MT-ITS 2025
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A Self-Supervised, Multitask Framework for Network-Wide Travel Time Prediction using Loop Detector Traffic Data

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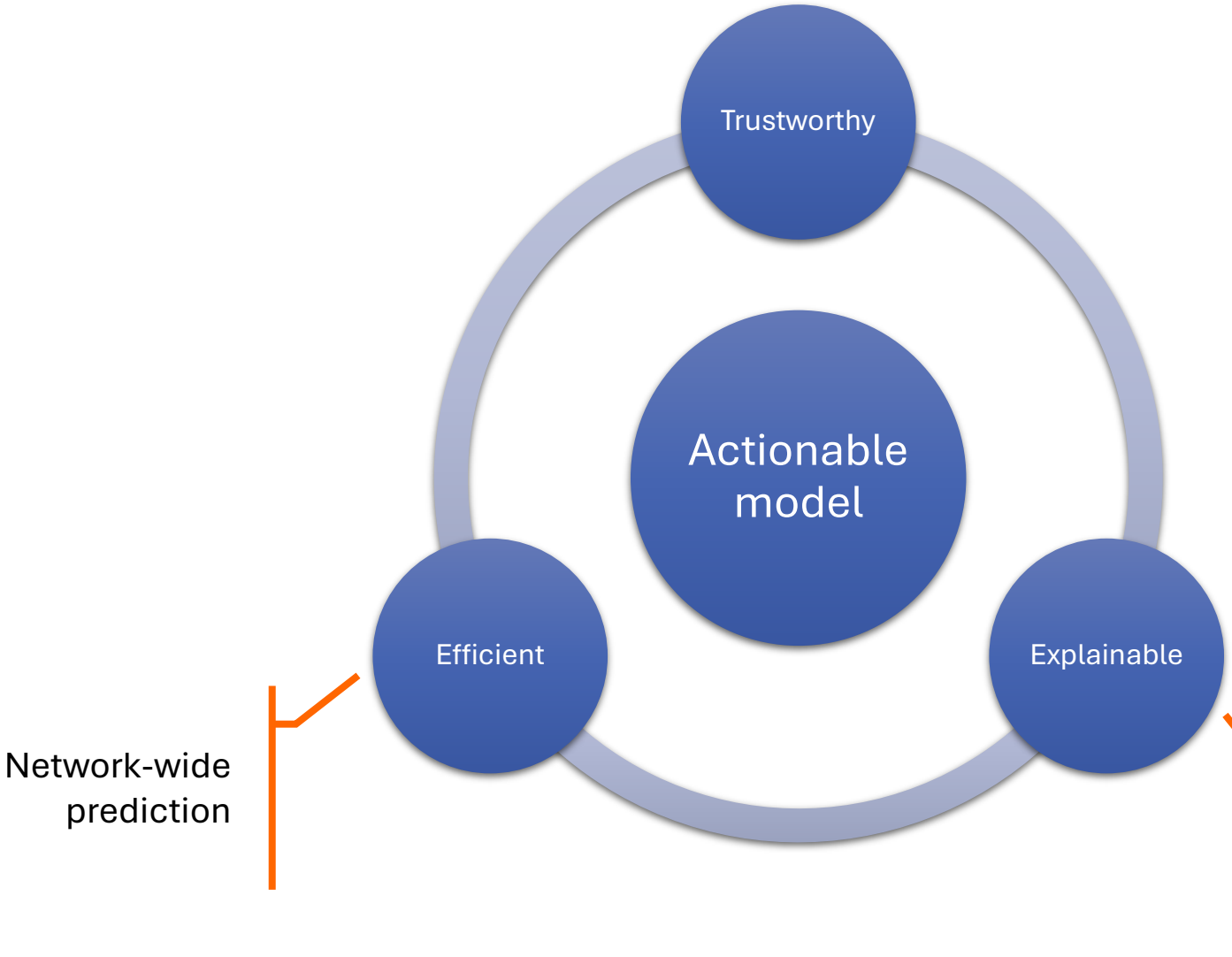
Background



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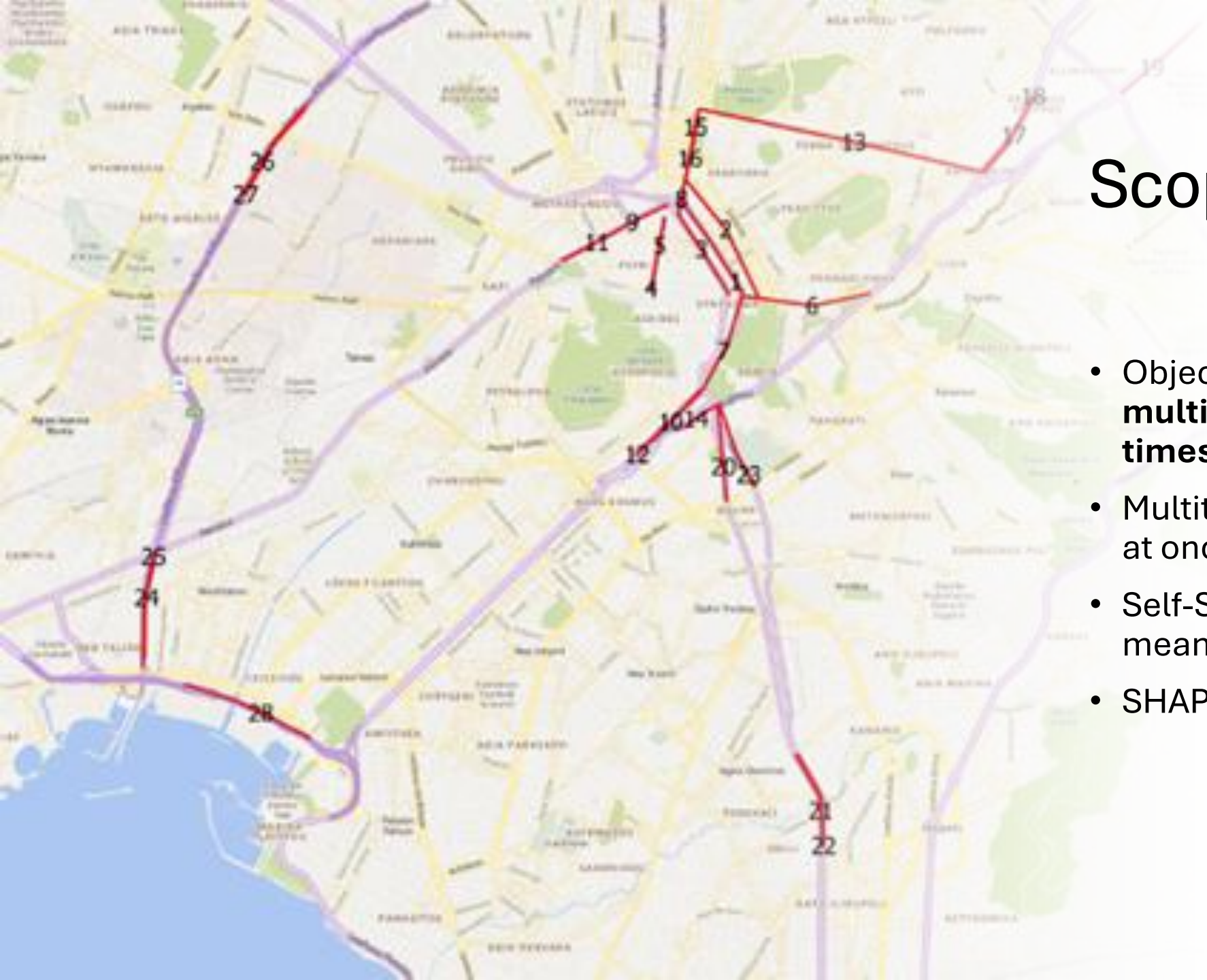
Deep Learning

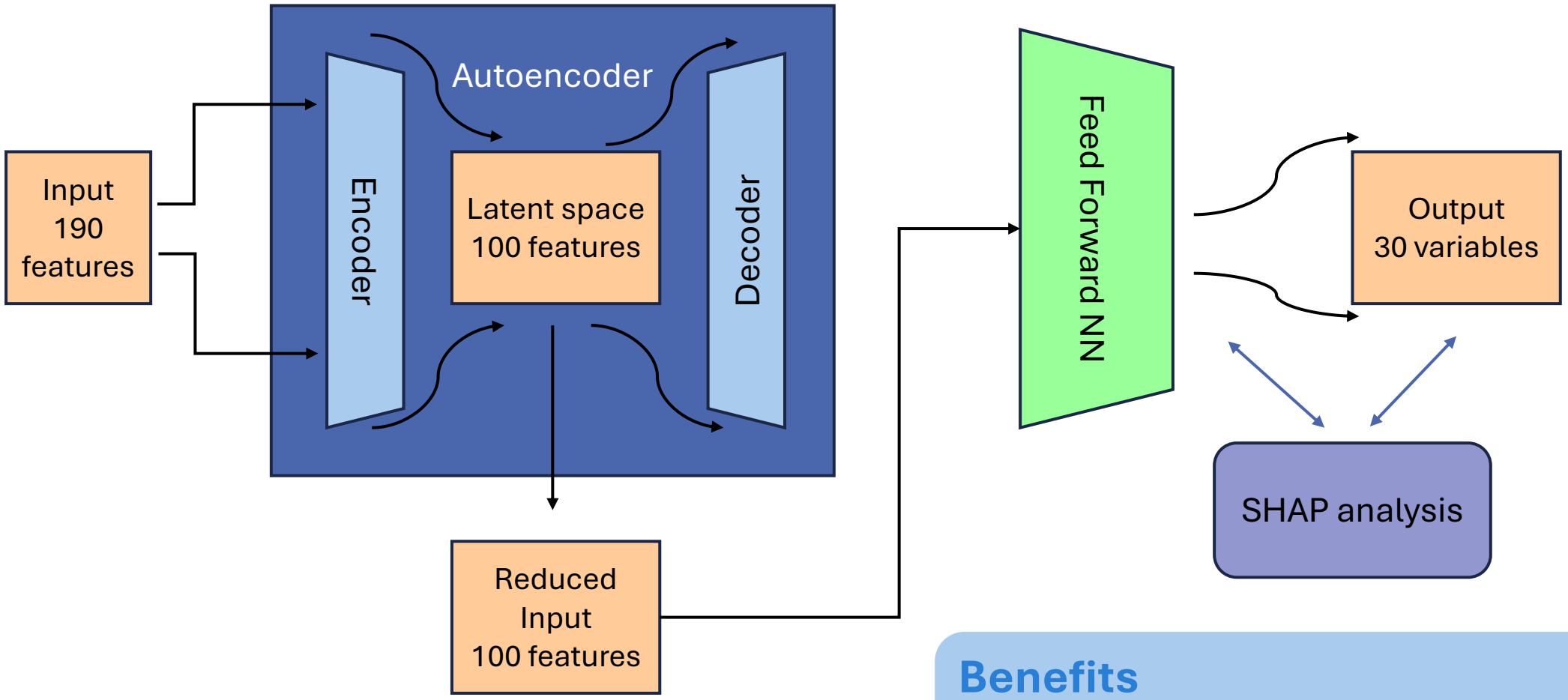
- "Black-box"
- Complex structure
- Computational requirements
- Data requirements



Scope

- Objective: **Single model – multivariate output (30 travel times in Athens)**
- Multitask: predict all variables at once
- Self-Supervised: more meaningful input space
- SHAP values explanations

Methodological approach



Benefits

- Learn complex, network-wide relations **Multitask**
- Automatic feature extraction **Self-Supervised**

Data

- Travel Times
  - Google Maps API
  - Peak hours (8-10am, 12-7pm)
  - June-December 2021
  - 4-5 min/km (city center), 2 min/km (highways)
- Traffic Volume
  - 190 loop detectors
  - Metropolitan area of Athens

Prediction results

Baselines

- Multi-output **NO autoencoder** model
- Single output **30** models
- Local information models
- Historical Average

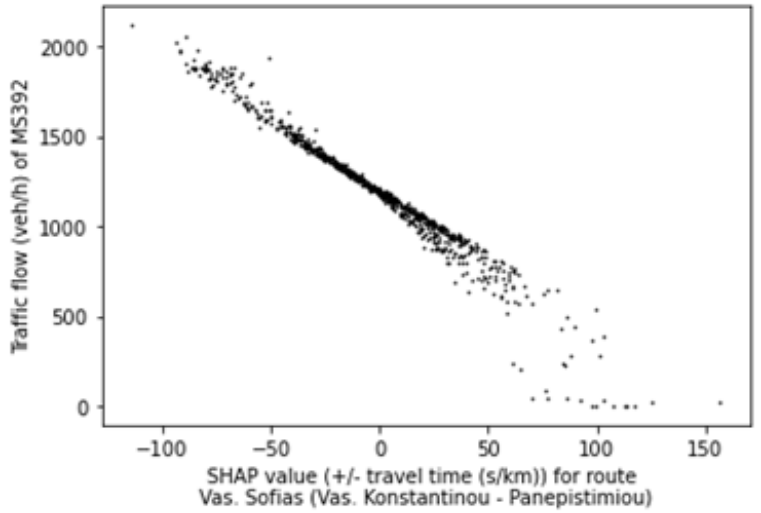
Models' MAPE

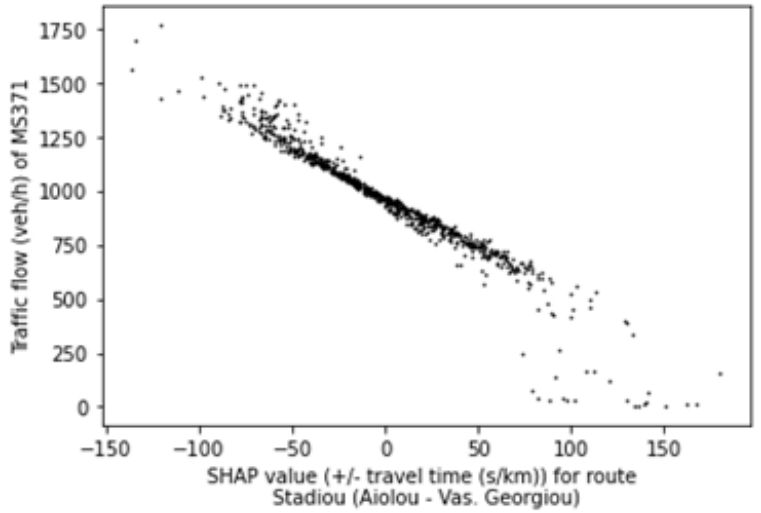
AE-FFN (ours)	FFN	30 Single output	Local info	HA
11.4%	12.9%	12.9%	18.3%	26.9%

SHAP analysis

Main outcomes

- Congestion (low flow) → High SHAP values
- Routes close to city center: Higher SHAP in general
- Traffic volume – Travel time (SHAP) relation: Almost linear
- High SHAP values for distant locations





Conclusions

Multitask Self Supervised framework → Improved performance

- Autoencoder → more accurate compared to raw input
- Multitask → better than single-task, simpler models
- Network-wide input data → better than local information (existence of complex relationships)

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Thank you!

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