



Deployment of charging infrastructure toward large-scale vehicle electrification

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MIT Mobility Initiative Vision Day

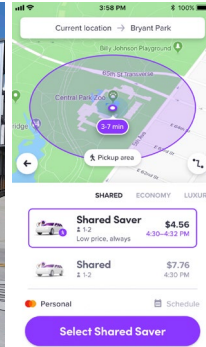
10/25/2024

A research agenda in large-scale optimization to promote efficient, reliable and sustainable mobility

Air traffic management



Demand-responsive transit



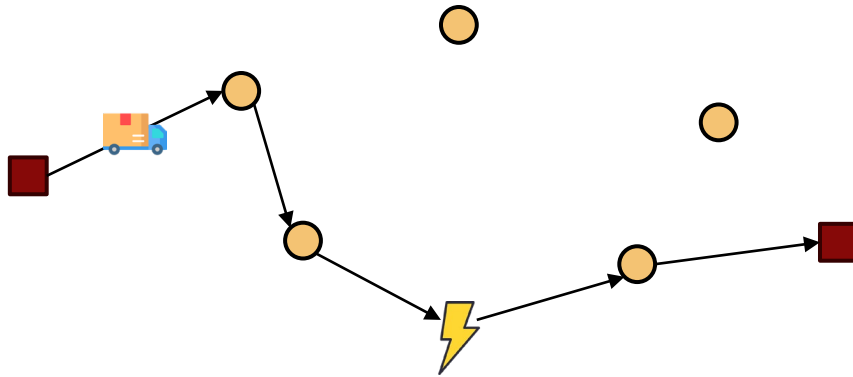
Transportation decarbonization



Transportation for social good



Routing & charging optimization can significantly improve performance in centralized logistics fleets



5-8%

**Reduction in operating costs
vs. routing-then-charge solutions**

10-25%

**Reduction in charging costs
vs. no-charging-cost solution**



Benefits from large-scale optimization algorithms to support emerging vehicle technologies toward sustainable logistics

Mass urban electrification raises new technical and planning challenges for infrastructure planning

WIRED

January 24, 2022

Wait, so where will urbanites charge their EVs?



AXIOS

February 08, 2023

Cities race to add EV charging stations

The Washington Post

March 14, 2023

\$2.5B in grants for EV chargers aim at underserved areas

How to deploy an efficient, reliable and equitable charging network: number, locations, size and technology of EV chargers in cities?

Phase 1: We developed a computer vision methodology to identify feasible locations for EV chargers

1. Google Street View data to identify patterns in urban landscape
2. Active learning to label feasible vs. infeasible charging locations
3. Machine learning and computer vision to detect feasible vs. infeasible charging locations, and extrapolate findings



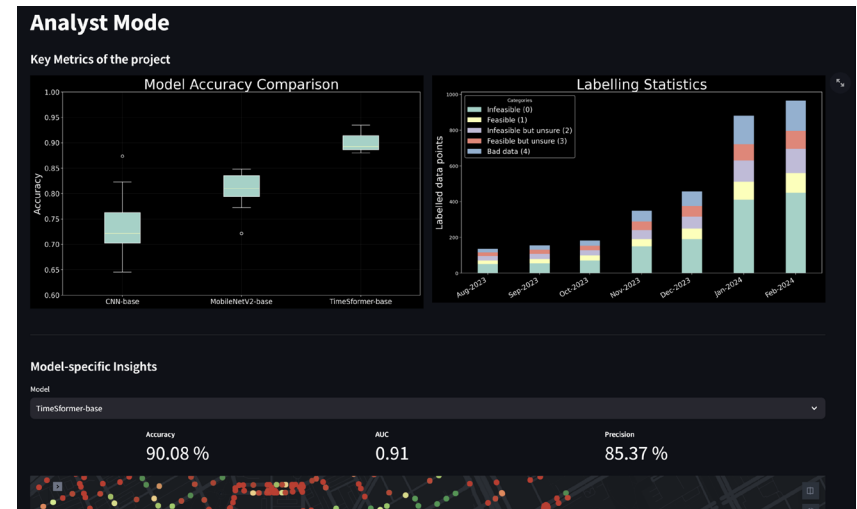
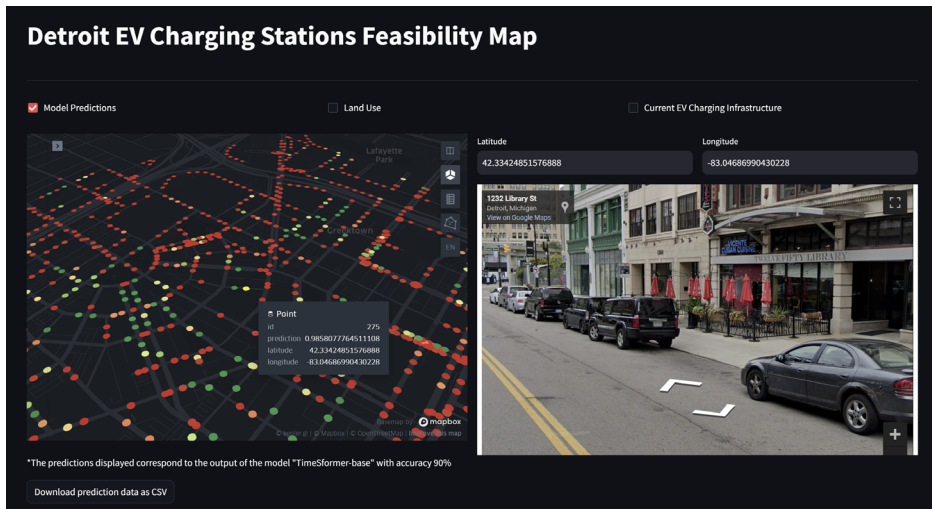
Phase 1: The computer vision methodology achieves strong out-of-sample performance at a large scale

90% Accuracy

0.91 AUC

100+ Models Trained

100k Datapoints

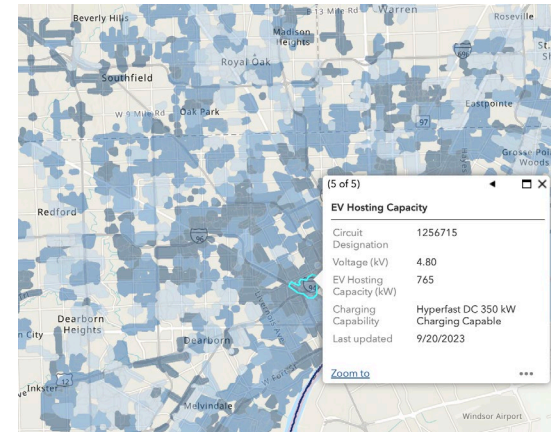


Interactive visualization to explore the map and data-driven results

<https://detroit-ev-feasibility-mit.streamlit.app/>

Phase 2: We have developed optimization models to support the deployment of EV charging networks

- Optimization of the location of charging sites in an urban area
 1. Map of the city with feasible EV charging sites (Phase 1)
 2. Trip-based travel demand in a metropolitan area



Tailored, differentiated charging networks based on spatial-temporal patterns: number, location, size and technology of charging stations

Phase 2: Optimization algorithms can support the deployment of hybrid charging networks

Dense network of smaller stations with Level 2 chargers?

Concentrated network of larger stations with DC fast chargers?



Hybrid solution for best of both worlds



10–20%

Benefits of hybrid network vs. one-size-fits-all technology

20–30%

Benefits of optimization vs. demography-based solution

Benefits of integrated and granular optimization of EV charging networks versus simpler easily-accessible benchmarks



Thank you!