



# RSS 2022

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## Which driving performance parameters affect speeding? A naturalistic driving experiment

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# Objective

**Aim** of this study is:

- To investigate **which driving performance parameters affect speeding** using data obtained from smartphone sensors during naturalistic driving
- In particular, to investigate which factors are correlated with speeding while driving in different driving environments
  - Urban
  - rural



# Background

- Speeding is considered as **the most important road accident** contributory factor as is a key factor in around 30% of road fatal accidents
- In Greece, **40-50% of drivers drive faster than the recommended speed** limit and 10-20% exceed the limit by more than 10kph
- Speeding apart from increasing the possibility for a driver to get involved in an accident, also **increases the possibilities of severe injuries or fatalities**
- **Speeding includes:** excessive speed (driving above the speed limit) and inappropriate speed (driving too fast for the conditions, but within the limits)





# Smartphone data collection (1/2)

- 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



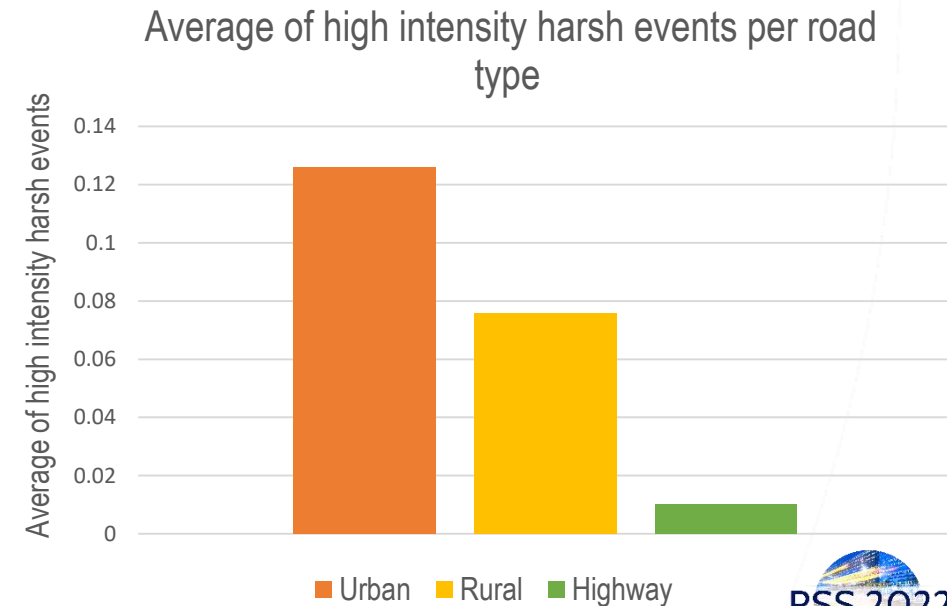
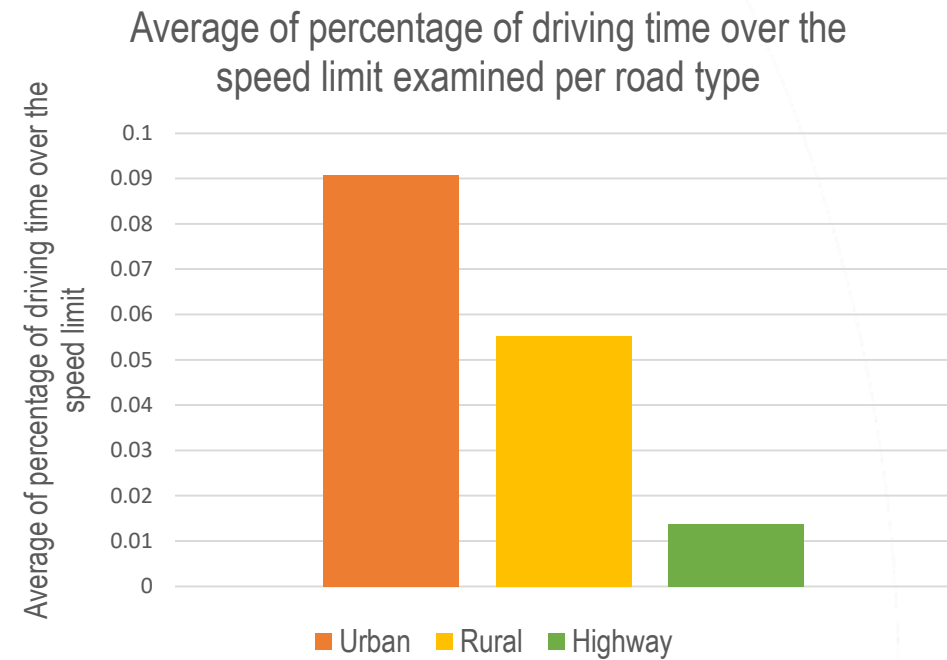
# Procedure of Data Collection (2/2)

- **Indicators** are designed using:
  - machine learning algorithms
  - big data mining techniques
- Data collected for **49,018** trips from **116** drivers for a period of 6 months (2019-2020)
- The database analyzed was in **.csv format**
  - Drivers' trips are stored per row, the characteristics of which are stored in each column's variables



# Descriptive statistics

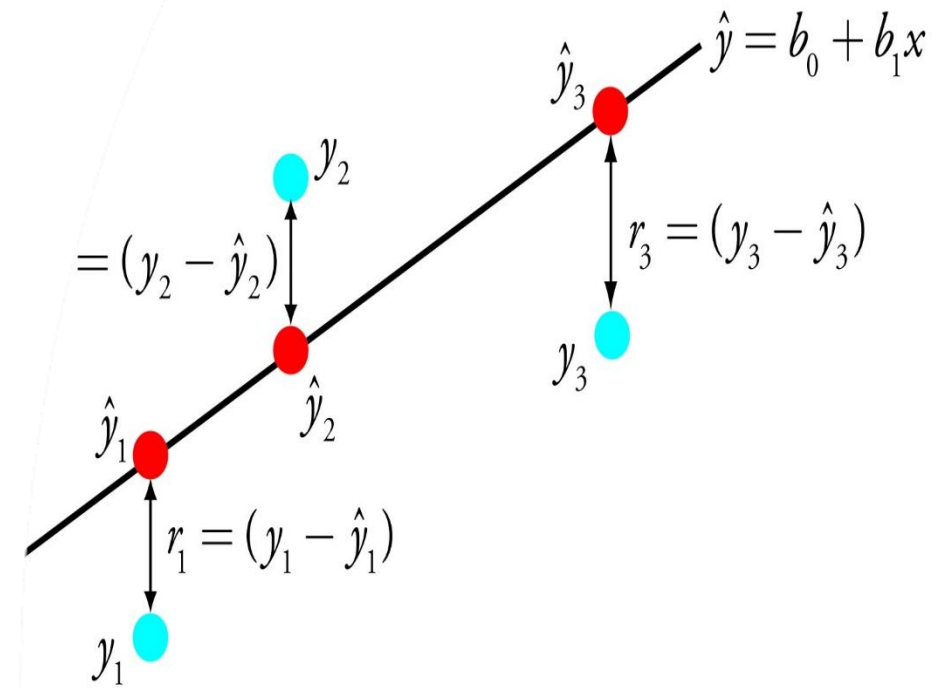
- The **highest** and **lowest** percentage of speeding is found in the **urban** environment and **highways**, respectively.
  - This is probably because the speed limits on highway are already high enough
- The **largest** number of **high intensity harsh** events takes place in the **urban** environment mainly due to its characteristics e.g.:
  - high traffic conditions
  - Not clear driving environment
  - overall parameters that lead to a more nervous driving performance



# Methodology (1/2)

➤ When a variable  $Y$  is linearly depended on more than one variables  $X$  ( $X_1, X_2, X_3, \dots, X_k$ ), **multiple linear regression** is used. The relationship between the dependent and the independent variables is given by the following formula:

$$\text{➤ } y_i = \beta_0 + \beta_1 * x_{1i} + \beta_2 * x_{2i} + \beta_3 * x_{3i} + \beta_k * x_{ki} + \varepsilon_i$$



# Methodology (2/2)

- **Three linear regression** models forecasting the percentage of driving duration of driving above the speed limit were developed: **one overall** model and **two** models for each different **road type** (urban, rural):
  - Model 1: Predicting the percentage of speeding – overall model
  - Model 2: Predicting the percentage of speeding on urban road
  - Model 3: Predicting the percentage of speeding on rural road





# Results (1/2)

- Linear models for speeding for **urban and rural roads** separately

Independent Variables	Models					
	<i>Overall</i>		<i>Urban</i>		<i>Rural</i>	
	B	t	B	t	B	t
Constant	-0.119	-71.819	-0.215	-183.421	-0.053	-71.287
speed_avg	0.002	110.299	-	-	-	-
harsh_acc	0.006	33.368	-	-	-	-
work_weekend	0.009	10.574	-0.002	-2.013	-0.003	-3.354
smooth_eco	0.189	58.158	-	-	-	-
speed_urban_avg	-	-	0.010	275.838	-	-
harsh_acc_urban	-	-	0.003	10.748	-	-
speed_rural_avg	-	-	-	-	0.002	136.085
harsh_acc_rural	-	-	-	-	0.007	20.873
Adjusted R <sup>2</sup>	0.316		0.630		0.310	



# Results (2/2)

- As the **average speed and the harsh acceleration events** increase, the higher the speeding percentage in a trip
- These two factors both **indicate an aggressive driving behaviour** which is strongly correlated to speed exceedance while driving
- The **eco-friendly driving variable** is included only in the overall model indicating that the different road environment does not affect eco-driving performance in terms of speeding
- In the overall model the **weekdays variable** has a positive correlation to speeding, but both in the urban and rural models, weekends indicates increase of speeding percentage



# Conclusions

- **Average speed**, number of **harsh acceleration** events occurred, have all been determined as statistically significant and positively correlated with the speeding percentage in all different models
- Drivers who tend to accelerate harshly and frequently, also tend to exceed the speed limit in a **greater amount of travel time**
- It is also found that drivers traveling more in terms of **distance and time**, usually drive at a higher speed indicating that they are at higher exposure, behavioural risk and speeding percentage

CONCLUSIONS

A.

B.

C.





# Future Research

- Analysis of different driving behavior parameters identified by the road safety literature as **risk factors** (e.g. exceeding speed limit, mobile phone distraction)
- Analyses per gender, age, history of accidents, self-assessment, driving experience and more **demographic** characteristics
- Investigation of **driver feedback** effect on driving behavior and safety of both drivers and motorcyclists







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