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Road Safety Modelling: Macroscopic and Microscopic Approach

George Yannis [a], Anastasios Dragomanovits [a], Alexandra Laiou [a], Ourania Basta [a], Xuesong Wang [b]

[a] *National Technical University of Athens, Greece*
[b] *Tongji University, China*

Introduction

Crashes are responsible for **1,35 million road traffic deaths** per year (World Health Organization 2018) and road traffic injuries are the **8th leading cause of death** worldwide and the **1st cause of death among children and young adults** (5-29 years old).

As budgets for road safety measures are limited, decision makers and road safety stakeholders worldwide have to decide about the most effective use of available funds. To this purpose, policy makers need prediction tools and decision support systems developed through the utilization of **quantitative road safety modelling research**, at a microscopic or macroscopic level, allowing them to:

- analyze potential safety issues,
- identify appropriate safety improvements,
- estimate the potential effect of these improvements in terms of crash reduction.

Microscopic Road Safety Modelling

Analysis of crashes at microscopic level, usually referred to as accident prediction modelling (APM) aims at identifying the relation between with road crashes and injuries, and road infrastructure characteristics and traffic. Microscopic or in-depth models and factors are very useful for estimating the **safety effects of a specific infrastructure treatment applied in a specific location of the road network** (e.g. increasing shoulder width, improving road alignment in a specific horizontal curve by increasing curve radius etc.)

This is usually achieved through appropriate statistical modelling, the type of which mostly depends on data availability.

Existing literature on microscopic road safety modelling includes:

- **Highway Safety Manual** (under revision),
- **EU Research Projects**: RIPCORD-iSEREST, RISMET, PRACT
- **Online toolkits**: FHWA CMF Clearinghouse, Austroads Road Safety Engineering Toolkit, SPF Clearinghouse, iRAP Road Safety Toolkit, PRACT Repository, SafetyCube Decision Support System
- Large number of related **journal papers** on the development of stand-alone APMs, the development od Safety Performance Functions according to HSM procedures or the calibration of HSM model.

Largely depending on data availability and accuracy (georeferenced crash data, traffic data and road infrastructure geometry and equipment data), microscopic models can provide a detailed and in-depth understanding of craches and crash related fatalities and injuries.

Macroscopic Road Safety Modelling

Macroscopic safety analysis is related to traffic crashes at **aggregate spatial levels** (e.g. traffic analysis zone, county or region) with demographic, socio-economic, built environment, traffic attributes and roadway characteristics varying at the geographic-unit of analysis level. While microscopic level analysis is more focused on road infrastructure, the macroscopic analysis provides a broader spectrum for long-term policy-based measures such as enactments of traffic laws, police enforcement, education and area-wide road-design solutions

A large number of **journal papers** related to macroscopic road safety modelling exist. Literature review aims to identify and assess:

- Various **modelling techniques** used in previous studies. These techniques are classified into groups based on the purpose of the study and the number of road safety indicators used:
  - Times-series models, used mainly for forecasting purposes based on historical trends
  - Cross-sectional models, aiming to define road safety patterns by using various explanatory variables
  - Non-parametric approaches, permitting the use of a large number of indicators in relation to the sample size
- The **road safety indicators** found significant in cross-country or cross-region analyses
- The **transferability of the models** among countries or regions with different background (e.g. motorization level, economic status, policy framework etc.).

Conclusions

Quantitative road safety models are a valuable tool for more effective measures, interventions and policies, aiming to reduce the number of fatalities and injuries in road traffic crashes.

Microscopic and macroscopic models complement each other according to the nature of the examined road safety polices and decision support tools based on both types of models should be available in the arsenal of transport decision makers.

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