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Spatial analysis of driver safety behaviour using data from smartphones

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Objectives

The aim of this research is to conduct a spatial analysis of driver safety behavior using data from smartphones. It investigates how the number of harsh accelerations and decelerations per day, which are key elements of everyday driving, is influenced with both the road environment and road users' behaviour.

Data collection

The recorded driving behavior data originate from the various sensors of smartphones and data fusion algorithms developed by OSeven Telematics. OSeven uses an integrated system for recording, collecting, storing driving behaviour data and data processing using advanced machine learning algorithms.

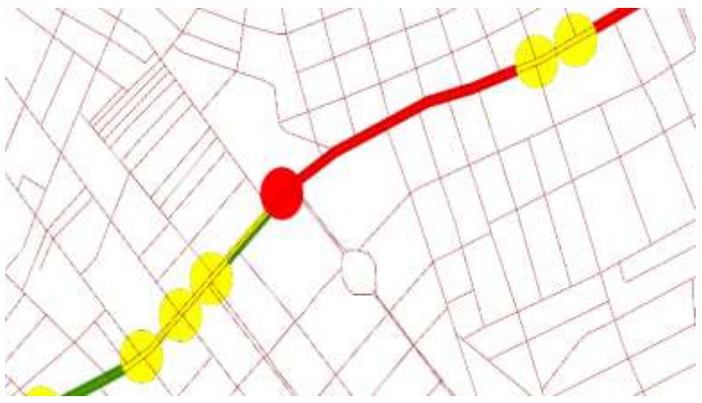

Fig. 1 Colour grading of a selected area of the road arterial

The anonymized data received from OSeven are in the form of databases that contain a total of 194,850 observations from 319 users. The datasets exploited included information about the harsh events of each user's trip, such as the:

- type of the event (braking, acceleration)
- time of the event
- coordinates (latitude & longitude)
- driving speed at the beginning of the event
- speed difference between the start and end of the event
- accelerometer value
- type of road network

The events occurred at the examined road arterial (Leoforos Mesogeion) were projected on a map using a GIS software and the road was divided into node areas and sections considering specific parameters to define these areas.

Methodology

Data pre-processing & visualization

Data were processed and transformed in a GIS computer software, so they can be processed thereafter. Additionally, analytic maps were developed that aimed to indicate patterns of the accumulation and ranking of the harsh events in the selected road segments.

Variable correlation

The correlation between dependent and independent variables is examined and all independent variables with high correlation are included in the model development.

Statistical analysis

In order to achieve the goals of the study, regression analysis was conducted through linear regression as the nature of the depended value (continuous), deemed it appropriate. Four linear regression models are developed:

- Harsh braking events on nodes
- Harsh acceleration events on nodes
- Harsh braking events on sections
- Harsh acceleration events on sections

The degree of influence of the independent variables on the dependent variable is quantified through the magnitude of the relative influence.

Results

After numerous tests, the best models describing the number of harsh events in node and section areas feature the independent variables shown in Table 1.

Table 1. Model results for harsh events per day in node & section areas

Model type	Model	Coefficients	Bi	t - ratio	Significance
Nodes	Harsh decelerations	Constant	-0.112	-2.532	0.020
		Number of right exits	0.029	2.432	0.025
		Standard deviation of event speed	-0.019	-6.647	0.000
		Max of speed difference	0.005	7.496	0.000
	Harsh accelerations	Constant	0.275	2.229	0.037
		Number of right exits	0.100	3.348	0.003
		Standard deviation of event speed	-0.058	-4.987	0.000
		Max of speed difference	0.008	3.632	0.002
Sections	Harsh decelerations	Constant	0.0810	4.535	0.000
		Bus lane existence	0.0310	2.794	0.009
		Section length	0.0001	1.900	0.067
		Minimum distance of the event	-0.0240	-3.540	0.001
	Harsh accelerations	Constant	0.0710	2.243	0.037
		Bus lane existence	0.0440	2.940	0.006
		Section length	0.0002	4.056	0.000
		Minimum distance of the event	-0.0400	-3.126	0.004

The most influencing factors found are the typical deviation of event speed, the maximum speed difference and the number of right exits from the for both node models and the section's length, the existence of bus lanes and the minimum distance of event for both section models.

Future research

Future research should:

- Exploit real-time information for dynamic road network monitoring and assessment
- Deep dive into the areas identified as blackspots and analysis of their characteristics
- Analyze a larger and more diverse driving sample and include drivers' characteristics in the analysis

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