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Telematics, Big Data and Road Safety

George Yannis, Professor
Katerina Folla, Research Assistant
Dimitrios Nikolaou, Research Assistant

Department of Transportation Planning and Engineering,
National Technical University of Athens

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NTUA - Dpt of Transportation Planning & Engineering

Department of Transportation Planning & Engineering

- The mission of the NTUA DTPE is to **educate scientists engineers and promote science** in the field of transportation planning and engineering.
- The NTUA DTPE is a **Research and Innovation Center of Excellence** with global recognition [Ranked 9th in Europe, 39th worldwide (Shanghai Ranking's 2017), Scientific citations: 3rd in Europe, 19th worldwide (Pulse 2017), Road Safety: 2nd in Europe, 6th worldwide (AAP, 2018)].
- A **Team of 60+ Scientists**: 7 Internationally recognized Professors, 15 Senior Transportation Engineers and PostDoc, 25 PhD Candidates, 15 Transportation Engineers and other scientists.
- **NTUA DTPE Activities in figures** (since mid 80s):
  - More than 1.100 Diploma and 30 **PhD Theses**,
  - More than 330 road safety research **projects**, mostly through highly competitive procedures,
  - More than 1.100 scientific **publications** (> 400 in Journals), widely cited worldwide,
  - More than 150 scientific **committees**,
  - International **collaborations**: European Commission, UN/ECE, OECD/ITF, WHO, World Bank, EIB, CEDR, FEHRL, ERF, IRF, UITP, ETSC, WCTR, TRB, decades of Universities and Research Centers.

NTUA Road Safety Observatory

- An international reference road safety information system since 2004, with the most updated data and knowledge, with:
  - more than 3.000 visits per month,
  - tens of items and social media posts/tweets annually

Background

Background

- Road transport is responsible for the majority of transport fatalities, with an annual 1,35 million road traffic deaths worldwide.

- Innovative data-driven solutions could contribute to a proactive approach of addressing road safety problem, which is a core principle of the Safe System.

- The rise of smartphones, sensors and connected objects offers more and more transport data.

- The interpretation of these data can be made possible thanks to progress in computing power, data science and artificial intelligence.

Need for New and Big Data

- Alternative data that could lead to new advanced road safety analyses in order to:
  - more efficiently identify key road risk factors
  - address road user behaviour and errors
  - address proactively critical traffic, infrastructure and vehicle risk factors.
- Continuous driver support with aim to improve driver behavior and develop better road safety culture at all road users.
- Great new potential for evidence based public and private road safety decision making at all levels.

Road Safety Big Data

Road Safety Big Data Sources

- Mobile Phone Data
  - Sensor Based Data (e.g. Google Maps, Waze)
  - Cellular Network Data (e.g. Cosmote, Vodafone, Wind)
- Vehicle On-Board Diagnostics Data
  (e.g. OEM industry)
- Data from Cameras
  - On-vehicle (inside and outside)
  - On the road (cities, operators)
- Data from Car Sharing Services
  (e.g. Uber, Lyft, Bla bla car)
- Data from Bike Sharing Services
  (e.g. 8D Technologies, Mobike)
- Social Media Data
  (e.g. Facebook, Twitter)

Road Safety Big Data Sources

- **Telematics companies**
  (e.g. OSeven, ZenDrive, Octo,)
- **Private Agencies' Sensor Data**
  (e.g. INRIX, Waycare)
- **Travel Cards Data**
  (e.g. Oyster card, Opal card)
- **Public Authorities Sensor Data**
  (e.g. Ministries, Public Transport Authorities, Cities, Regions)
- **Weather Data**
  (e.g. AccuWeather, ClimaCell)
- **Census Data**
  (e.g. Eurostat, National Statistics)

Road Safety Big Data

- GPS traces of the app users are the main core data elements.
- Data coming from connected navigation devices (embedded in cars, applications in smartphones etc.)
- Various sources may be combined by some companies: vehicle sensors, smartphones, PNDs, road sensors, connected cars, fleet management companies etc.
- Data related to road network, traffic parameters and speed are the most available.
- Traffic accidents may be recorded as a subgroup of recorded incidents mainly through:
  - Crowdsourcing,
  - Partnerships,
  - Algorithmically generated flow-based incidents

Accident Data Collection (1/2)

- Automatic data collection is possible through
  - instrumented floating vehicles and/or
  - smartphones (hard braking, poor road surfaces, speed).

- Active safety systems can also be considered among surrogate safety metrics, such as:
  - ABS for anti-lock braking,
  - ESP for electronic stability control and
  - AEB for autonomous emergency braking

Accident Data Collection (2/2)

- Technologies like automatic crash notification and event data recorders propose data-driven responses to post-crash problems.
- Street imagery, also collected by floating vehicles, supports the assessment of road safety performance (star-rating for roads).
- Drones and satellites started complement the range of data, capturing solutions and play an increasing role.

Telematics for Driver Performance Feedback

Telematics solutions

- A range of telematics solutions already exist for:
  - fleet management,
  - usage-based insurance,
  - eco-driving and
  - safe driving coaching.

- Driver telematics were initially based on On-Board Diagnostics (OBD), having access to data from the engine control unit.

- Current technological advances make data collection and exploitation substantially easier and more accurate through Smartphones.

Telematics metrics

Smartphone and OBD driver behaviour telematics metrics:

- Mileage driven
- Road network used (through GPS position)
- Duration and time of the day driving

- Speed
- Harsh braking
- Harsh acceleration
- Harsh cornering

- Mobile phone use (smartphone only)
- Fuel consumption
- Seat belt wearing (OBDs only)
- Drink and drive / fatigue (additional devices)
- Driver state (additional devices)

The example of OSeven Telematics

- OSeven is a pioneer technology company that is specialized in Driving Behaviour Analysis and Telematics Solutions.
- Business: Insurance (PAYD, PHYD, PAHYD), Fleet management, Rental and Leasing, Ride sharing, Taxi Hailing, Car pooling, Automotive, Banking.
- Platform components
  - User-friendly smartphone apps
  - A state of the art backend infrastructure for big data analysis
  - A web app for the visualization of the metrics and scores
  - Sophisticated Machine Learning algorithms
  - Driving Scoring Model for the evaluation of the driving behaviour
- Data flow in OSeven Platform:
  - Mobile App detects the start and stop of driving, without any user involvement
  - Data from smartphone sensors is recorded and transmitted to OSeven backend (WiFi or 3G/4G)
  - Data is analyzed via the OSeven algorithms to produce driving metrics and scores
  - Results per trip and overall can be viewed by the driver in the smartphone app and by the corporate clients for their fleets in the web app
- Risk Exposure and Driving Behaviour indicators
- Unique value proposition to drivers, companies and society

Monitoring Driver Behaviour

- New vehicles can include distraction and drowsiness alerts as standard.

- Crash investigators could have access to eye tracking data through event data recorders.

- Smartphone apps developed by insurers should prevent drivers from using the phone.

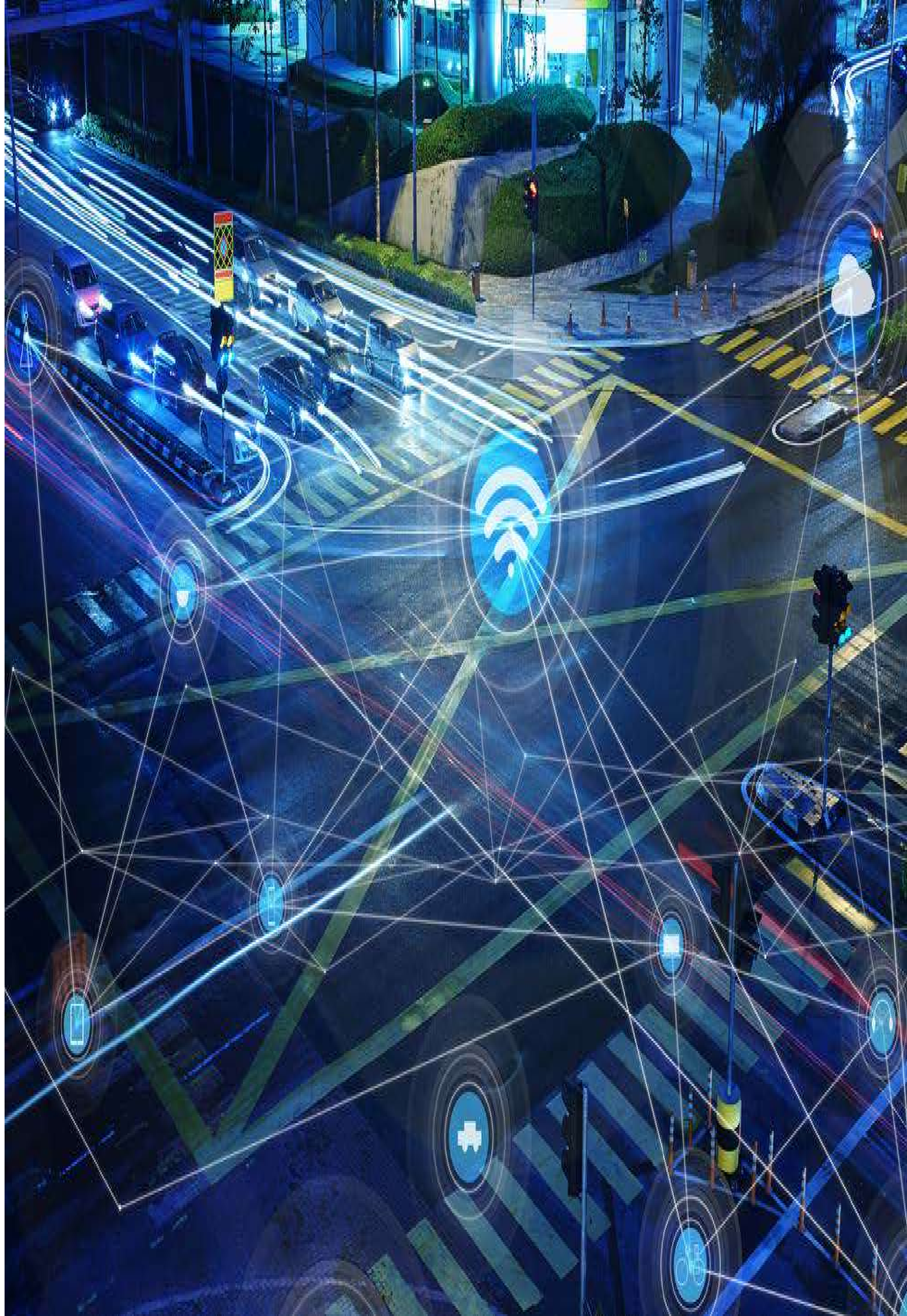
- Ride-sourcing and delivery platforms sharing data on driving and riding time via the licence number for preventing gig economy sector from breaking the driving hours restrictions.

Driver Performance Telematics Feedback

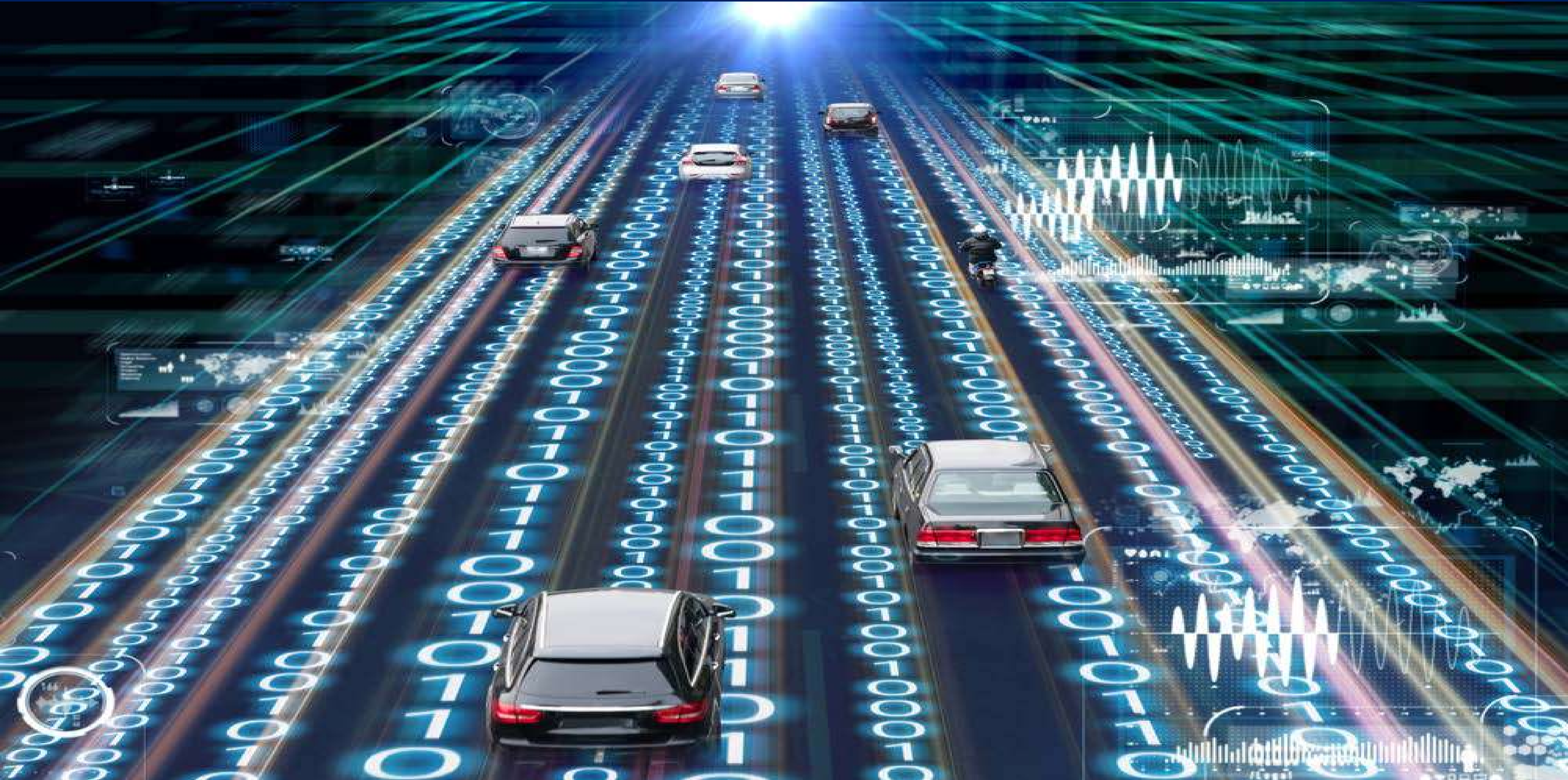
- Feedback to the driver through the Driver Performance Telematics (vehicle or smartphone)
- real time feedback
  + avoid distraction
  - produce distraction
- safety performance star rating
  + engage in the long term
  + great motivation to improve driving behaviour
  + identification of need for re-training
  - demotivation in case of non progress
  - demotivation when non favorable comparison with peers
- The feedback loop should be optimized.

Data Crowdsourcing

- Cyclists and Pedestrians report:
  - safety problems (roads, behavior)
  - exposure (routes, traffic, etc.)
  - crash data (with injuries, material damage only)
  - star rating
- Not uniform nor systematic reporting practices though
- Feedback on network safety performance
  - useful for the cyclists
  - useful for the decision makers (all levels)
  - useful for business

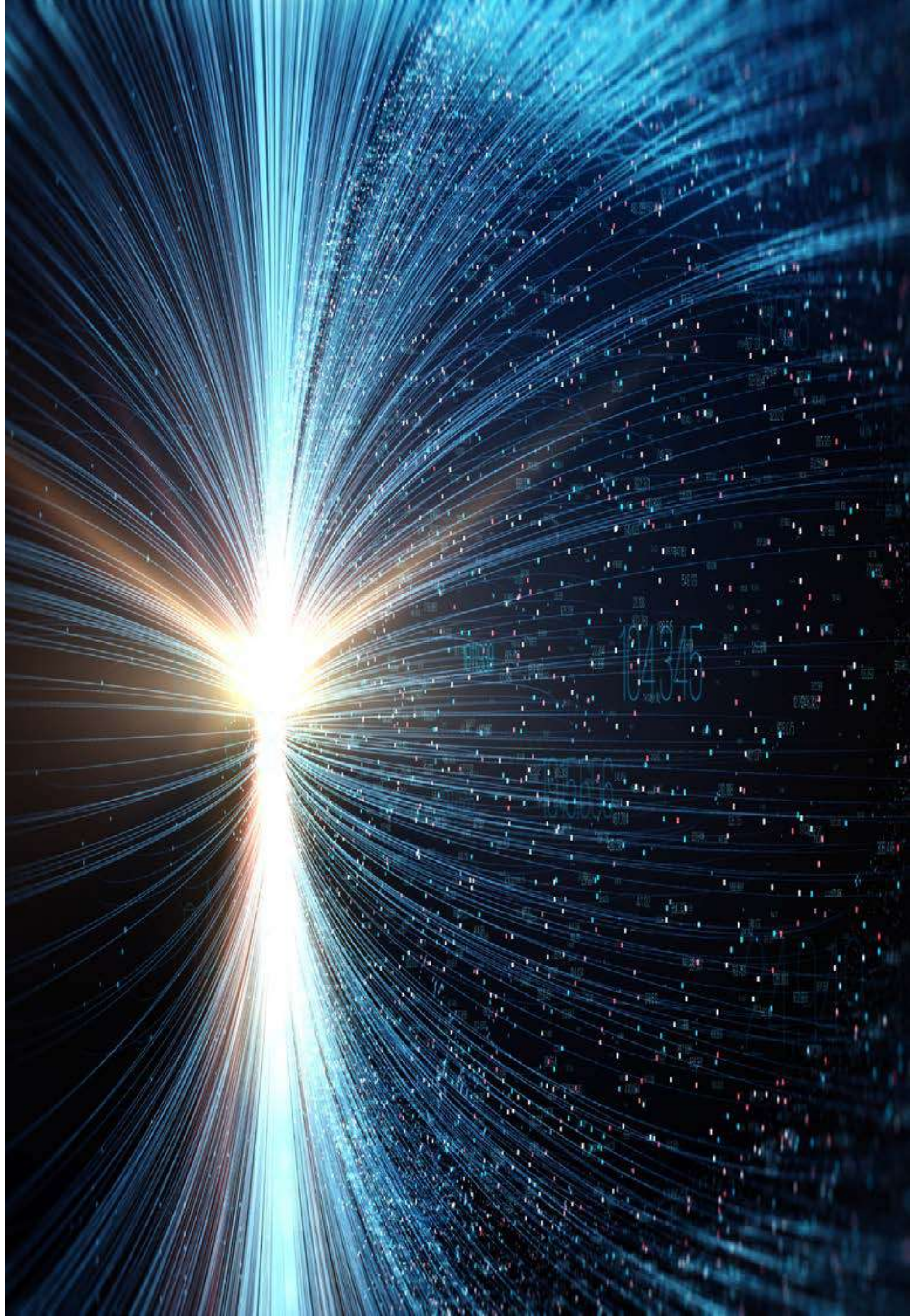


Open Issues



Critical Issues (1/2)

- Punishment Vs Positive Feedback (Incentives)
- Regulatory and Voluntary Data
- Secure anonymisation might increase penetration (e.g. blockchain)
- Ownership of data
- Exploitation of data (charging schemes)
- Sharing of safety data (EU legislation)

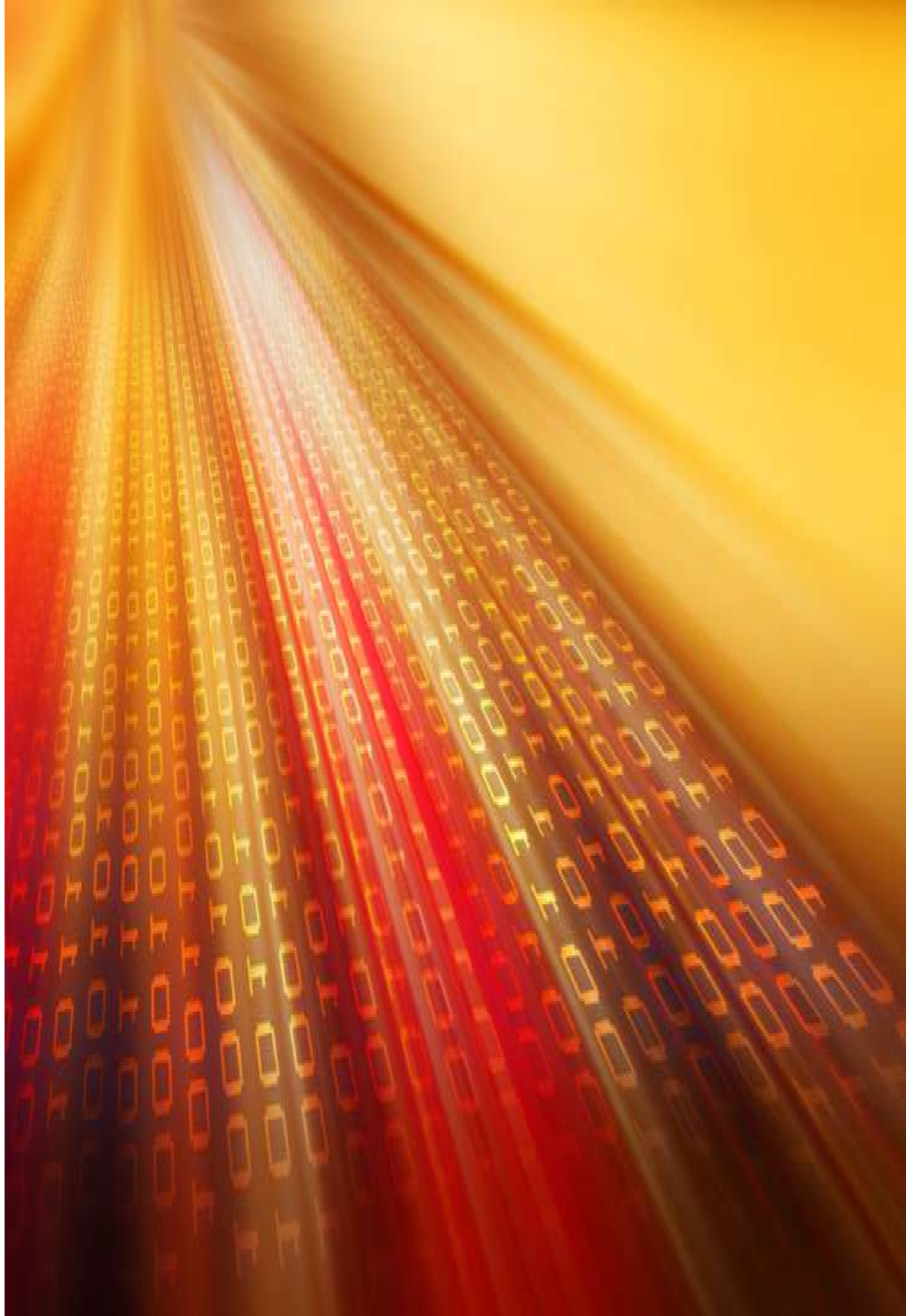


Critical Issues (2/2)

- Harmonisation and compatibility of:
  - data
  - metrics
  - data collection methodologies
  - data processing methodologies

- Define proper and properly the KPIs
- Clean properly the data
- Linking KPIs with respective interventions

- Control in-vehicle distraction devices
- Define safety policy focus (behavior, VRUs, infrastructure, traffic)



Technology Weaknesses

- Big Data is not only prone to many of the same errors and biases in smaller data sets, it also creates new ones.
- Big data creates privacy threats, especially with the risk of re-identification of individuals in datasets.
- Hacking is an important risk requiring advanced protection measures.
- Drivers using social driving apps may be distracted by new services (navigation, coaching, C-ITS alerts, infotainment, etc.).

Privacy Protection

- Explicit guidelines should be available to stakeholders concerning the protection of personal data, but also to offer reassurance on the legality of data collection and analysis.

- The use of strong de-identification techniques, data aggregation and encryption techniques are critical.

- Issues concerning video images used for close call analysis should be addressed.

Big Data versus Big Biases

- Every data set should be considered biased towards some user groups, trip purposes or in any other dimension.
- The consequences of using data which isn't representative of the whole population should be assessed.
- There is a high risk for the drivers and the decision makers to be misled by the opportunistic analysis of seemingly low-cost data in absence of qualified data scientists and statisticians.

New Data Sharing Partnerships

- New data ownership frameworks will be developed along the lines of "A New Deal on Data".

- Partnerships enabling both the private and public sector can be created.
  - Work is required to define the scope and scale of data collection that is in line with public mandates.

- Open source or commercial solutions are developed to collect, harmonise and aggregate mobility data.

- Stakeholders should make road safety data freely available through such platforms.

Concluding Remarks

Road Safety Technology Perspectives

- Technology can be the new road safety driver, through:
  - Public private partnerships
  - Clear problem analyses (well defined objectives)
  - Systematic effectiveness monitoring

- Great need for:
  - more data and knowledge
  - better exploitation of current and future data
  - broader geographical coverage

- Data focus on:
  - more accurate road accident data
  - exposure data and performance indicators
  - measures and policies effectiveness evaluation

Road Safety Digitalization Perspectives

- Digitalization opens great new data possibilities for:
  - road user support and guidance
  - evidence based public and private road safety decision making at all levels

- New great potential for seamless data driven procedures from safety problems identification to selection and implementation of optimal solutions

- New increased net present value of road safety data, available for (real-time) early problem detection and prompt and customized decision support

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