FIFTH UNITED NATIONS GLOBAL ROAD SAFETY WEEK
6-12 May 2019

Save Lives
#SpeakUp

Smartphone exploitation for event spatial analysis & mapping – SESAME –

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Together with George Yannis

PhD Research Identity

Research organization

- National Technical University of Athens, Department of Transportation Planning and Engineering - www.nrso.ntua.gr

Supporting organizations

- OSeven Telematics - www.oseven.io
- Traffic Management Centre of Athens - www.patt.gov.gr

Duration of the project:

- 30 months (April 2018 – September 2020)

Research framework

This research is co-financed by Greece and the European Union (European Social Fund- ESF) through the Operational Programme «Human Resources Development, Education and Lifelong Learning» in the context of the project "Strengthening Human Resources Research Potential via Doctorate Research" (MIS-5000432), implemented by the State Scholarships Foundation (IKY)»

Road Safety Background

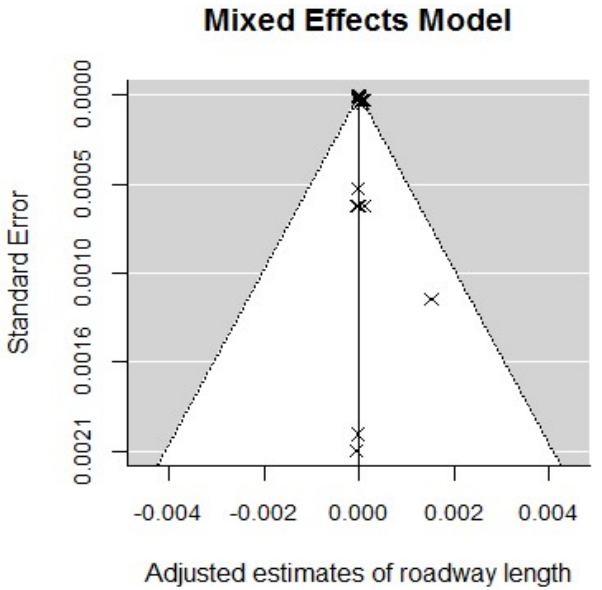
- Road safety casualties have platooned during the past 18 years worldwide (largely stable numbers)

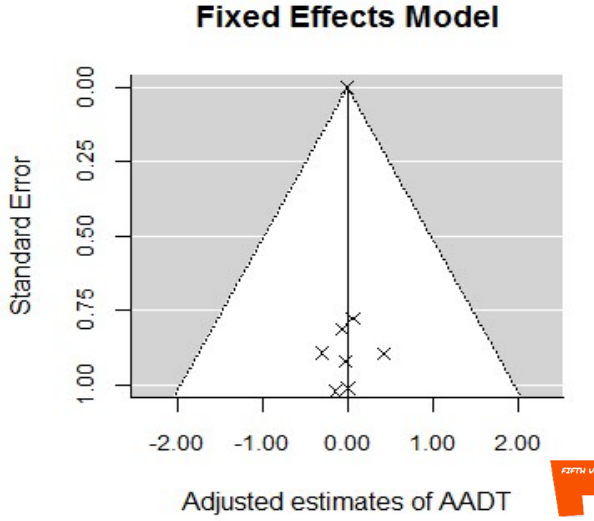
- More targeted interventions are required, alongside informed road network evaluation and assessment

- The Internet of Things (IoT) and smartphone sensors provide a wealth of information of driver behavior
  - More effortless and wide-range data collection
  - Increased coverage/network completeness
  - Big Data analysis approach
  - Several emerging open-source platforms offer uncharted capabilities

Scientific literature findings

- Spatial analyses of crashes have been adopted in road safety for decades, however there is no research conducting spatial analyses of driver behavior on a road network level.
- Several zonal levels have been explored, such as regional, zonal or road segment level approaches. Network investigations are demanding and uncommon.
- A plethora of spatial and spatio-temporal statistical models has been implemented for crash investigation.
- Meta-regression techniques were applied to the impact of 3 common exposure parameters on their reported coefficients on crash counts:
  - Road length (affected by examining fatality crashes only)
  - Traffic volume (affected by speed limit and road user age)
  - Vehicle distance travelled (affected by the size of study zones examined)





Objectives - Research Questions

- Can smartphone sensors provide concise trip data for road network formulation and evaluation?
- What are the characteristics of the best and worst-performing road segments based on driver behavior?
- How can personal driver behavior metrics be statistically analyzed while taking spatial – network effects into account?
- Is there a way to predict road segment performance based on driver behavior without available past driver data?

Implementation Framework

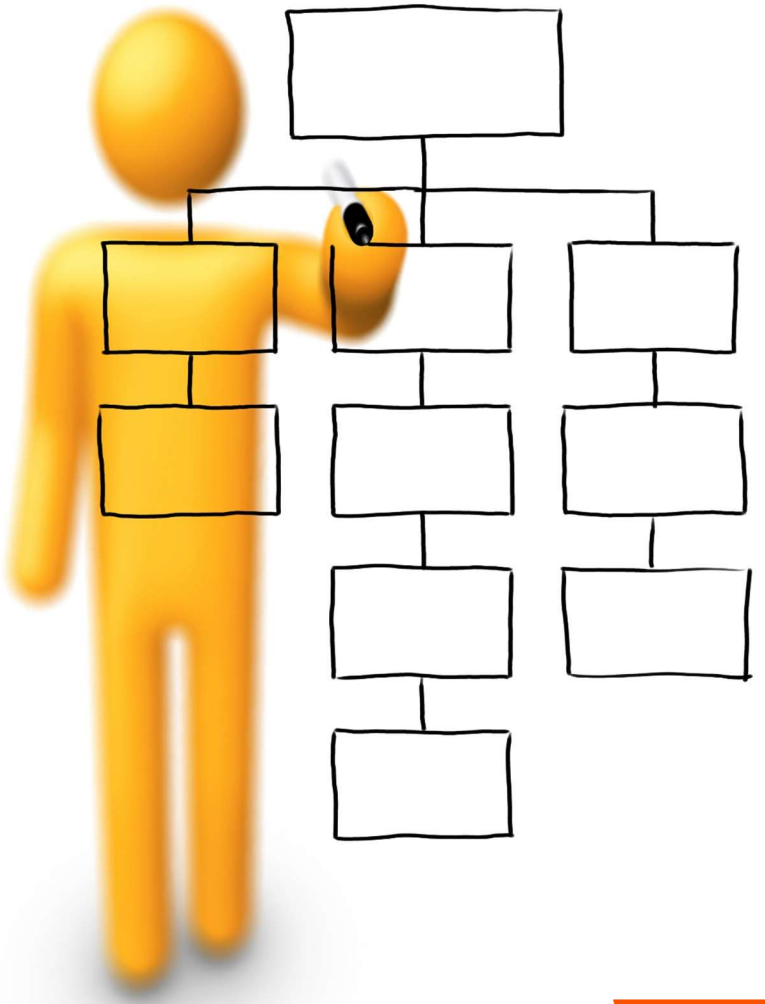
- Description of network through several data sources and map-matching harsh events and trips to road segments
- Separation of road segments in three categories, based on their available data:
  1. Full-info segments (all information available)
  2. Sparse-info segments (trip information with no events)
  3. Zero-info segments (neither trip nor harsh event information)
- Calibration of advanced statistical models while considering spatial effects from neighboring segments using full-info segments
- Prediction of harsh event rates in sparse- and zero-info segments (Bayesian inference for sparse-info segments with priors set to zero)
- Complete network assessment/road score allocation and possible harsh event hotspot identification

Methodological Challenges

- Combination of several diverse data sources
  - OSeven Telematics: driver trip/behavior data
  - OpenStreetMap: geometrical parameters
  - USGS/NASA SRTM: precise altitude data
  - Traffic Management Centre: traffic data

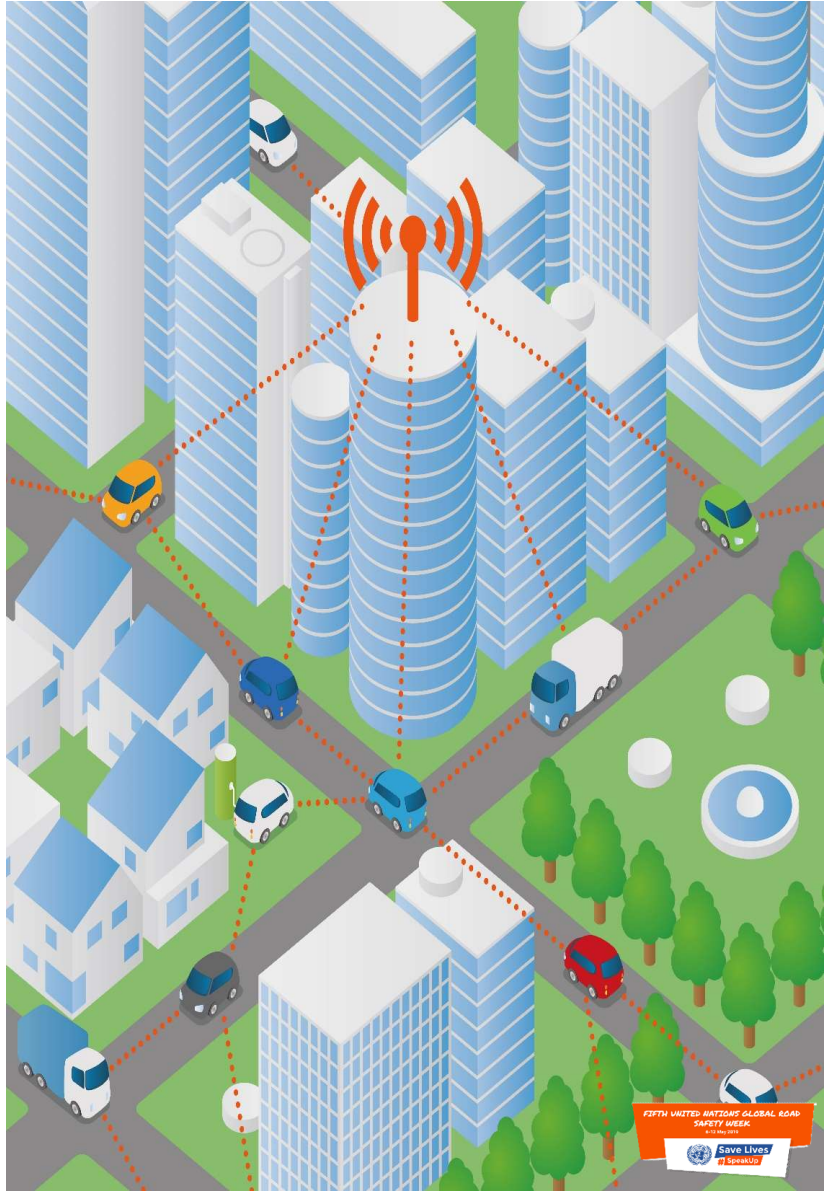
- Manipulating and analyzing very large datasets
  - Initial testbed area in Chalandri: 527 road segments
  - Trip info file contained 1,980,628 trip seconds, of which 336,070 in the testbed area
  - 14 month range yielded 638 harsh events in testbed

- Solving the riddle of road safety performance prediction: Integration of several statistical models
  - Geographically Weighted Regression (GWR models)
  - Conditional Autoregressive Priors (CAR models)
  - XGBoost – Extreme Gradient Boosting (machine learning)



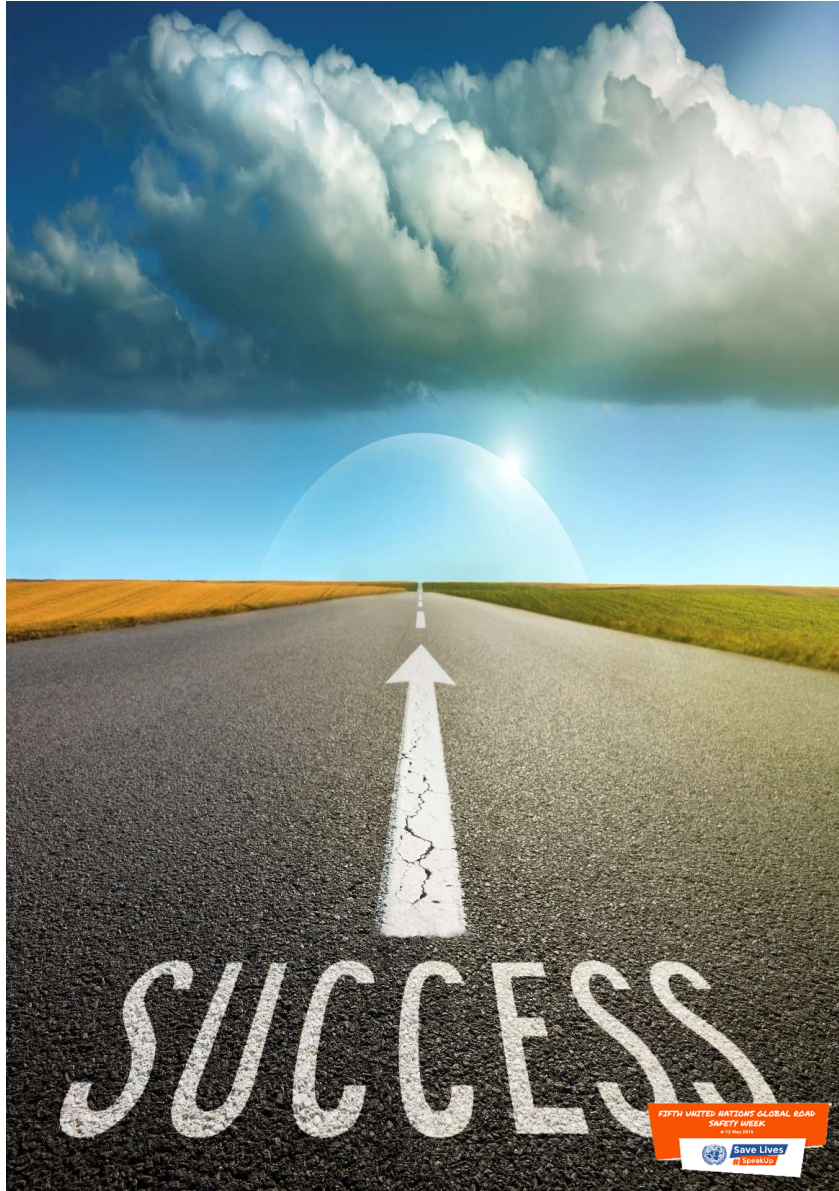
Scientific and Social Impact

- Development of a highly useful complete spatial road safety assessment tool
  - In road safety, driver behavior is innovatively analyzed spatially on a network
  - Identification of critical parameters for each road segment and overall
  - Identification of road safety event hotspots on developed maps
  - Increased transferability of results and methodology due to its concept
  - Final result is comprehensive to individual drivers and road management authorities alike



Future Challenges

- Identification of the degree that harsh events hotspots match with crash hotspots and quantification of that relationship
- Investigation of the possibility of temporal effects within the data after separation in different time-periods
- Exploration of the impacts of examining different road types (e.g. a full urban network vs. a solely urban highway network)
- Exploitation of the limitless potential of road safety map creation, enhanced by open-source capabilities



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