Naturalistic Cycling Studies

November 26\textsuperscript{th} 2013

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Summary

- The cycling safety problem
- Naturalistic cycling data
- Some results from past studies
- Ongoing studies in Europe
The cycling safety problem (2011)

- 45%
- 14%
- 21%
- 7%
The cycling safety problem: fatalities 2011
The cycling safety problem: cycling trend
The cycling safety problem: cycling trend
The cycling safety problem: cycling trend (urban fatalities)
What is Naturalistic Data?

Data collected in **traffic**, by road users performing their **usual daily activities**.

Traditionally recorded from **instrumented** cars and trucks.
Why do we collect naturalistic data?

- Understand **accident causation**
  Off-road glances longer than 2s double accident risk [Klauer, 2006]
  100 Car Naturalistic Driving Study

- Investigate driver **behaviour**
  Texting increases accident risk 23 times [Hanowski 2009]
  Commercial Vehicle Operations Study (CVO)

- Inform **regulations** and **infrastructure** design
  Kangaroo effect of speed cameras / Relation between curb design and lane departures [Victor 2010]
  SeMiFOT - Sweden-Michigan Naturalistic Field Operational Test

- Test **intelligent systems**
  LDW improves lane keeping [Sayer 2010]
  Integrated Vehicle-Based Safety Systems (IVBSS)
Why do we collect naturalistic data?

- Understand **accident causation**
- Investigate driver **behaviour**
- Test **intelligent systems**
- **Regulations and infrastructures**

2000+ cyclist killed yearly (6-7%)
70% single bicycle crashes
Most of deaths at **intersections**

Cycling is increasing.
**Distraction**, obedience to rules
Speed with new e-bikes

New apps on **smartphones** promise to help cyclists.

1.2M e-bike in 2012
In Europe, bikelanes are designed very differently. New **e-bikes** may require new infrastructures.
Instrumented Bicycles

- Camera
- Inertial Measurement Units
- GPS
- Brake Force Sensors
- Cyclist Sensor
- Logger
- Simple HMI
Instrumented Bicycles in Europe

E-BikeSAFE, BikeSAFE

Pedelec vs S-pedelec

SEEKING

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There are 1.3 million reasons to work for safer traffic

Around 1.3 million people in Sweden travel to work by bike. Do you know how many accidents happen each year? A 2019 survey showed 11,000 accidents among cyclists, while the average number in other countries is 10. What do you think would be the consequences for society if we were to double this number?

In order to reduce the number of accidents among cyclists, we need to implement measures to improve road safety. These measures can include things like better infrastructure, better lighting, and increased visibility. The goal is to make it safer for cyclists to travel to work by bike, and to encourage more people to make the switch.
Naturalistic Cycling Data

- **Objective**
  - Videos
  - Position and Kinematics (GPS, IMU)
  - Controls (brakes, pedals)

- **Subjective**
  - Interviews
  - Diaries
  - Demographics and cycling behavior from questionnaires

- **Derived**
  - Glance behaviour
  - Maps (e.g. Google Earth)
Normal Cycling Behaviour

20 cyclists
332 trips
114 h
1549 km
13.6±3.2 km/h
22±8.6 min/trip

[BikeSAFE slutrapport, 2013]
Cycling Behaviour across Bicycle Types

Traditional Bicycles

Electrical Bicycles

Average 14 km/h

Average 23 km/h

[e-BikeSAFE lägesrapport, 2013]
Obedience to Cycling Rules

A. Gender

B. Helmet Use

C. Crossing

D. Proper Light

[BikeSAFER, final report, 2013]
Event-based Safety Analyses

- 63 critical events (crash and near crash) from button presses
- 126 baseline (randomly chosen) events
- Factors related to the environment and road users’ behaviour are annotated for all events.
- Odds ratios (difference between critical and baseline events in the prevalence of different factors) are computed
Risk Factor

[Dozza & Werneke, TRF, 2013]
Risk Factor

[Dozza & Werneke TRF 2013]

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Risk Factor

[Dozza & Werneke TRF 2013]
Conclusions

- In Europe, more than 2000 cyclists die each year in road accidents (6-7% of all road fatalities)
- Even if the number of road fatalities is overall decreasing, cyclist fatalities are either constant or relatively increasing depending on the EU country.
- Naturalistic cycling data can address:
  - accident causation (including pre-crash scenarios)
  - road users behavior (including obedience to traffic rules and distraction)
  - infrastructure design (very different across European countries)
  - intelligent applications (upcoming from several EU projects)
- Preliminary results from e-BikeSAFE raise safety concerns about fast e-Bikes.
- Results from BikeSAFE show how cyclists obey to traffic rules.
- Results from BikeSAFE show how intersections, road maintenance, and interaction with other road users are contributing factors to accident causation.
www.chalmers.se/safer

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