Road Rider Behaviors

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Last year (2007), one in eight motor vehicle fatalities were attributed to motorcycles.

Motorcyclist fatalities have been increasing for 10 consecutive years:
- In 1997 fatalities from motorcycle crashes were at a low of 2,116.
- In 2007 deaths from motorcycle crashes have risen to 5,154 (128% increase).

During the same 10 year period, deaths from motorcycle crashes rose from 5% to 13% of the national surface transportation fatality problem.
Background

Deaths in Vehicle Accidents Have Declined ...

- Fatalities in motor vehicle accidents
  - 50 thousand
  - 40 thousand
  - 30 thousand
  - 20 thousand
  - 10 thousand
  - 0 thousand

- Deaths per 100 million vehicle miles traveled
  - 2.5
  - 2.0
  - 1.5
  - 1.0
  - 0.5
  - 0.0

- Number of motorcycle riders killed
  - 5 thousand
  - 4 thousand
  - 3 thousand
  - 2 thousand
  - 1 thousand
  - 0 thousand

- As a percentage of all vehicle fatalities
  - 15%
  - 12%
  - 9%
  - 6%
  - 3%
  - 0%

... But Motorcycle Deaths Continue to Go Up

Source: National Highway Transportation Safety Administration

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Background

• Data suggests this trend will continue
  – Motorcycle registration in 2007 up 75% from 1997
  – Increasing fuel costs motivate motorcycle use
    • Many motorcycles achieve 50+ mpg

• Some casual factors appear to include
  – Impairment
    • In fatal crashes, riders are 2.5 times more likely to be intoxicated than car drivers
  – Inexperience
    • In fatal crashes, riders are 3 times more likely not to have a proper license than car drivers
  – Age
    • Many riders are middle-age and older drivers who rode when they were young and they “think they have the same reflexes” – James Port
    • Fragility of older riders
Limitations of Current Research

- Some of the best data we have is nearly 30 years old
  - “The Hurt Report”, published in 1981 is a primary reference for motorcycle crash data
- Most research is based on crash databases (police reports)
  - Studies such as 100-car have demonstrated inaccuracies self-reported pre-crash information
- Little is known about the factors prior to motorcycle crashes
  - What is the differences in rider behavior and exposure of those involved in crashes vs. those who are not involved
  - What was the rider doing prior to the crash/near-crash
  - What environmental factors differentiate crashes/near crashes from baseline driving
  - How common are secondary tasks while riding
  - What opportunities are there for crash mitigation (collision avoidance warnings, abs, regulations, etc)
Project Overview

• Phase I: Determine the feasibility of instrumentation (18 months)
  – Determine data acquisition system (DAS) requirements
  – Design and construct the DAS
  – Test and validate DAS (3 to 5 motorcycles)
  – Develop Phase II experiment
  – Recommend analyses for Phase III

• Phase II: Execute Naturalistic Study
  – Execution depends on the Phase I outcome
  – Instrument Personal motorcycle
  – Preliminary study size ~50-60 participants

• Phase III: Analyze Naturalistic Study Results
  – Design TBD based on Phase I and II outcomes

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Phase I: Major Research Goals

- Determine if the technology exists to instrument motorcycles
  - Can we capture the data necessary to answer Phase II preliminary questions

- Demonstrate the feasibility of using the technology on motorcycles for naturalistic data collection
  - Will be verified by an independent evaluator
Phase I Instrumentation Challenge

• Design and develop a DAS that
  – Fits unobtrusively in a motorcycle
    • Powerful
    • Small
    • Light weight
    • Weather proof
  – Is capable of providing the required data, for example:
    • Video of driving scene
    • Location (GPS, lane position, etc)
    • Dynamic state (velocity, acceleration, pitch, yaw, roll, etc)
    • Rider input (brake, throttle, fork rotation, etc)
Phase I Instrumentation Challenge (cont)

- Need to consider:
  - Effects of leaning in corner
    - Accelerometer orientation
    - Gyroscope orientation
    - GPS orientation
    - Radar orientation
  - Motorcycle capabilities
    - Higher acceleration
    - Rapid changes in roll angle
    - Wheelies
- Other sensor challenges
  - Capturing rider eye/face video
  - Fork rotation considering angle
  - Capturing rider hand position
  - Brake (front/rear bias)
  - Throttle

Figure Source: Hima, Nehaoua, Arioui, (2007)

Figure Source: Cossalter, Lot (2002)
Phase I: Preliminary Instrumentation

- VTTI is presently developing a DAS that is the likely candidate for motorcycles
  - Slightly larger than a deck of cards
  - Can process two channels of video
  - Expandable through CAN network
  - Accelerometer and gyro
  - Machine vision
  - WiFi
Phase I: Prove DAS Feasibility

• Test-track data collection
  – 3-5 motorcycle types
  – Naive participants
  – Prescribed set of typical maneuvers
  – Analyze results and improve the DAS

• On-road data collection
  – Use improved DAS from test-track results
  – 3-5 participants using their personal cycles
  – Two to four weeks per participant
  – Use expected Phase II methods
  – Analyze results and improve DAS
  – Recommend the final DAS for Phase II
Phase II Example Research Questions

• What are the riding behavior differences between drivers who have crash and near-crash events vs. those who do not
• What are riders attending to when they have conflicts, near crashes, and crashes?
• How is exposure related to crash and near crash involvement
• Under what environmental conditions do near crashes and crashed tend to occur
• How does lane placement effect crash and near-crash involvement
• How often do other vehicles appear to fail to see motorcycle?
Motorcycle-Like Vehicles
Opening the Market to Additional Drivers
References


