NREL
Transforming ENERGY

Count Every Trip: finding the uncertainty in energy estimates made from inferred travel modes

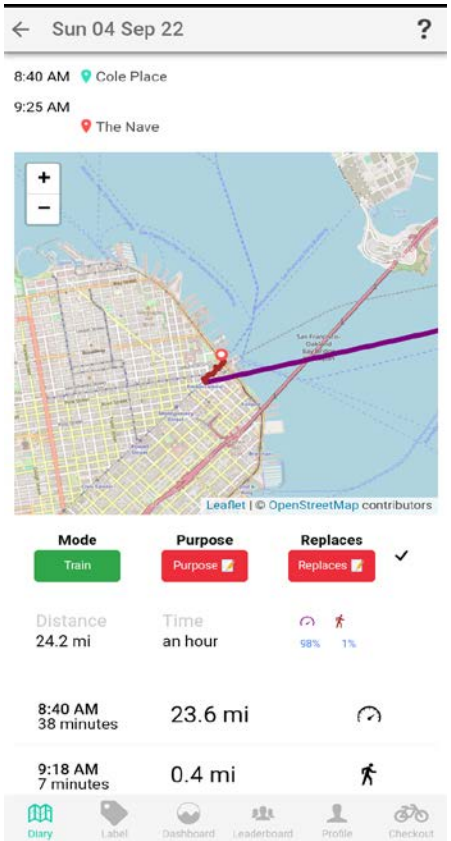
Michael Allen and K. Shankari

TRB Innovations in Travel Analysis and Planning
June 4-6, 2023

Photo from iStock-627281636

Smartphone travel diaries

- Smartphones can collect travel diaries
- Participants get tired of labeling trips
  - Only 38% (94k) of OpenPATH trips labeled
- Lots of unused information (146,000 trips)
- What if we try to use that information for decisions?



Screenshot from CanBikeCO app

Accounting for uncertainty

- Energy = Energy Intensity * Travel Length
- Need uncertainty in both inputs
- Accuracy not enough
- Used ground truth smartphone travel data set (MobilityNet (Shankari et al, 2020))
- Energy Intensity/Mode uncertainty – confusion matrix
  - Can find for any mode classification algorithm
- Length uncertainty – relative length error

Accounting for uncertainty

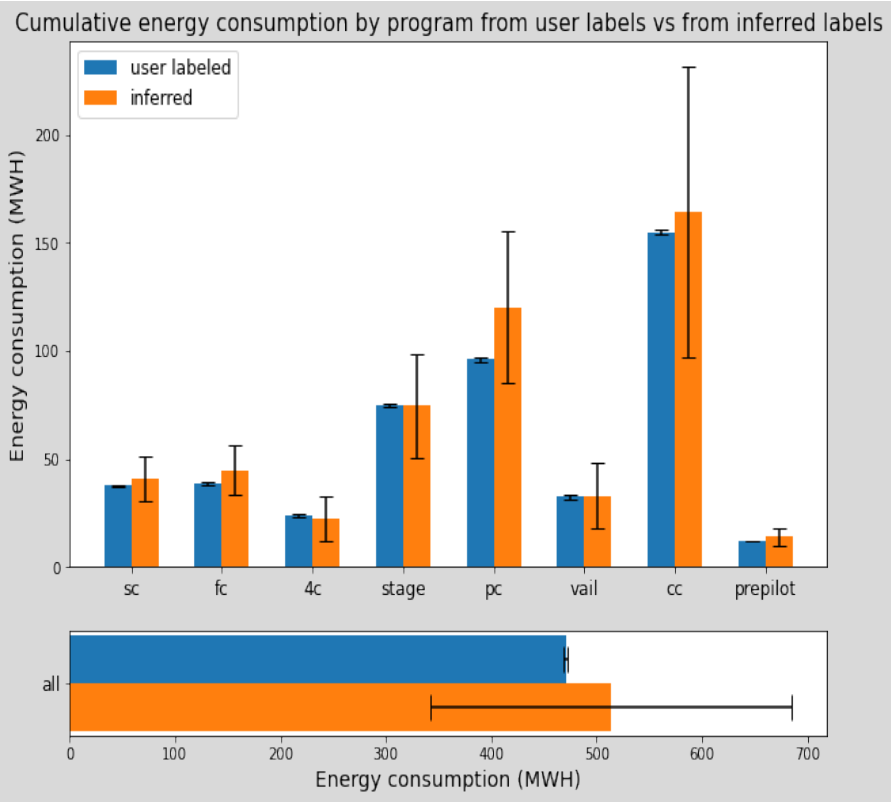
- Mode: confusion matrix
  - Given predicted mode
  - Mean and variance of energy intensity
- Length: relative length error
  - Given measured length
  - Mean and variance of actual length
- Combine with variance propagation

		Predicted Mode			
		Car	Ebike	Bike	Walk
Actual Mode	Car	0.7	0.2	0.1	0
	Ebike	0.2	0.5	0.3	0.1
	Bike	0.1	0.2	0.4	0.1
	Walk	0	0.1	0.2	0.8

Example confusion matrix
More modes were present in actual study

Results and multimodal equity

- Benchmark on CanBikeCO
  - 9.17% error
  - 85.5% within 2 sd
- Less labeling burden
- Local travel understanding
- Behavior models - better representation in travel demand forecasting



References

1. K. Shankari, J. Fuerst, M. F. Argerich, E. Avramidis, and J. Zhang. MOBILITYNET: TOWARDS A PUBLIC DATASET FOR MULTI- MODAL MOBILITY RESEARCH. ICLR 2020 Workshop on Tackling Climate Change with Machine Learning, page 6, 2020.

Stop by for questions!

www.nrel.gov

NREL/PR-5400-86201

This work was authored by the National Renewable Energy Laboratory, operated by Alliance for Sustainable Energy, LLC, for the U.S. Department of Energy (DOE) under Contract No. DE-AC36-08GO28308. This work was supported in part by the U.S. Department of Energy, Office of Science, Office of Workforce Development for Teachers and Scientists (WDTS) under the Science Undergraduate Laboratory Internships Program (SULI). This material is also based upon work supported by the DOE Office of Energy Efficiency and Renewable Energy Vehicle Technologies Office, as part of the Energy Efficient Mobility Systems program's Core Tools activity area.

NREL
Transforming ENERGY