Data science techniques for driving behavior evaluation

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Together with:
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Scope

- Develop methodological approach for driving behavior evaluation:
  - trip
  - driver
  - multi-criteria analysis

- Safety evaluation based on:
  - travel characteristics
  - driving behaviour metrics
  - smartphone devices

- Smartphone devices:
  - large-scale data
  - naturalistic driving conditions
Background

- Driving data collection
  - naturalistic driving experiments
  - driving simulator experiments
  - in-depth accident investigation

- Driving metrics - adequate amount
  - assessment of each driver
  - deficient amount of data => uncertain or unreasonable results
  - excessive amount of data => significantly increase required processing time

- Driving behaviour characteristics
  - speeding
  - harsh braking/ acceleration/ cornering
  - seatbelt use
  - mobile phone use
Research Questions

- How well can driving behavior be evaluated? Can data science techniques provide sufficient answers?

- What are the most important characteristics for driving behavior assessment?

- What is the required amount of driving data that should be collected for each driver?
### Driving Behavior Parameters

- **Risk exposure indicators:**
  - Total distance travelled

- **Driving behaviour indicators:**
  - Harsh events
    - Number of harsh braking (longitudinal acceleration) (HA)
    - Number of harsh acceleration (longitudinal acceleration) (HB)
  - Speeding (SP)
  - Mobile phone use distraction (MU)

- **Road types:**
  - Urban
  - Rural
  - Highways
Smartphone Data Collection

- A **mobile application** to record user’s driving behaviour (automatic start / stop)

- A variety of APIs is used to read mobile phone sensor data

- Data is **transmitted** from the mobile App to the central database

- Data are stored in a **sophisticated database** where they are managed and processed

- **Indicators** are designed using
  - machine learning algorithms
  - big data mining techniques

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Data Preparation

- Data are anonymized
  - user-agnostic approach
  - identify driving behaviors and patterns
  - causality between behaviour and other factors
  - large-scale samples
  - no information on demographics or accident record

- Python programming language
  - filter aggregate data
  - retain only necessary information
  - aggregate data
  - data analysis
Main findings

- **Required driving data amount:**
  - 40 trips
  - 400 km

- Speeding behaviour is **correlated** with several other driving behaviour parameters:
  - Frequency and severity of harsh events (acceleration, deceleration, cornering)
  - Driving aggressiveness
  - Mobile phone use

- **Total Mileage**
- **Traffic conditions**
- **Route frequency**
Scientific and Social Impact

- Significant reduction of individual **driving risk** and subsequent improved road safety level for the society

- Personal and general **feedback** to drivers on
  - their overall driving efficiency and its evolution
  - an inefficient trip is performed
  - driving characteristics that should be improved
  - each road type

- Develop **insurance pricing** schemes
  - charge premiums based on driving efficiency
Future Challenges

- Application in larger and diversified groups of drivers population
- Investigation of more critical risk factors
  - headways
  - lane changing
  - eye movement
  - drowsiness
- Type of analysis approach
  - macroscopic
  - microscopic
  - combination of micro- and macro-scopic
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