ICTR 2023

HIT- HELLENIC INSTITUTE OF TRANSPORT

HELLENIC INSTITUTE OF TRANSPORTATION ENGINEERS

11th INTERNATIONAL CONGRESS on TRANSPORTATION RESEARCH

Clean and Accessible to All Multimodal Transport

Heraklion, Crete, September 20th - 22nd 2023

Implementing traffic simulation for road safety assessment: A systematic literature review

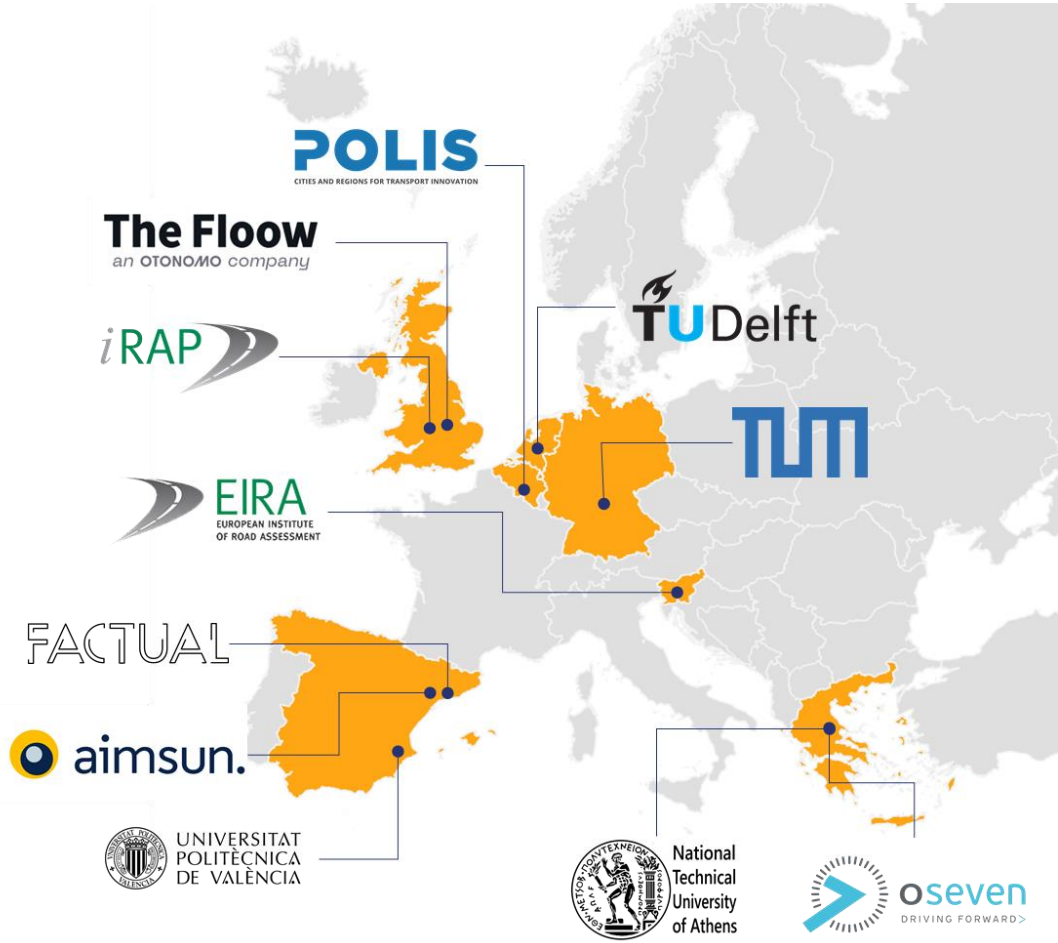
Apostolos Ziakopoulos

Transportation Engineer, PhD

Together with:
Maria Oikonomou and George Yannis

The PHOEBE project

- 11 Project partners:
  - EIRA (SI), NTUA (EL), TUD (NL), TUM (DE), AIMSUN (ES), POLIS (BE), FACTUAL (ES), UPV (ES), Oseven (EL), The Floow (UK), iRAP (UK)
- Duration of the project:
  - 45 months (November 2022 – July 2026)
- Framework Program:
  - Horizon Europe - The EU Union Framework Programme for Research and Innovation



Horizon Europe

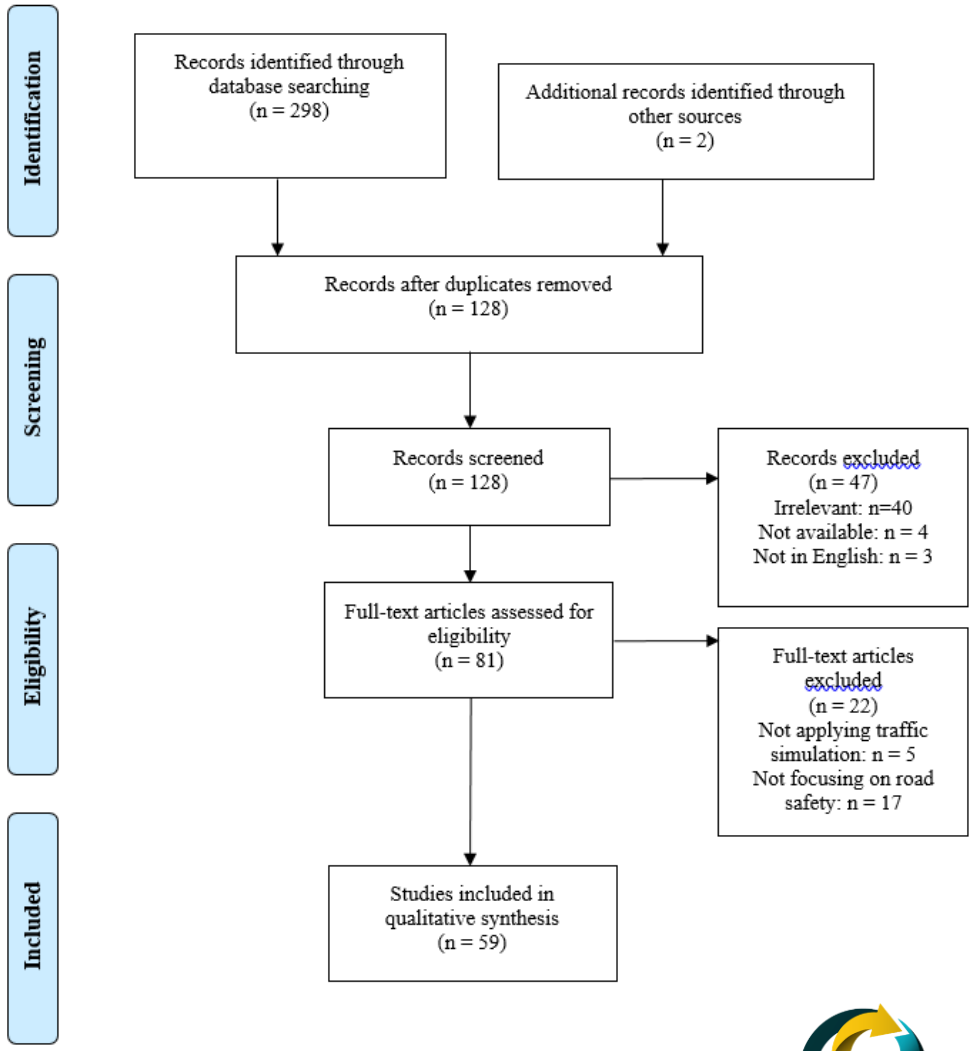
ICTR 2023

Introduction

- Traffic simulation analysis have gained significant traction in transportation engineering, providing valuable insights into complex transportation dynamics.
- Microscopic simulation refers to the modeling and analysis of individual vehicles and their interactions within a traffic system.
- Employing microscopic simulation offers the ability to simulate high-risk locations and complex traffic scenarios without the need for real-world crash data is particularly beneficial.

Systematic Review Methodology

- The systematic review method was performed based on the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) standard.
- The search terms "road safety assessments" OR "road assessments" OR "safety assessments") AND "traffic simulation" were applied to the Scopus electronic database.
- The search provided a total number of 126 records. Of these, 47 records were excluded after reviewing both titles and abstracts and 22 records after reviewing the full-text, resulting in 59 papers in total.



Safety assessment methods (1/2)

- The most common technique identified is the conflict-based approach using microsimulation that enable transportation engineers to investigate high-risk locations without the need of field crash data.
- Regarding particular infrastructure elements, microsimulation models found to become increasingly composite to reflect the element or environment under consideration.
- Some studies used microsimulation approaches tailored to specific countries or road types, considering local traffic behaviors, infrastructure, and regulations for more accurate safety evaluations.

Safety assessment methods (2/2)

- The traffic microsimulation applied to urban areas to assess road safety in densely populated and complex traffic environments, considering factors like mixed traffic modes and pedestrian interactions.
- Since there is lack of historical generalizable crash data in case of autonomous vehicles mobility, microscopic simulation method is considered as an ideal approach of studying their impacts on safety.
- The identification of the optimum geometric design through simulation is consider as ideal method of this kind of investigations due to the ability to test different configurations and evaluate safety.

Emerging data sources

- Using video data sources and following the corresponding video processing techniques, the identification of traffic conflicts is applicable as have been done in many studies aiming to validating conflicts extracted through traffic simulation.

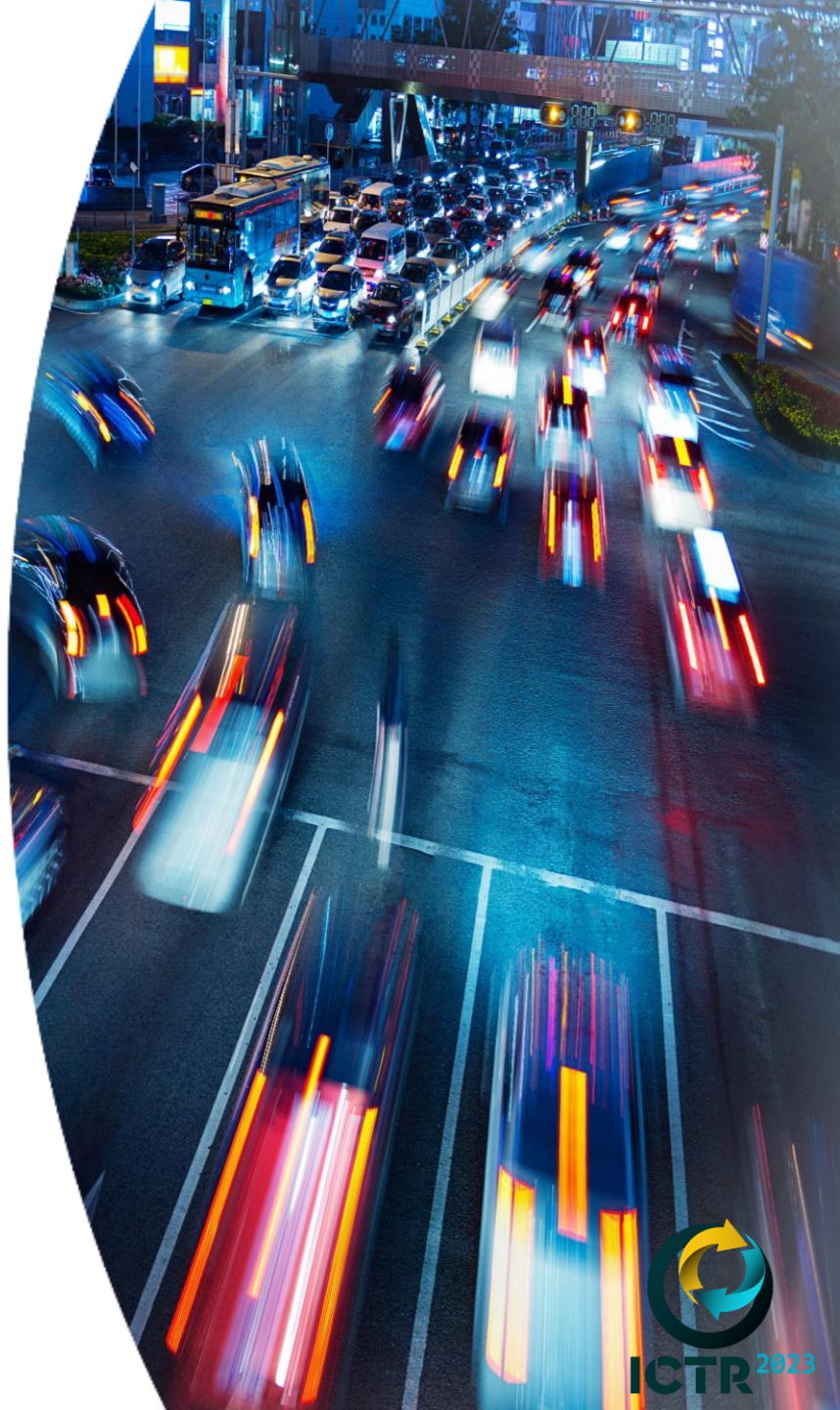
- Using highly disaggregated vehicle-based traffic data and exported conflicts from traffic microsimulation have been also used to real-time safety assessment.

Incorporating behaviour

- Researchers have developed nanoscopic driver agent-based behavior models that integrate driver intentions in real-time to create more realistic traffic simulations.
- Findings underscored the need to consider how emerging technologies can influence road safety, emphasizing the importance of keeping simulations up-to-date with evolving driving habits.
- While not directly addressing behavior, simulation can be employed to refine and fine-tune models that incorporate driver behavior data, ensuring that accurately represent real-world behavior.

Conclusions

- Various traffic simulation approaches have been widely used in transportation engineering not purely aiming to analyze complex transportation aspects in terms of traffic, as it is already known, but in terms of road safety as well.
- The trend of past research shows promising applications of traffic simulation in several pillars & approaches of improving road safety.
- Developers of traffic simulation software, practitioners and researchers can be supported in enhancing the existing microsimulation applications by enabling the acquisition of proactive and reactive surrogate safety measures.



ICTR 2023

HIT- HELLENIC INSTITUTE OF TRANSPORT

HELLENIC INSTITUTE OF TRANSPORTATION ENGINEERS

11th INTERNATIONAL CONGRESS on TRANSPORTATION RESEARCH

Clean and Accessible to All Multimodal Transport

Heraklion, Crete, September 20th - 22nd 2023

Implementing traffic simulation for road safety assessment: A systematic literature review

Apostolos Ziakopoulos

Transportation Engineer, PhD

Together with:
Maria Oikonomou and George Yannis