Optimizing driver behavior for safe, green and energy efficient mobility - OptiMo

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Artificial Intelligence for Road Safety and Mobility Workshop

8th UN Global Road Safety Week

Athens, 15 May 2025

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The OptiMo project

- **OptiMo partners**:
  - **Department of Transportation Planning and Engineering**
    National Technical University of Athens
    transport.ntua.gr/
  - **Institute of Structural Analysis and Antiseismic Research**
    National Technical University of Athens
    isaar.civil.ntua.gr/
- **Duration of the project**:

  23 months (Feb 2024 – Dec 2025)
- **Framework Program**:

  Basic Research Financing (Horizontal support for all Sciences), National Recovery and Resilience Plan (Greece 2.0)

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H.F.R.I. Hellenic Foundation for Research & Innovation

Greece 2.0 NATIONAL RECOVERY AND RESILIENCE PLAN

Funded by the European Union NextGenerationEU

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Background

- Rapid urban population growth and car use intensify challenges in urban mobility:
  - Traffic congestion
  - Road crashes
  - Air pollution
  - Energy overconsumption
- These challenges must be addressed simultaneously to achieve sustainable urban mobility
- Driver behavior is a key factor in improving road safety, reducing fuel consumption, and lowering car emissions
- Driver behavior optimization becomes urgent towards achieving the objectives defined in the EU \Green Deal and the Vision Zero targets
- Leveraging and integrating advanced technologies and smart systems is essential for sustainable mobility within the framework of the smart city

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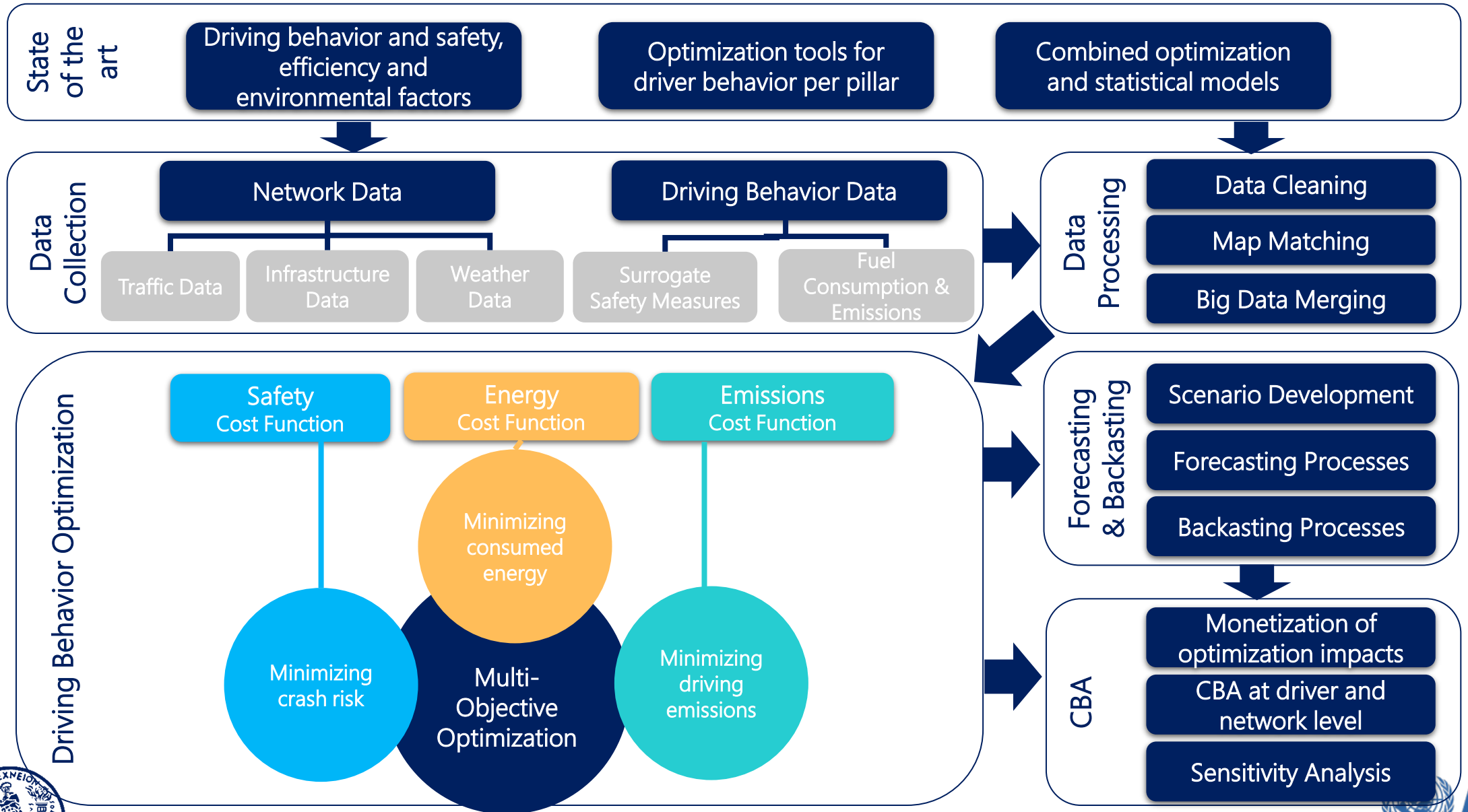
Objectives

Driver behavior optimization for combined …

… Mobility

- Meaningfully **merging the three transport pillars** of traffic safety, energy efficiency and environment, with common metrics and reference frameworks
- Achieve driver behavior optimization **without jeopardizing network traffic efficiency**
- Explore the exact **sensitivity and dose-response** of the impact of behavioral change to the critical pillars especially on the dynamic entirety of smart city transport networks

Methodological Approach



Data Collection

The data collection and processing conducted within the road network of Attika Region for the periods Mar-May 2022-2024

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Driving Behavior Data

- **Parameters:** GPS points, speed metrics, SSMs, fuel consumption, CO_2 emissions
- **Sample**: 120 M driving seconds → 122,055 trips

Road Infrastructure Data

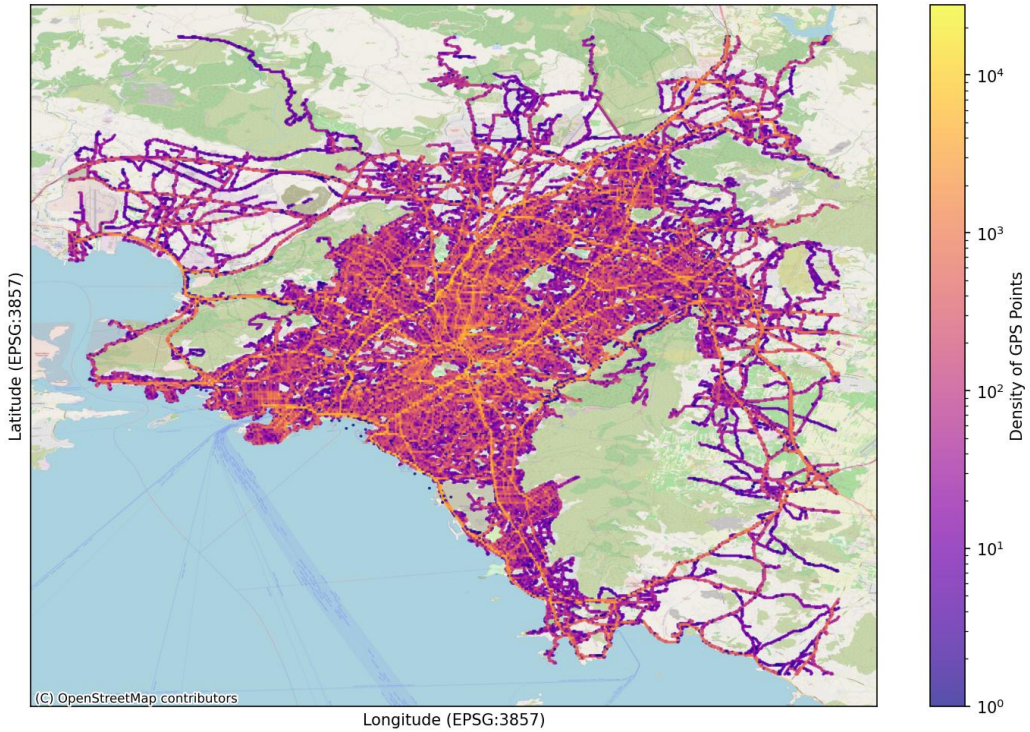
- **Parameters:** road type, junction type, segment length, elevation, slope
- **Sample**: 34,889 road segments
- Residential [50%], Tertiary [22%], Secondary [14%], Primary [8%], Motorway [1.6%], Trunk [1.4%]/ Mean slope=2%

Traffic Data

- **Parameters:** traffic speed, traffic volume
- **Sample**: 62 Road axes (Google)/ 389 traffic loops (TMC)

Weather Data

- **Parameters:** rain, day/night, temperature, cloud coverage, humidity
- **Sample**: hourly measurements for the examined period



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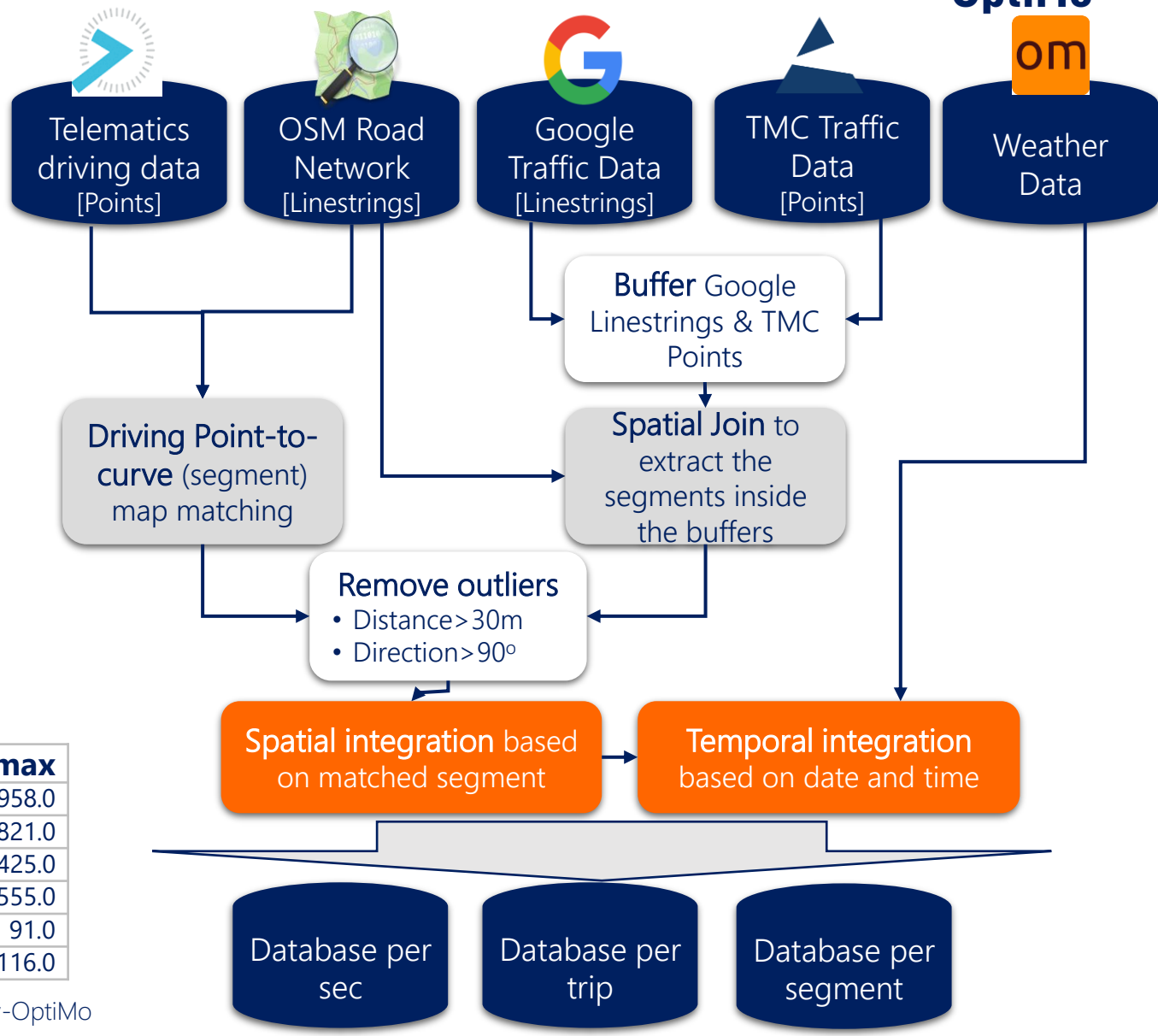
Data Fusion Architecture

- The spatial and temporal integration of multisourced data is essential for:
  - Analyzing and optimizing driver behavior across both individual trips and network-wide segments
  - Maintaining traffic flow efficiency
- **Map Matching**: Assign telematics points to OSM segments using point-to-curve methodology
- **Spatial Join**: Link traffic data to matched segments using buffered zones around traffic measurement locations
- **Outlier Removal**: Filter mismatches based on the spatial proximity between driving points and assigned segments, as well as alignment in travel direction
- **Temporal Merge**: Align data streams based on timestamp

	mean	min	75%	max
Driving seconds per segment	743.4	1.0	478.0	139,958.0
Unique TripIds per segment	52.3	1.0	56.0	1,821.0
Speeding Events per segment	40.0	0.0	1.0	14,425.0
Mobile Use Events per segment	39.3	0.0	24.0	5,555.0
Harsh Acceleration per segment	0.7	0.0	0.0	91.0
Harsh Braking per segment	1.0	0.0	0.0	116.0



Results

- An innovative driving behavior optimization framework combining safety, fuel efficiency, and environmental protection
- AI-based tools for analyzing and optimizing driver behavior at both individual and network levels
- The key driving and traffic factors that accelerate climate-neutral and energy-efficient mobility
- Cost-Benefit Analysis to quantify the economic feasibility of optimized driving
- Open-source models and data fusion protocols for wider research and city applications
- Policy recommendations for integrating optimized driving into sustainable mobility and road safety strategies

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- All road users will benefit, as OptiMo aims to reduce road crashes and environmental degradation by optimizing driving behavior
- Drivers will achieve direct economic savings, by minimizing fuel consumption
- Public authorities and policymakers will benefit with data-driven tools to integrate behavior optimization into strategies for Vision Zero and the EU Green Deal
- Evidence-based policy recommendations will drive EU and national/regional initiatives toward safer, greener, and more energy-efficient mobility ecosystems

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Scientific and Social Impact

Science

- An innovative optimization methodology integrating safety, energy efficiency, and environmental goals through unified metrics and frameworks
- Scalable AI tools for data fusion and smart mobility planning
- Open-source outcomes to advance research and applications

Society

- Reduction in road injuries and fatalities, energy consumption, and air pollution from road transport
- Improved quality of life for citizens

Economy

- Reduction of the socio-economic cost from fatal road crashes, fuel consumption, and emissions
- Fostering of new prototype products and startups aligned with OptiMo's objectives

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Future Challenges

- Balancing conflicting objectives (e.g., maximizing safety while minimizing travel time or energy use) in complex, real-world traffic environments
- Prioritization and weighting of multiple objectives according to different stakeholder needs
- Transferability of optimization models to cities and regions with different geographical, societal, and cultural characteristics
- Adaptation to emerging mobility trends, such as automated vehicles, micro-mobility, and shared transport systems
- Maintaining user engagement and behavioral change over time

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