Using Computer Vision on Crowdsourced Streetview Data to Register Safety Performance Indicators for Motorcyclists

Background – Motorcycle helmet use

- Motorcycle helmets can lower the risk of fatal injuries of riders by 42% and reduce the risk of injury by 69% in case of a crash
- In high-income countries, helmet use on motorcycles is close to 100%

  France: 98%

  Denmark: 98%

  Germany: 99%

- But what about LMIC countries?
  - Where motorcycles are the main mode of transportation?

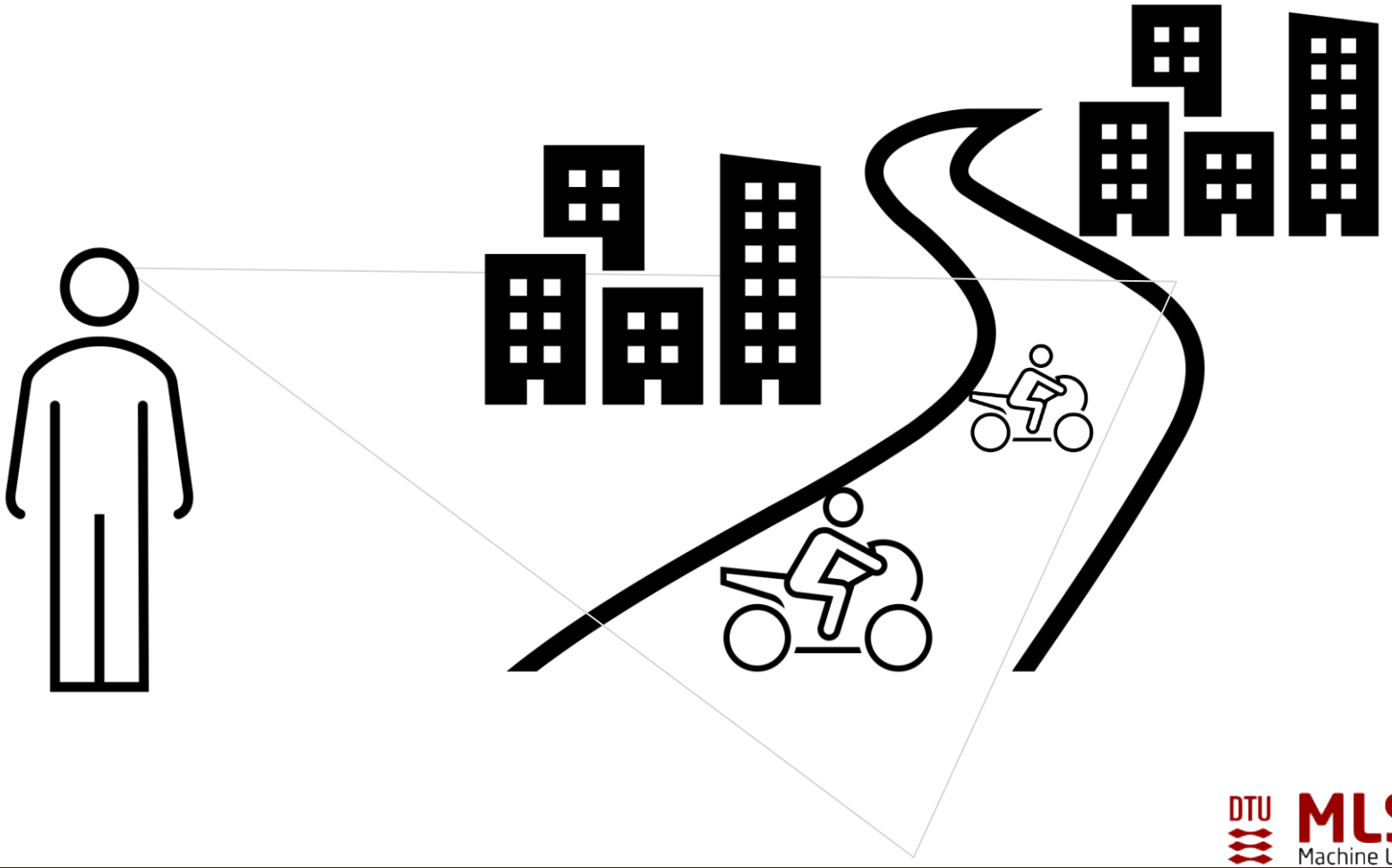
Liu, B. C., Ivers, R., Norton, R., Boufous, S., Blows, S., & Lo, S. K. (2008). Helmets for preventing injury in motorcycle riders. *Cochrane Database of Systematic Reviews*, 1.

World Health Organization (2018). Global status report on road safety 2018. World Health Organization.

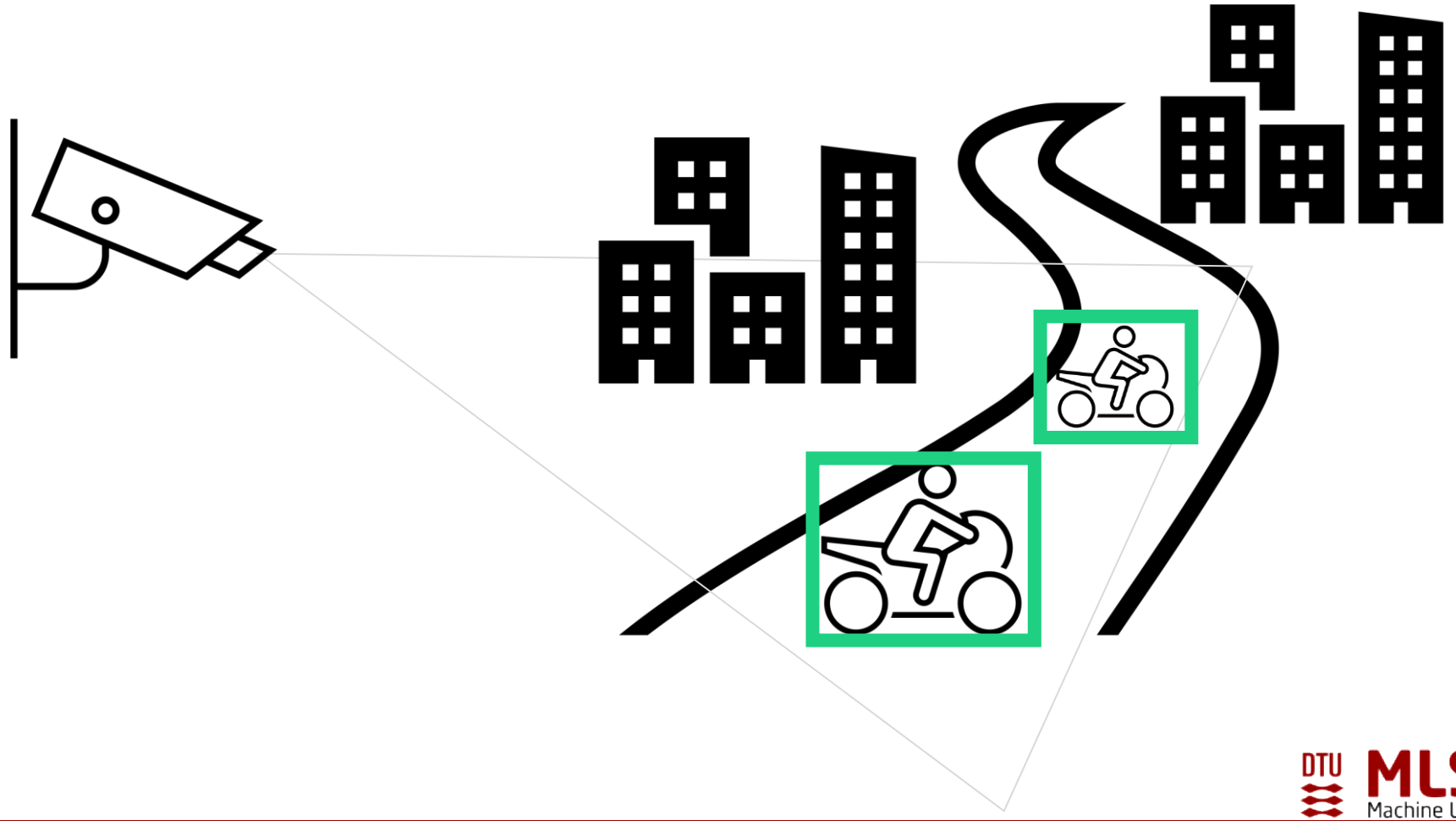
Some previous work

- Previous research in Myanmar and Nepal
  - Nepal hand counted.

Human counted

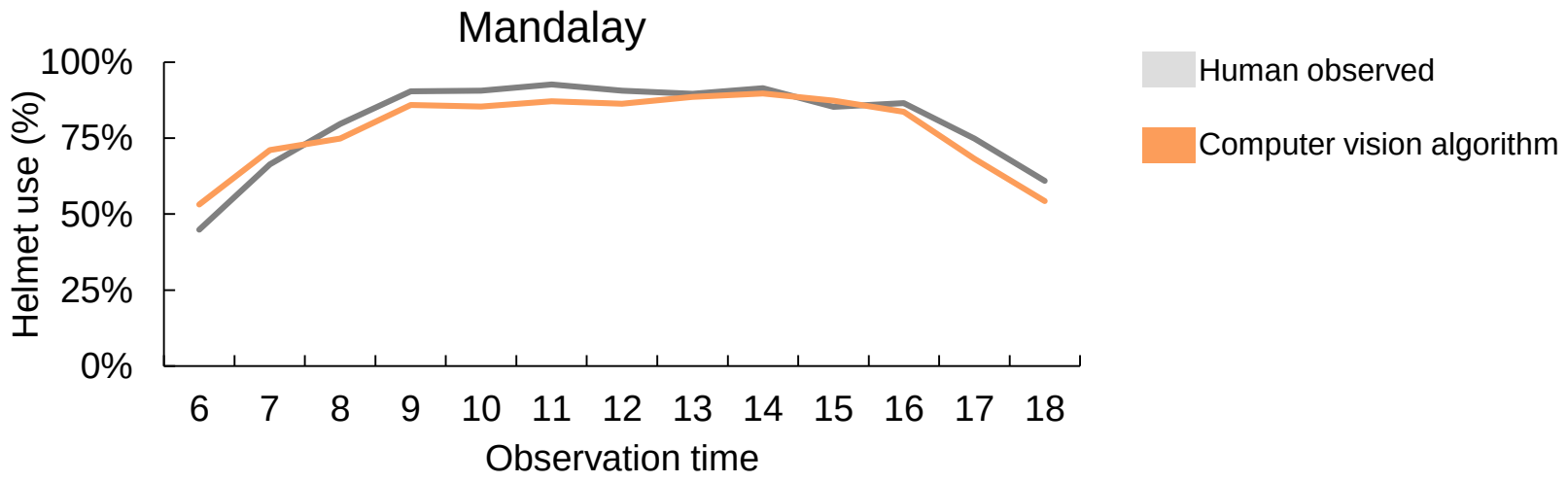


Computer vision counted



Some previous work

- Previous research in Myanmar and Nepal
  - Nepal hand counted.
  - Myanmar computer vision



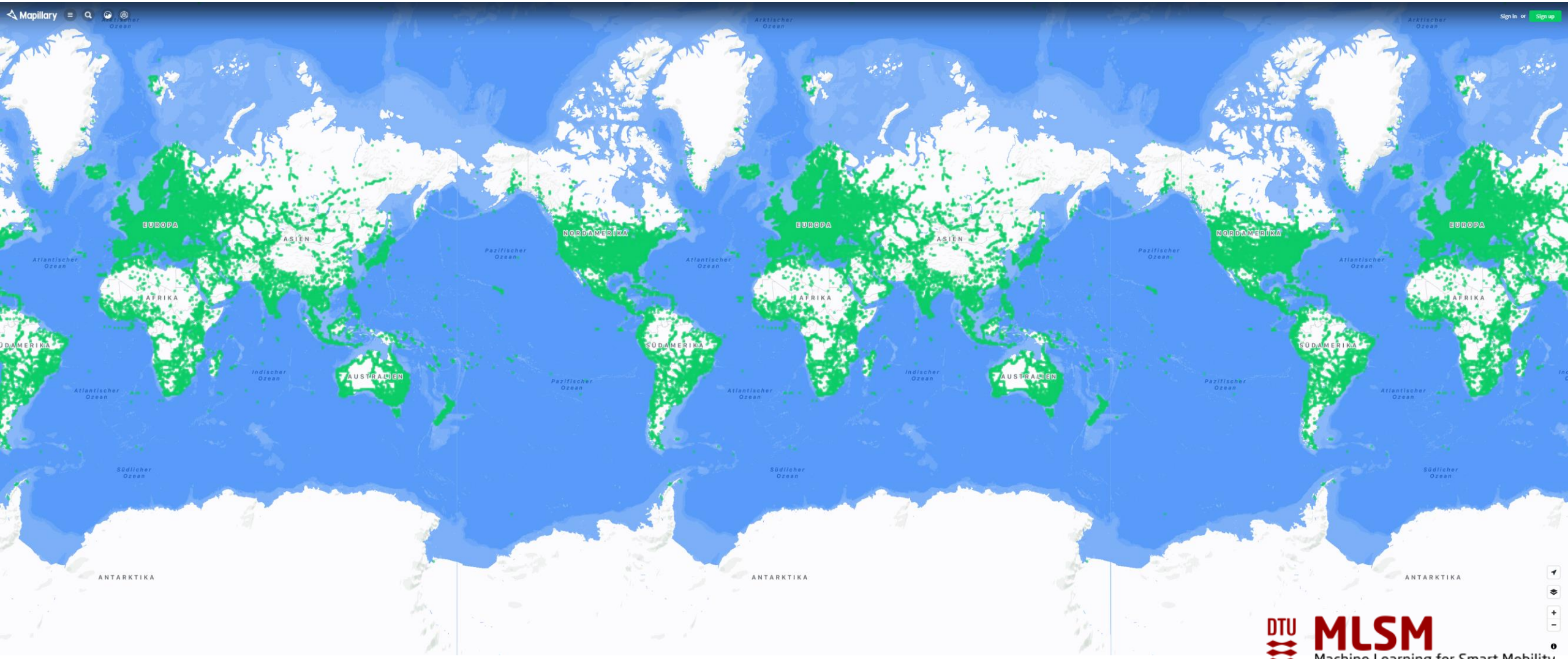
Siebert, F. W., & Lin, H. (2020). Detecting motorcycle helmet use with deep learning. Accident Analysis & Prevention, 134, 105319.

Lin, H., Chen, G., & Siebert, F. W. (2021, September). Positional Encoding: Improving Class-Imbalanced Motorcycle Helmet use Classification. In 2021 IEEE International Conference on Image Processing (ICIP) (pp. 1192-1198). IEEE.

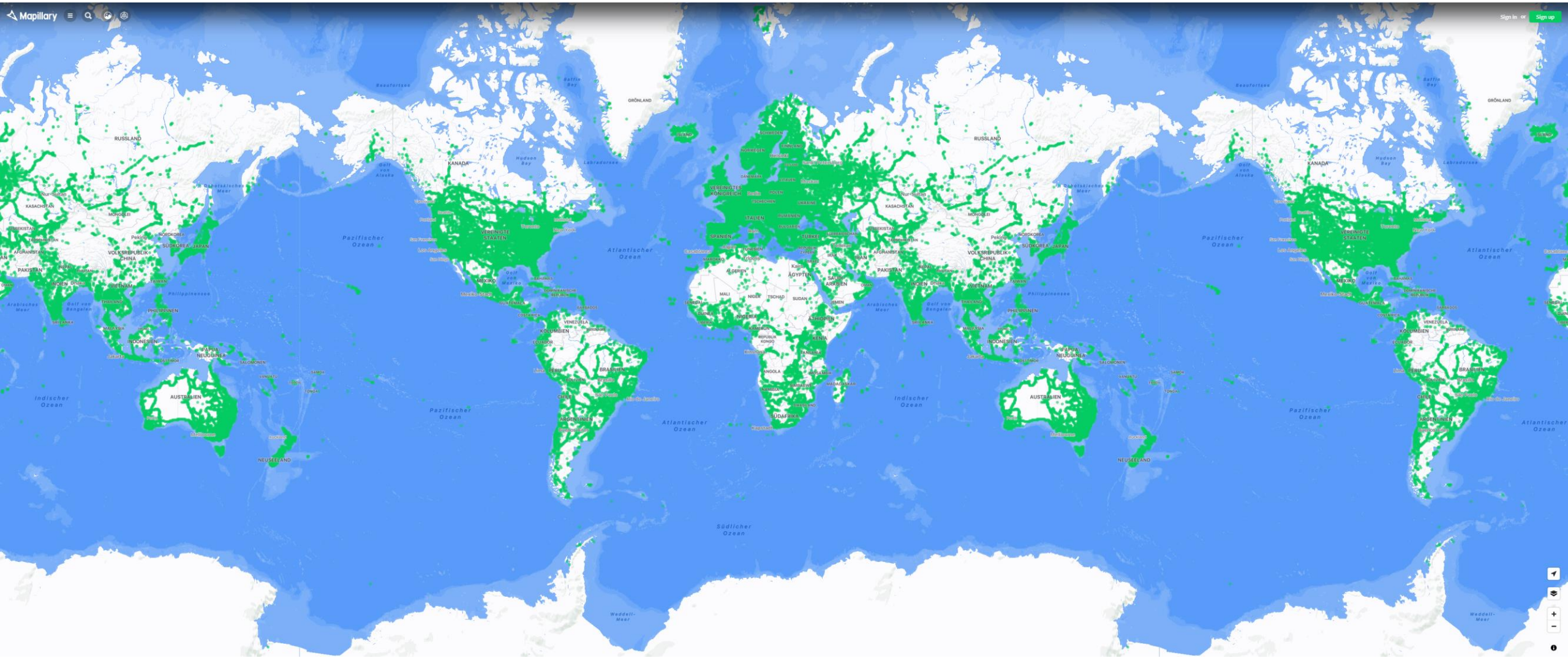
Lin, H., Deng, J. D., Albers, D., & Siebert, F. W. (2020). Helmet use detection of tracked motorcycles using cnn-based multi-task learning. IEEE Access, 8, 162073-162084.

Results from Myanmar

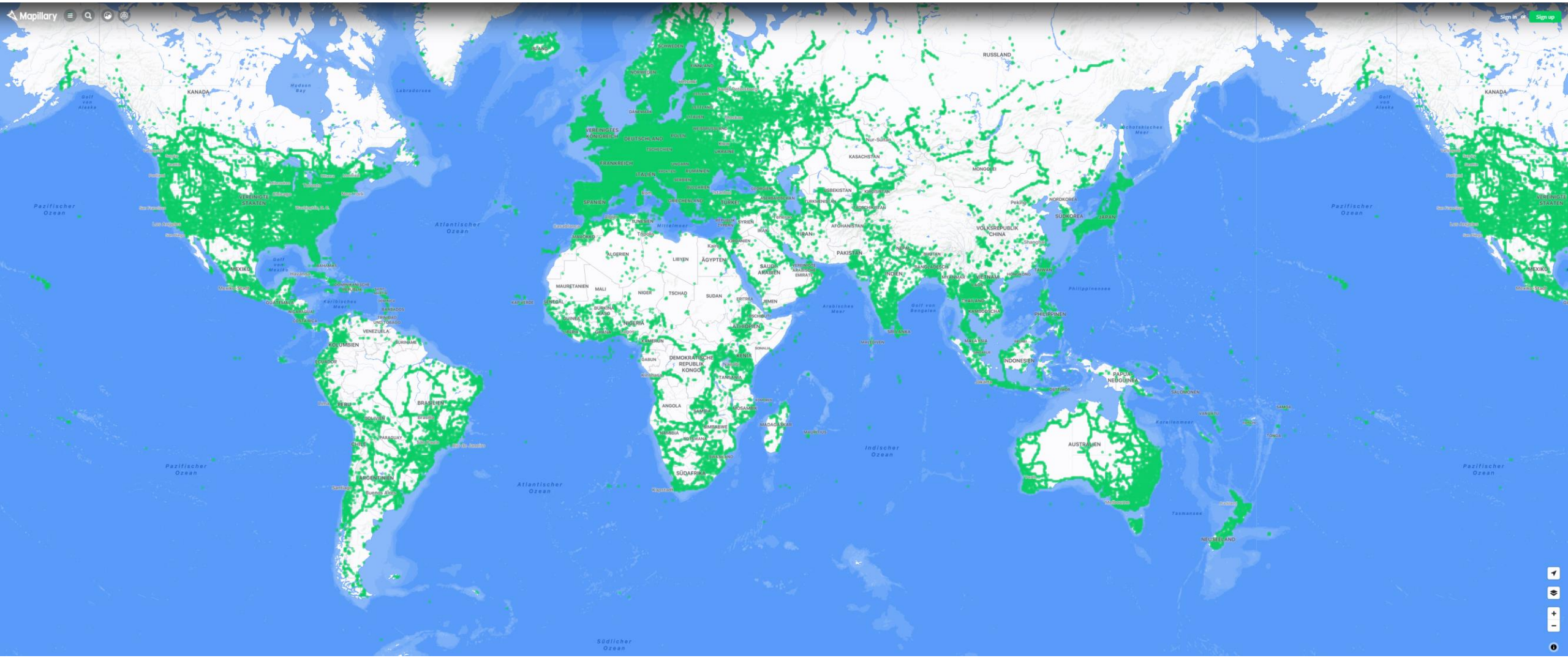
But the world is big…

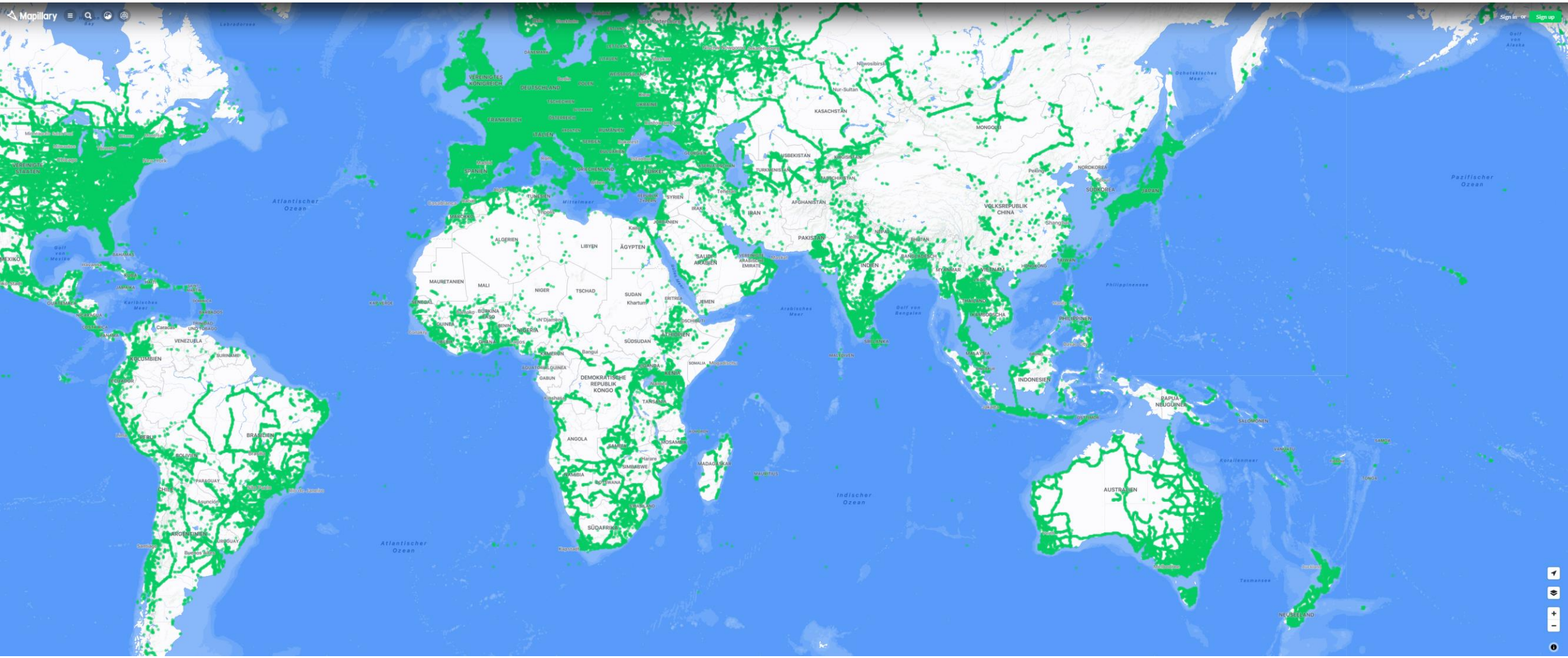


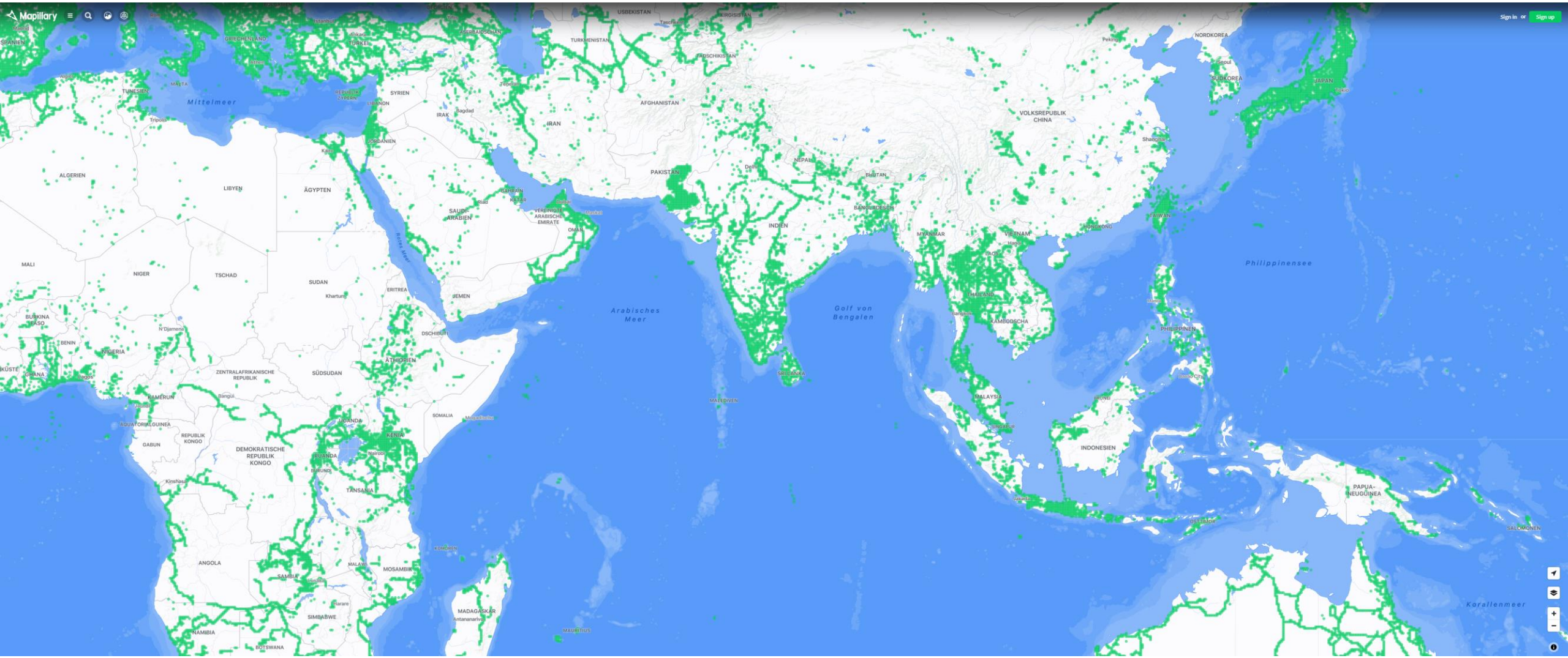
DTU MLSM
Machine Learning for Smart Mobility



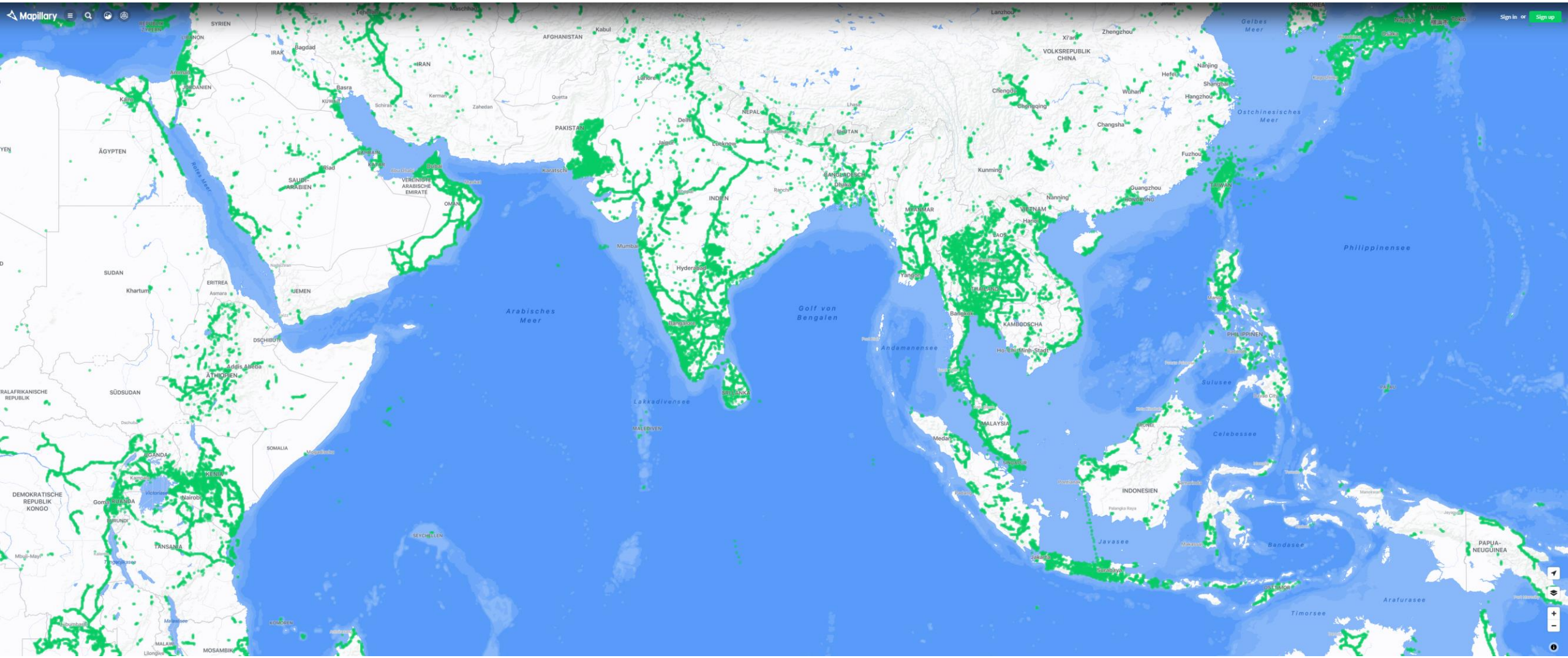
DTU MLSM
Machine Learning for Smart Mobility


Mapillary
Sign in
Sign up
KANADA
VEREINIGTE STAATEN
MEXIKO
BRASILIEN
KOLUMBIEN
PERU
CHILE
ARGENTINIEN
VENEZUELA
PARAGUAY
VEREINIGTES KÖNIGREICH
DEUTSCHLAND
FRANKREICH
SPANIEN
ITALIEN
SCHWEDEN
NORWEGEN
FINNLAND
POLEN
UKRAINE
RUSSLAND
TÜRKEI
GRIECHENLAND
ALGERIEN
LIBYEN
ÄGYPTEN
MAURETANIEN
MALI
NIGER
TSCHAD
SUDAN
NIGERIA
ÄTHIOPIEN
KENIA
TANSANIA
DEMOKRATISCHE REPUBLIK KONGO
ANGOLA
NAMIBIA
BOTSWANA
SÜDAFRIKA
MADAGASKAR
SAUDI-ARABIEN
IRAN
IRAK
SYRIEN
JORDANIEN
AFGHANISTAN
PAKISTAN
INDIEN
KASACHSTAN
USBEKISTAN
MONGOLEI
VOLKSREPUBLIK CHINA
NORDKOREA
SÜDKOREA
JAPAN
INDONESIEN
PHILIPPINEN
VIETNAM
THAILAND
MALAYSIA
PAPUA-NEUGUINEA
AUSTRALIEN
NEUSEELAND
Pazifischer Ozean
Atlantischer Ozean
Indischer Ozean
Südlicher Ozean
Arabisches Meer
Golf von Bengalen
Golf von Mexiko
Golf von Alaska
Hudson Bay
Labradorsee
Tasmansee
Korallenmeer

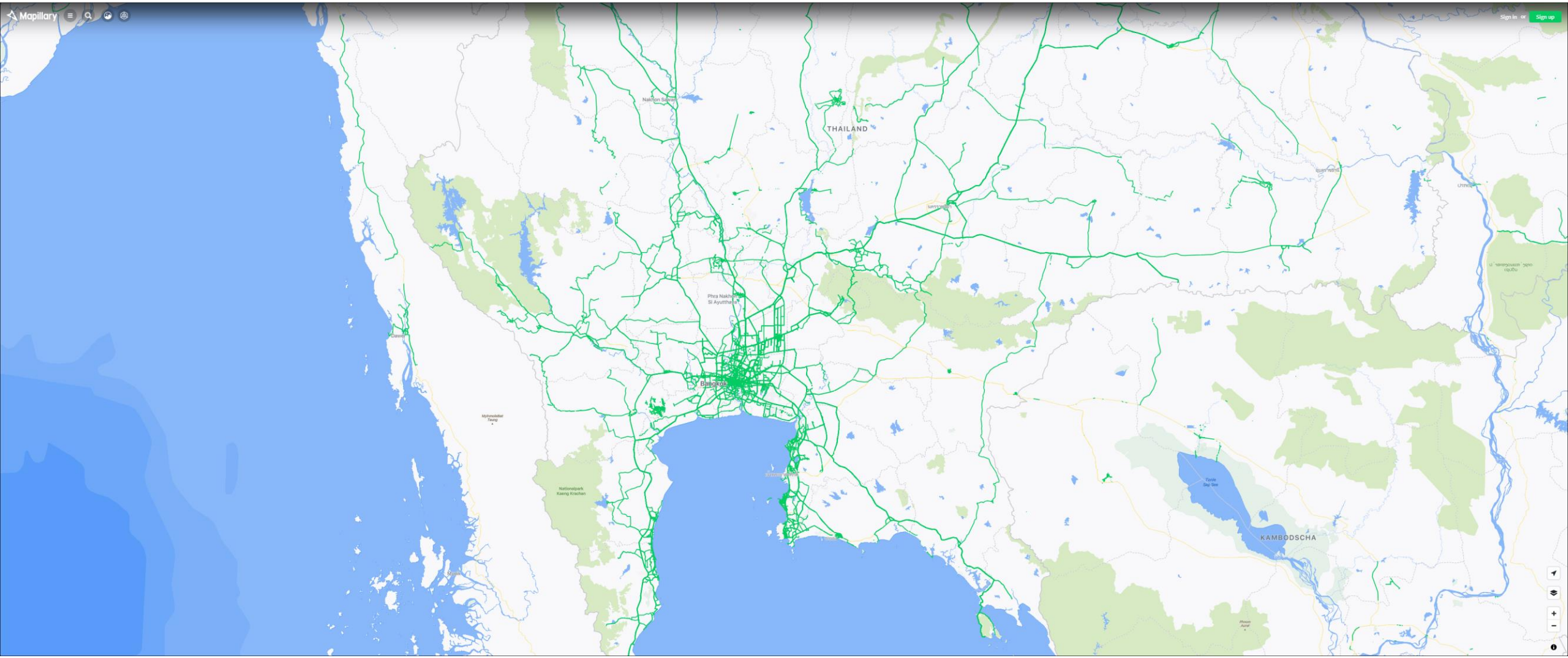

Mapillary
Sign in or
Sign up
Atlantischer Ozean
Pazifischer Ozean
Indischer Ozean
VEREINIGTES KÖNIGREICH
DEUTSCHLAND
FRANKREICH
SPANIEN
ITALIEN
TÜRKEI
KASACHSTAN
MONGOLEI
USBEKISTAN
AFGHANISTAN
IRAN
PAKISTAN
INDIEN
VOLKSREPUBLIK CHINA
NORDKOREA
SÜDKOREA
JAPAN
VIETNAM
MYANMAR
PHILIPPINEN
INDONESIEN
PAPUA NEUGUINEA
AUSTRALIEN
NEUSEELAND
SAUDI ARABIEN
JEMEN
ÄGYPTEN
LIBYEN
ALGERIEN
MAURETANIEN
MALI
NIGER
TSCHAD
SUDAN
ERITREA
ÄTHIOPIEN
SÜDSUDAN
NIGERIA
GHANA
KAMERUN
DEMOKRATISCHE REPUBLIK KONGO
KENIA
TANSANIA
ANGOLA
SAMBIA
SIMBABWE
NAMIBIA
BOTSWANA
SÜDAFRIKA
MADAGASKAR
MOSAMBIK
KOLUMBIEN
VENEZUELA
BRASILIEN
PERU
BOLIVIEN
CHILE
ARGENTINIEN
URUGUAY
MEXIKO
GUATEMALA
KUBA
HAITI
JAMAICA
VEREINIGTE STAATEN
Arabisches Meer
Golf von Bengalen
Philippinensee
Tasmansee
Korallenmeer

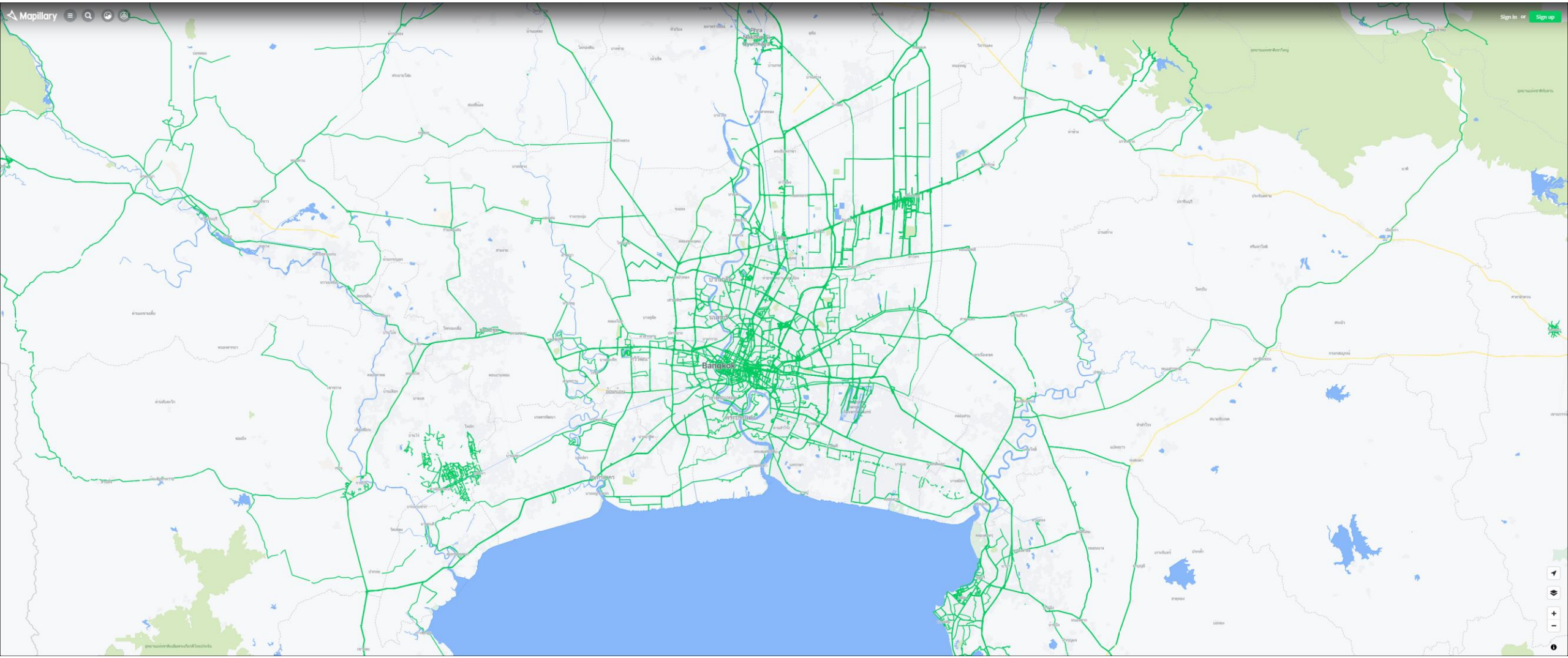


DTU MLSM Machine Learning for Smart Mobility

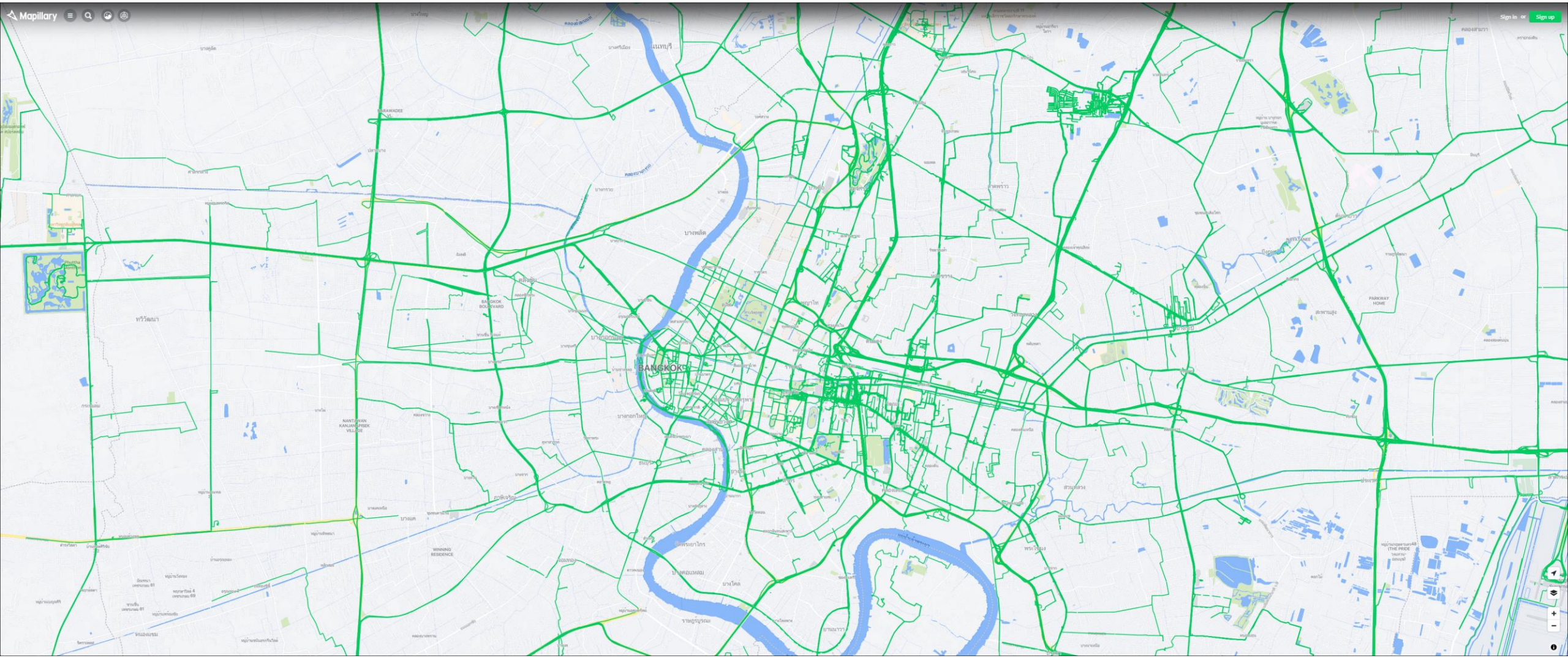


DTU MLSM
Machine Learning for Smart Mobility

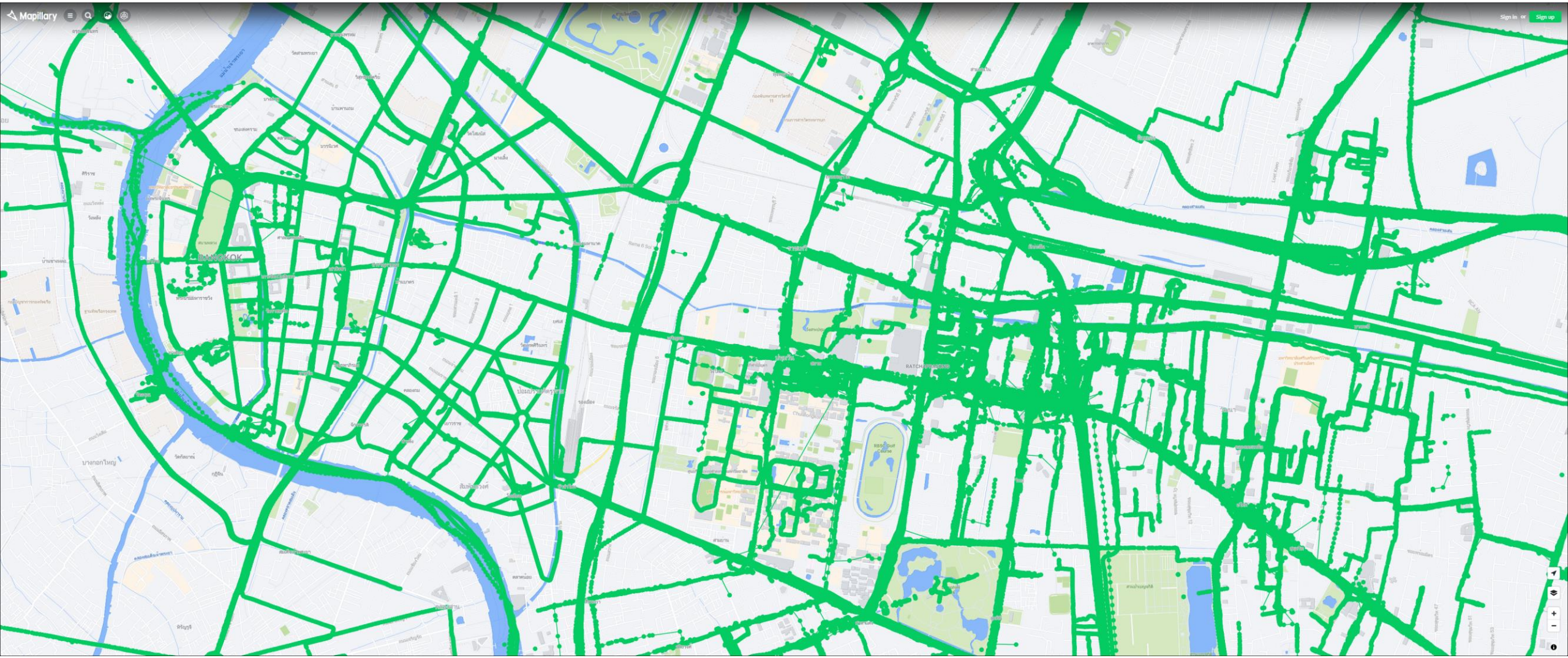

Mapillary
Sign in
Sign up
THAILAND
Bangkok
KAMBODSCHA



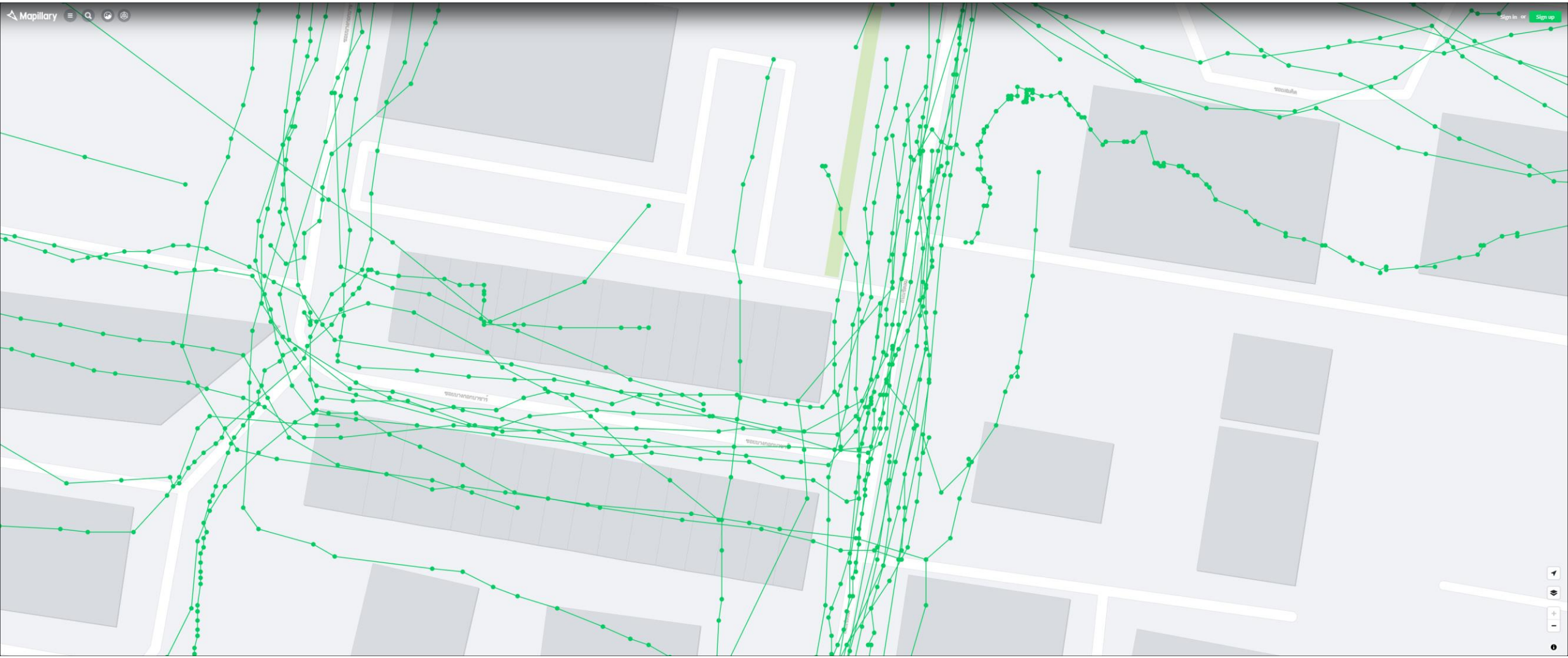
MLSM
Machine Learning for Smart Mobility



MLSM
Machine Learning for Smart Mobility

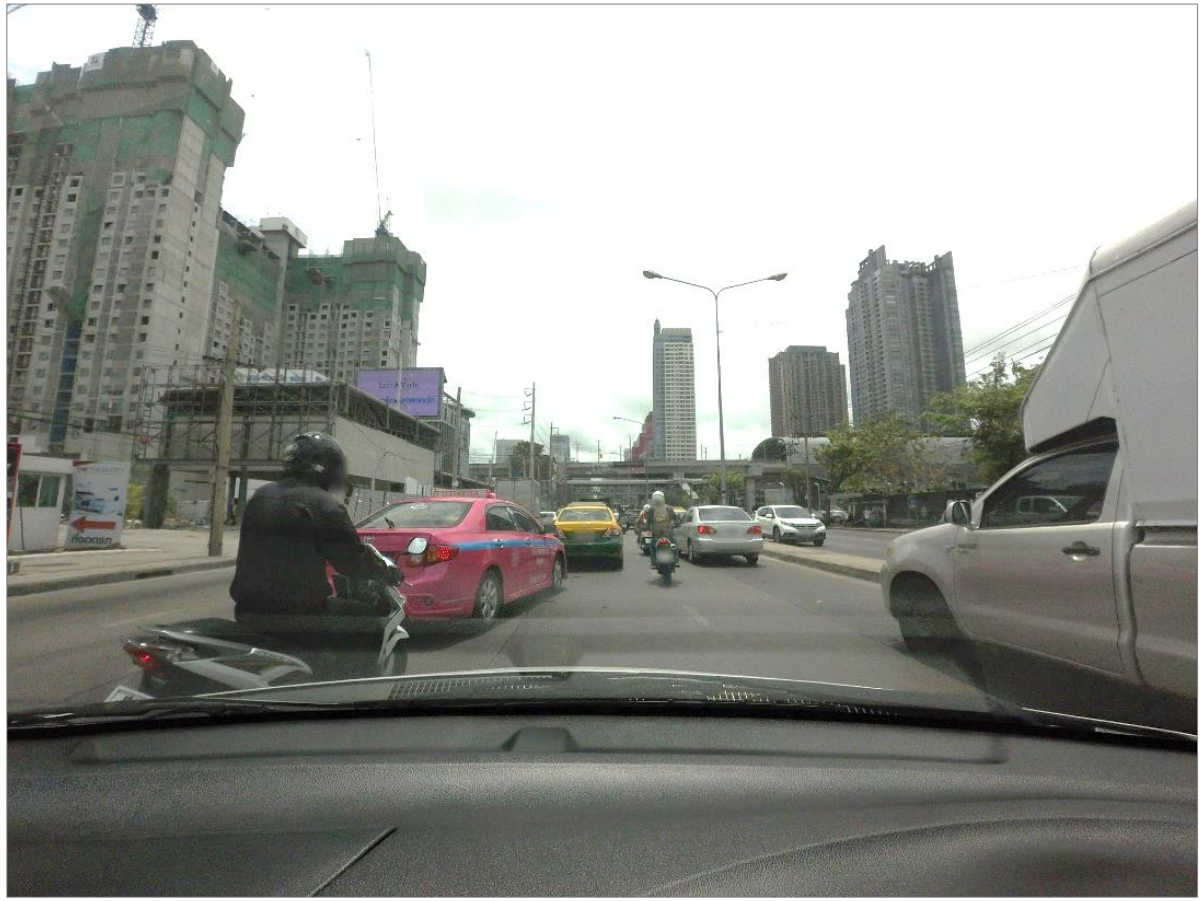

Mapillary
Sign in or Sign up
BANGKOK

MLSM
Machine Learning for Smart Mobility



MLSM
Machine Learning for Smart Mobility

Images from Bangkok



- On-the-road perspective
- Anonymization of faces and license plates
- Images differ in resolution and overall quality
- Different lighting, angles and orientations of motorcyclist

Assessing helmet use in Bangkok

Main road infrastructure (OpenStreetMap data)

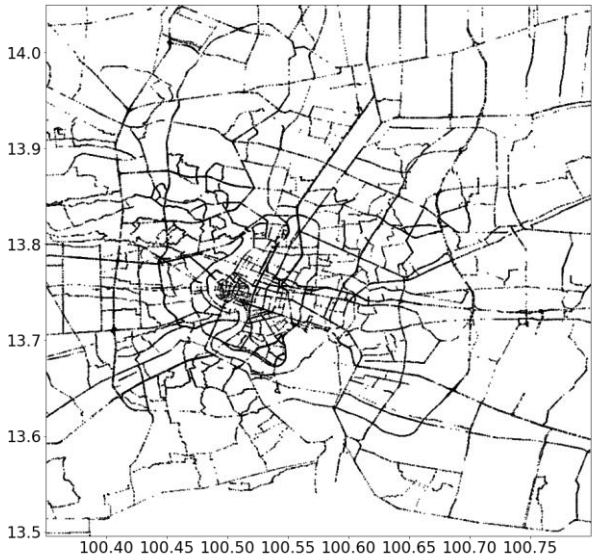
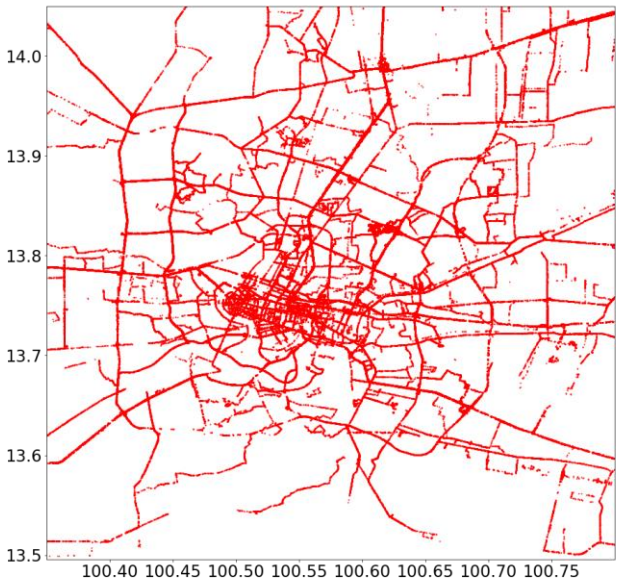
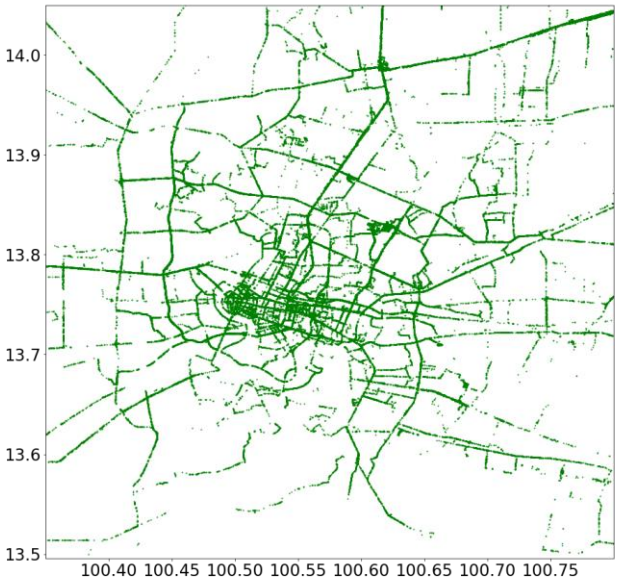


Image locations on Mapillary



Motorcycles detected on Mapillary images with YOLO



DTU MLSM Machine Learning for Smart Mobility

Assessing helmet use in Bangkok

- We annotated 2600 images for their helmet use.
- We trained the algorithm on 2000 images and tested on 600 images (with a total of 1631) bikes
- For the detection of active motorcycles, we achieve:
  - A precision of 91%
    (i.e. when an active motorcycle is detected, the detection is correct in 91% of cases)
  - A recall of 51%
    (i.e. only about half of active motorcycles present in the data are detected by the algorithm)

Assessing helmet use in Bangkok

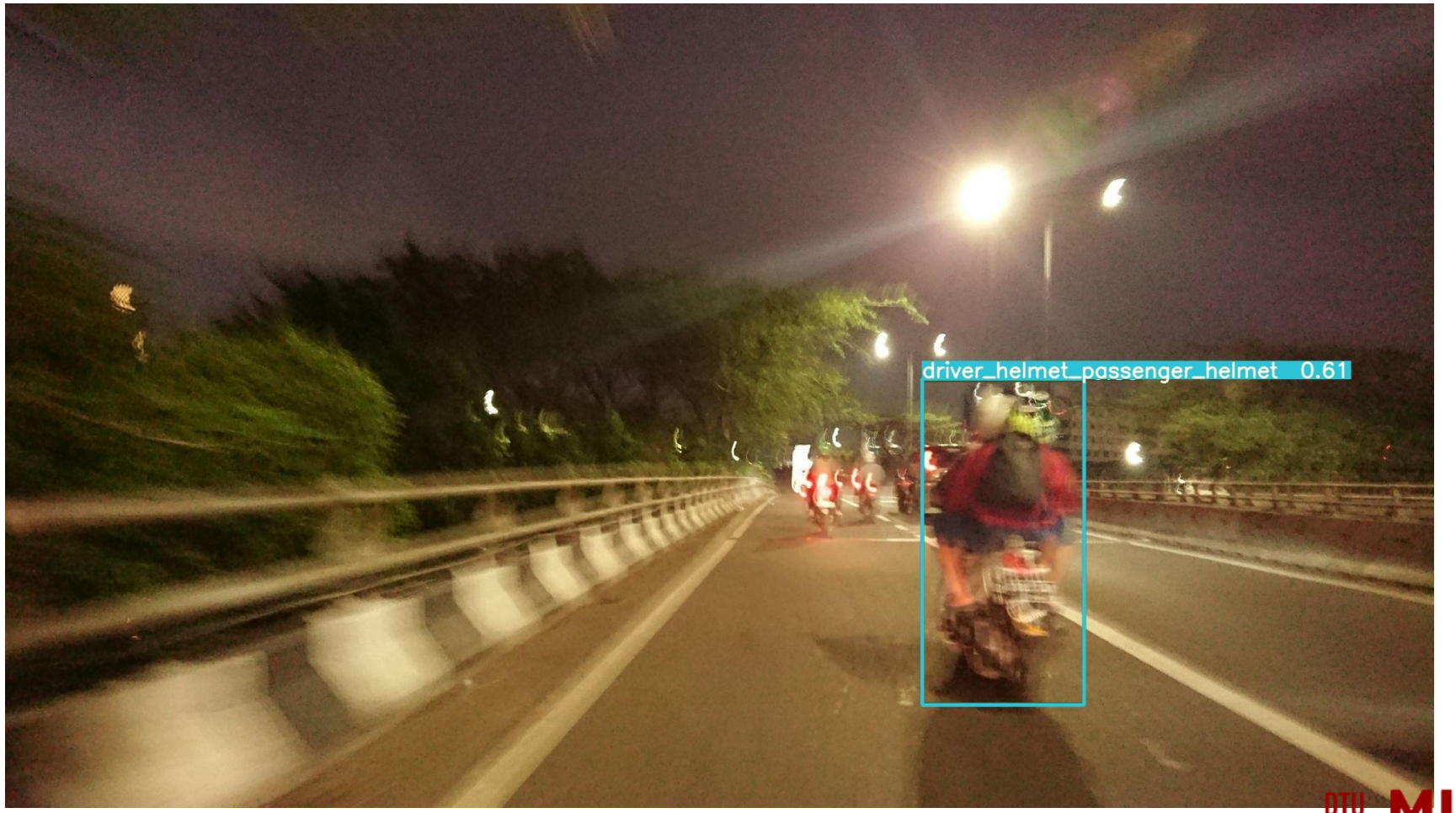
Assessing helmet use in Bangkok

driver_helmet 0.98

Room for improvement

Room for improvement

Room for improvement



Assessing helmet use in Bangkok

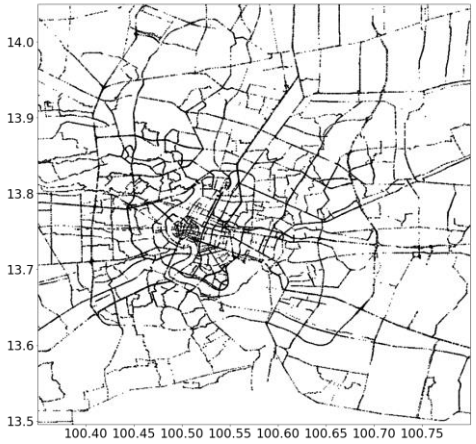
- We annotated 2600 images for their helmet use.
- We trained the algorithm on 2000 images and tested on 600 images (with a total of 1631) bikes
- For the detection of active motorcycles, we achieve:
  - A precision of 91%
    (i.e. when an active motorcycle is detected, the detection is correct in 91% of cases)
  - A recall of 51%
    (i.e. only about half of active motorcycles present in the data are detected by the algorithm)

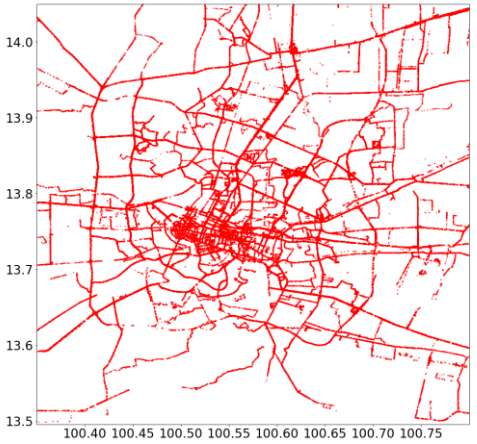
- Helmet use in the Test data is 67.8%, due to the missing detections, the algorithm produces a relatively inaccurate helmet use estimate of 53.1%

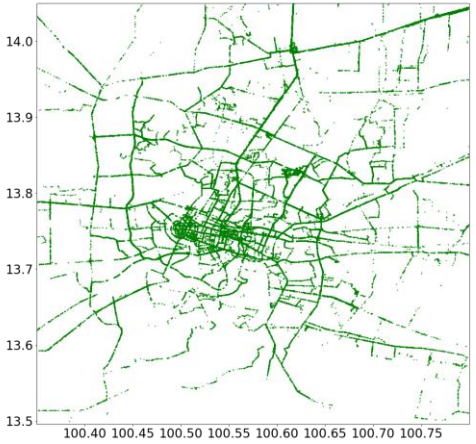
MLSM Machine Learning for Smart Mobility

Scaling beyond Bangkok

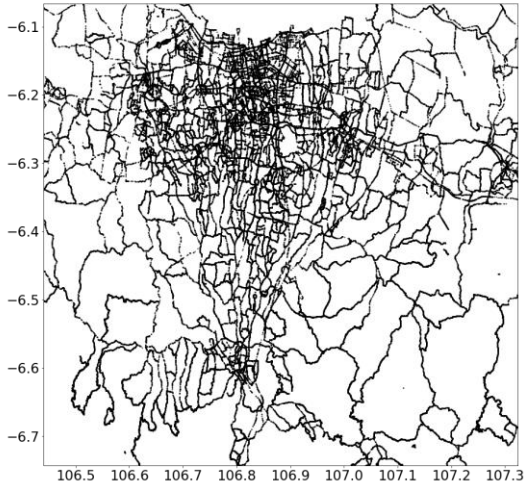
Bangkok

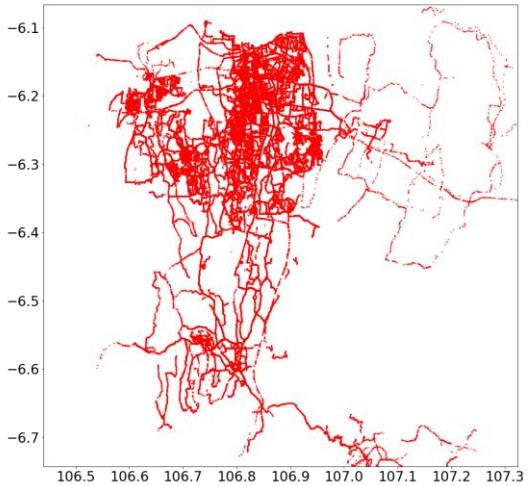


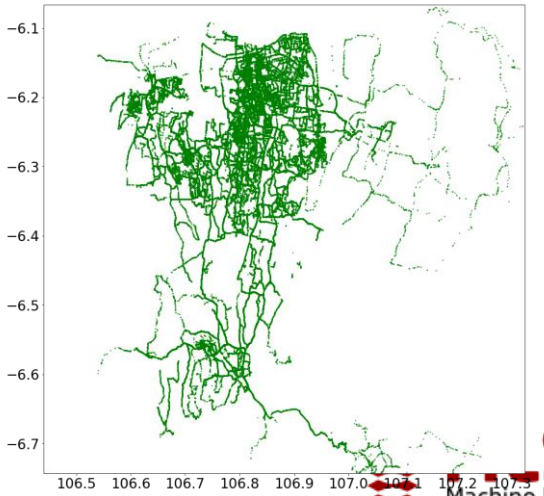




Jakarta







Machine Learning for Smart Mobility

In conclusion and the future

- It is a cheap and scale able solution register safety performance indicators in LMIC
- Already seeing performance increase with more data and better data cleaning.
- In the progress of scaling this to multiple cities and countries.

➢ Most important: Always use a helmet when travelling on a motorcycle! (and bike)

DTU MLSM Machine Learning for Smart Mobility

Merci!

Felix Siebert
DTU
felix@dtu.dk

Christoffer Riis
DTU
chrrii@dtu.dk

Frederik Hüttel
DTU
fbohy@dtu.dk

MLSM
Machine Learning for Smart Mobility