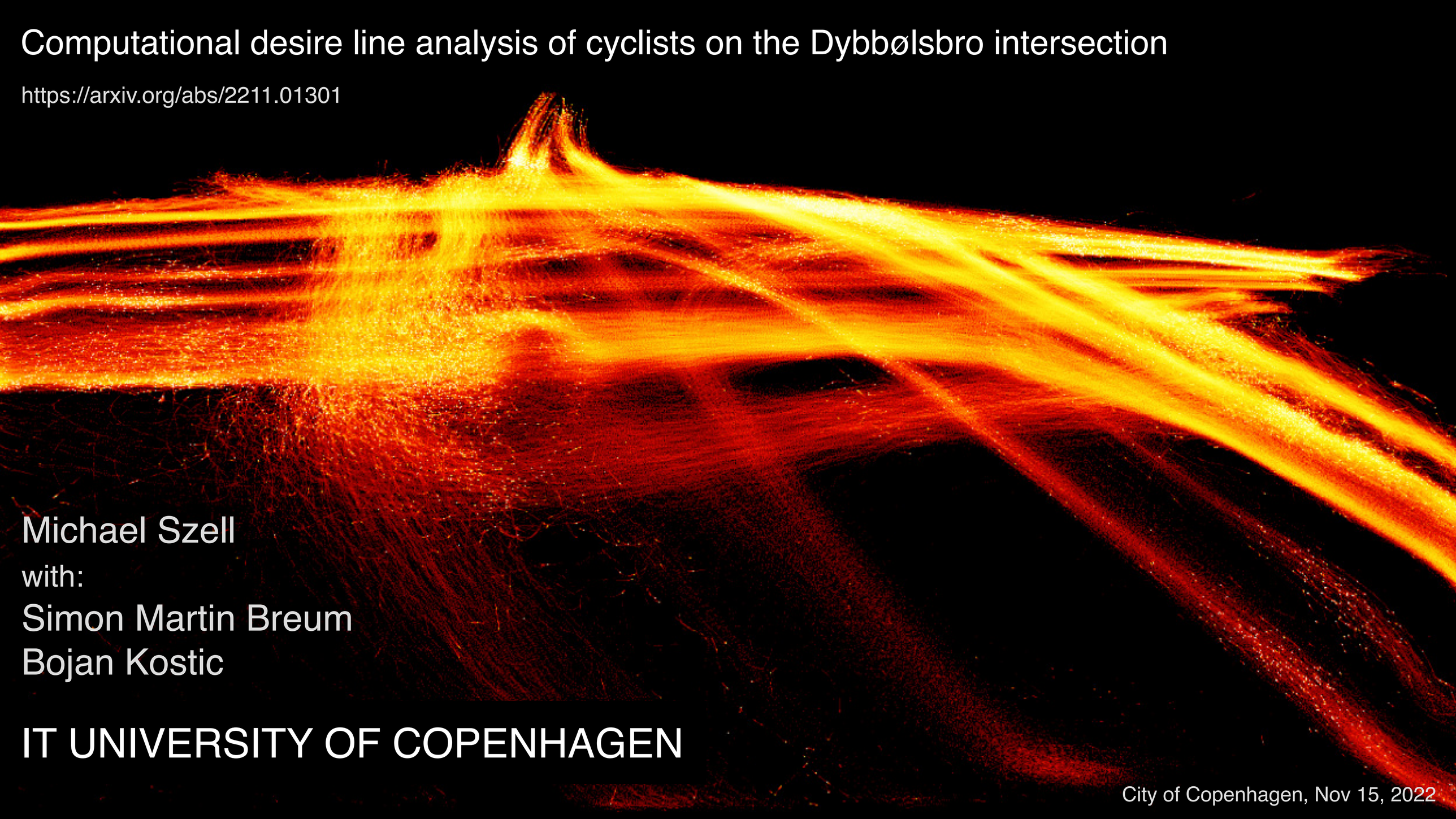
Computational desire line analysis of cyclists on the Dybbølsbro intersection

https://arxiv.org/abs/2211.01301



Michael Szell

with:

Simon Martin Breum

Bojan Kostic

IT UNIVERSITY OF COPENHAGEN

City of Copenhagen, Nov 15, 2022

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14 members, founded 2019, Network science expertise

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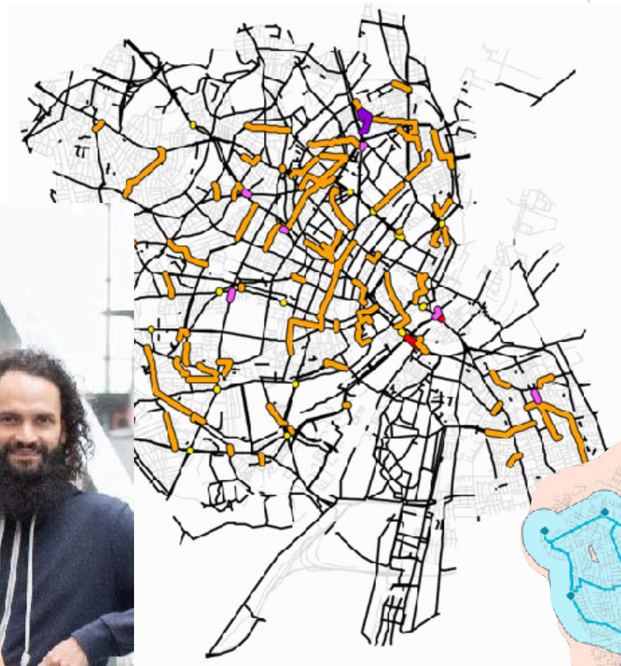
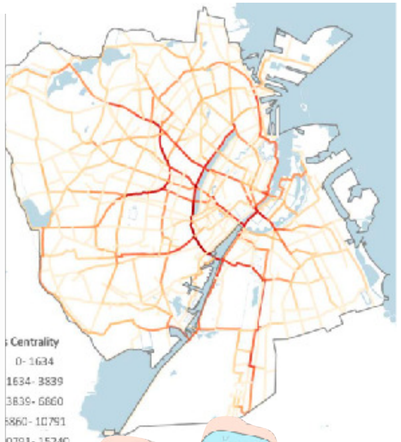
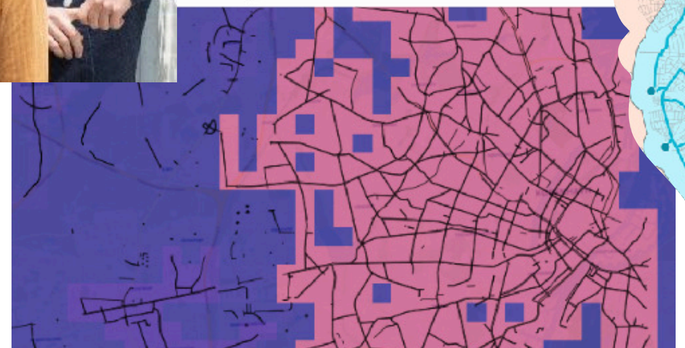


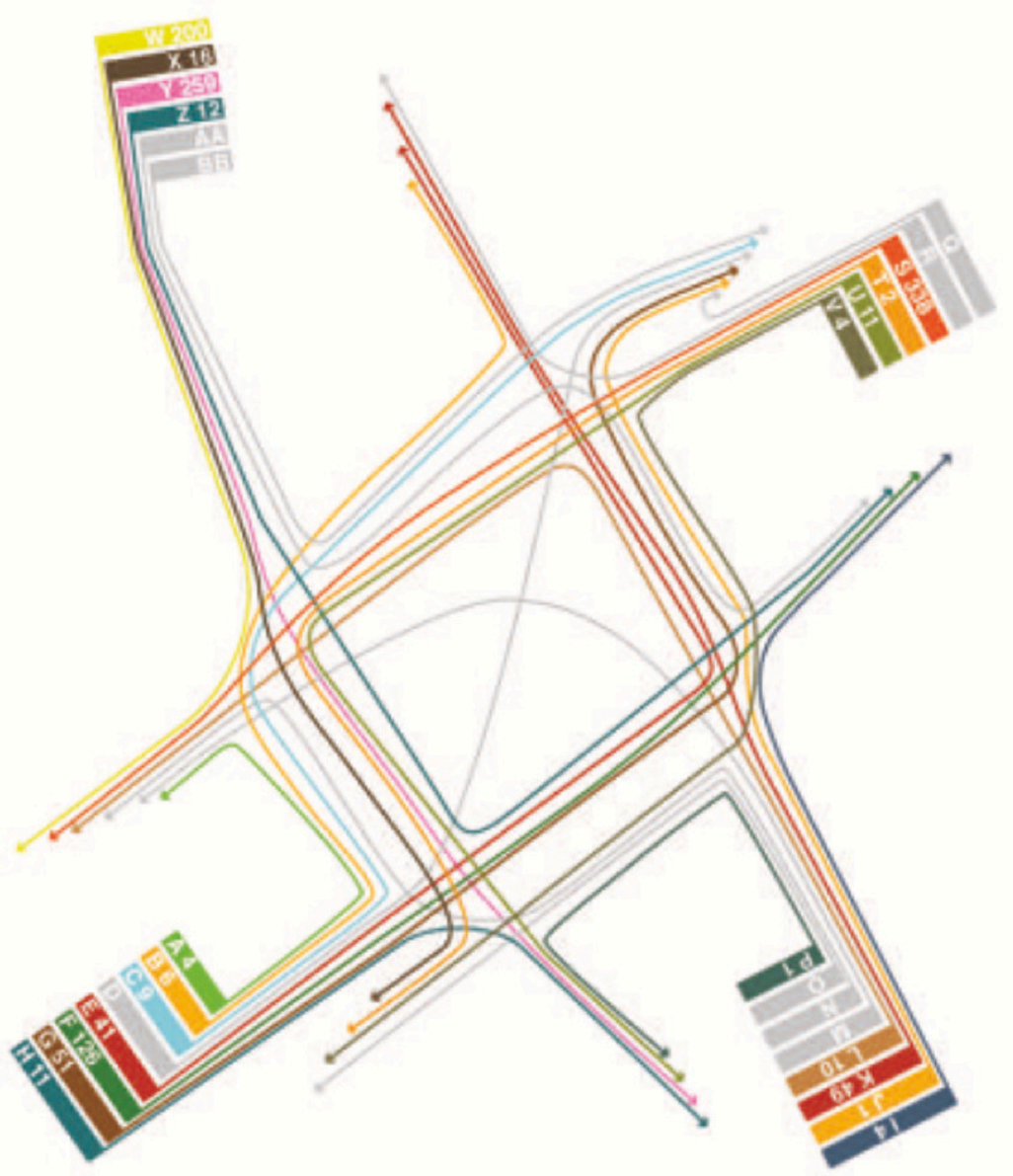




Vejdirektoratet

Desire line analysis is important

Uncovers discrepancy between cyclist behaviour and design

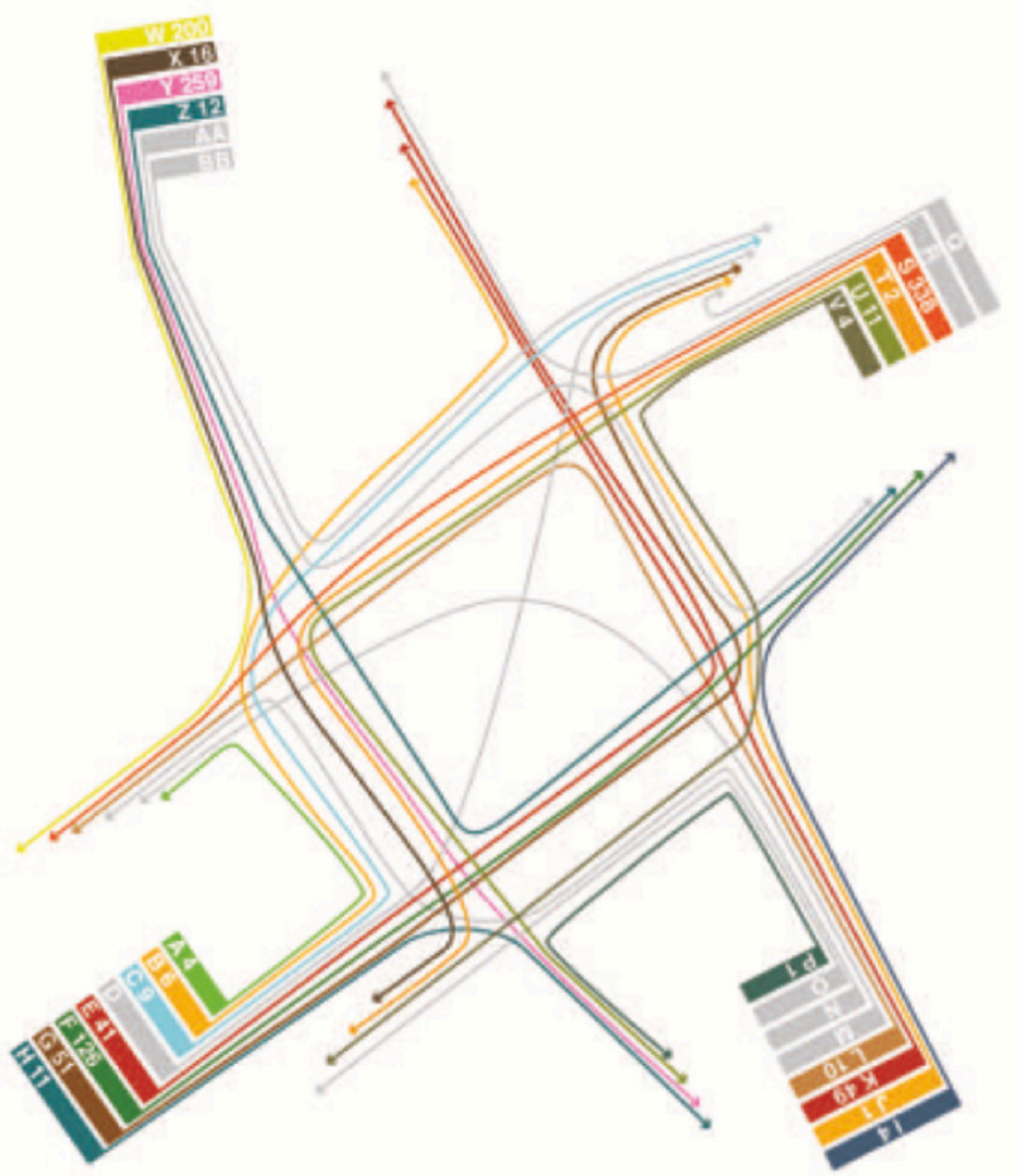


Copenhagenize

Desire line analysis is manual, therefore costly

What I learned from staring at 106,000 cyclists

Can count paths, but not quantify them rigorously



Copenhagenize

Automated methods have some problems

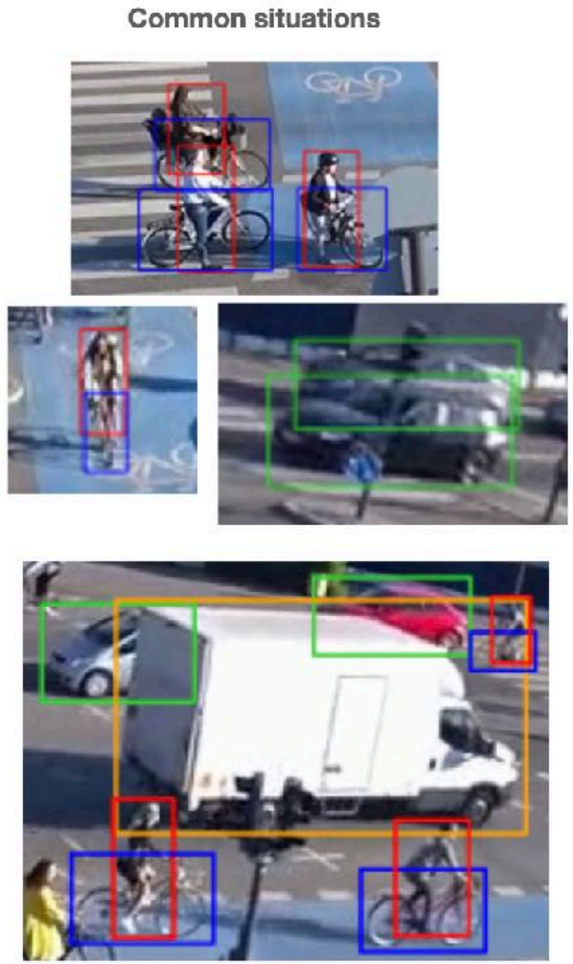
Heavy-weight

Car-centric

Focus on counting

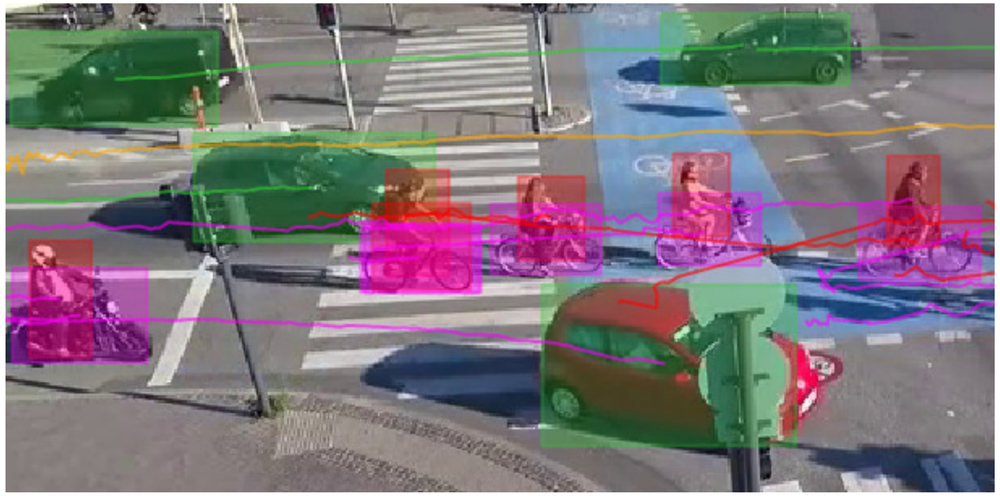
To fix this, we trained a detection algorithm for cyclists

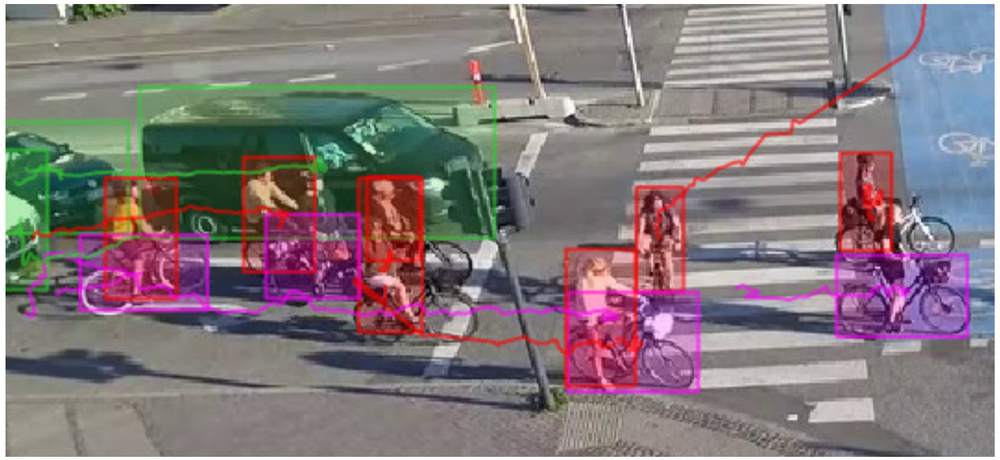
Manual annotation



To fix this, we trained a detection algorithm for cyclists

Good detection ➔ easier tracking





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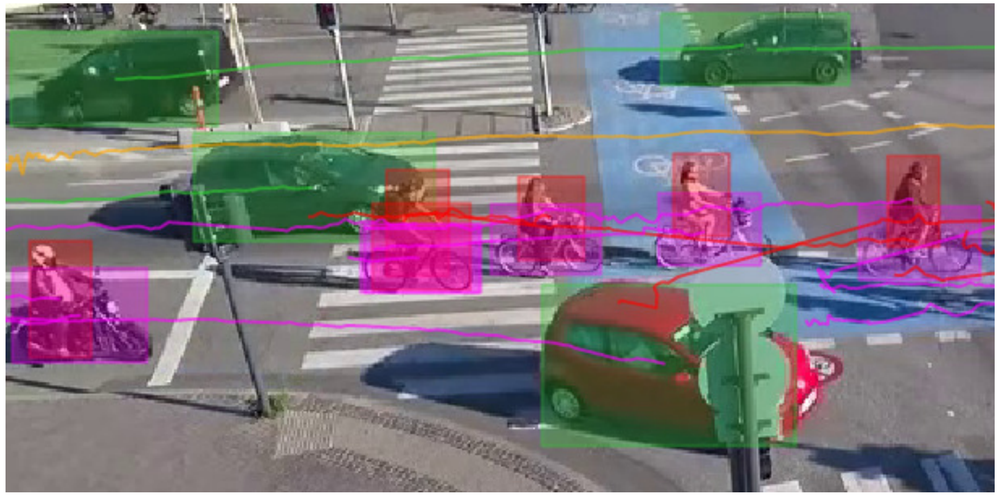
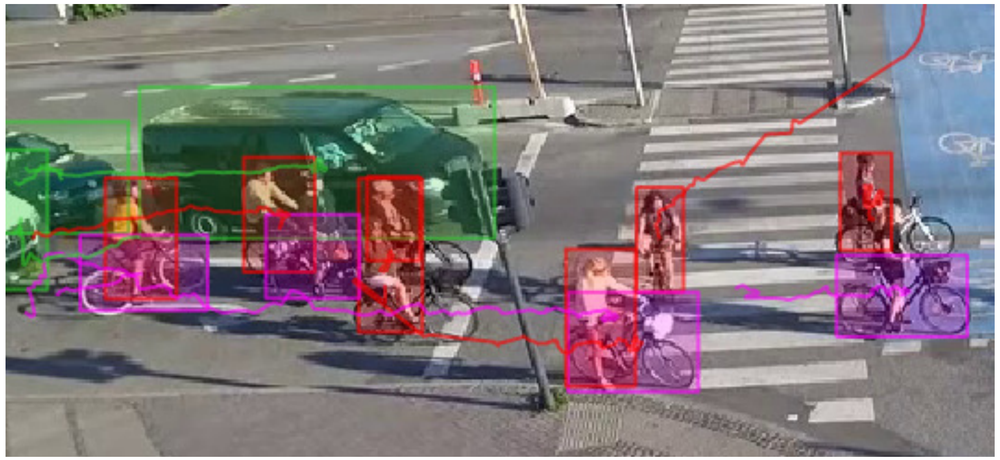
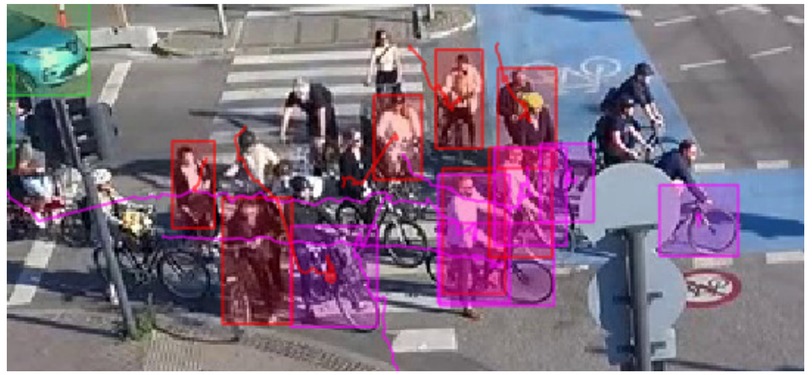
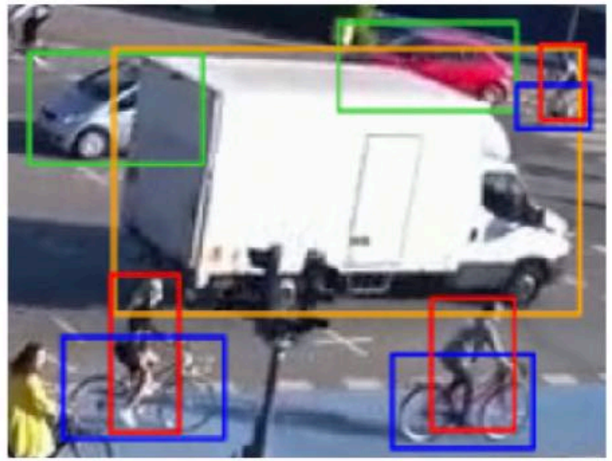




Bad detection ➔ difficult tracking

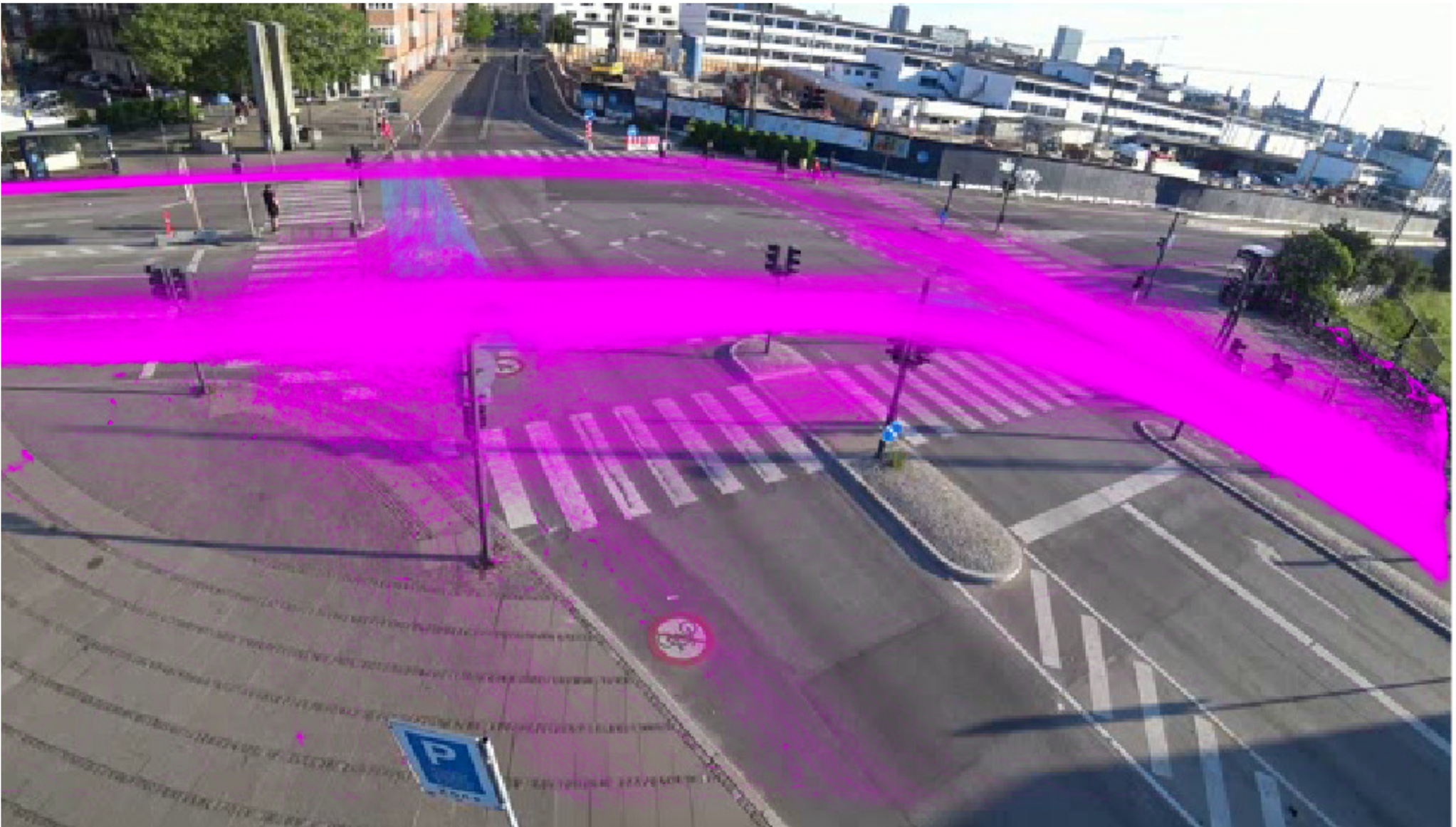




There are still many issues...

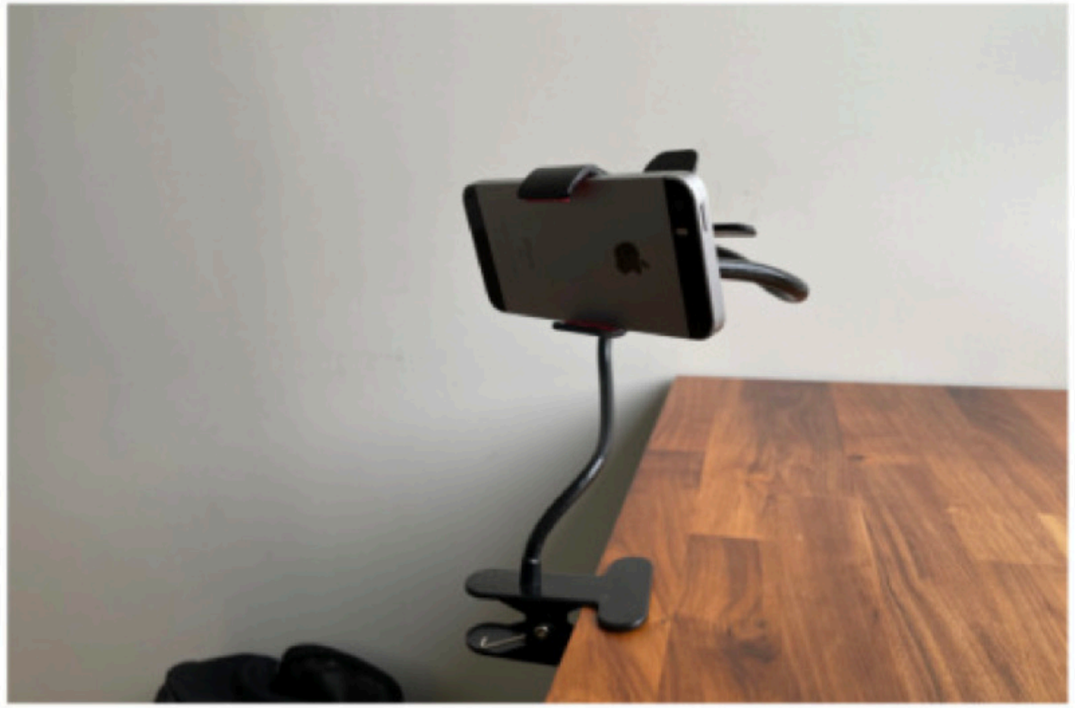
Here we work with 11,553 cyclist trajectories

Wednesday, June 9th, 2021, 7:00-8:00



Video was taken by COWI, but mobile phone also possible

Wednesday, June 9th, 2021, 7:00-17:00



Adjustable arm with grip

Self-made cardboard holder

"Citizen science"?

The Dybbølsbro intersection is a tough nut

Local Round-Up: City planners rethink problematic Fisketorvet junction – again!

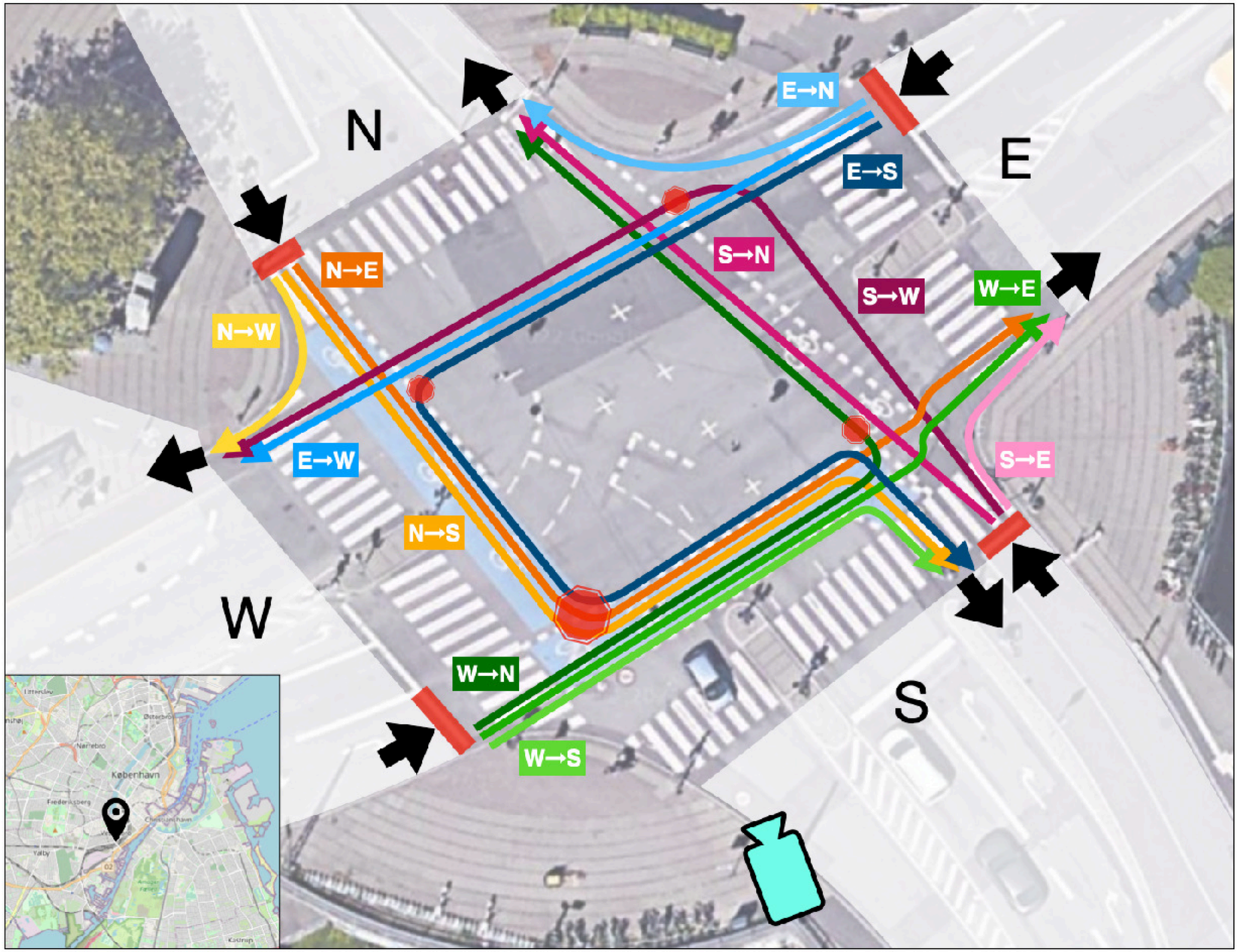
Also evolving is the way we sort our rubbish, with residents heavily involved in the process!

Omstridt og berygtet lyskryds får løsning, der aldrig før er set i Danmark

Politikerne i Københavns Kommune sætter nu 3,5 millioner kroner af til at forsøge at rette op på det trafikale kaos i lyskrydset ved Dybbølsbro. Skulptur må lade livet.

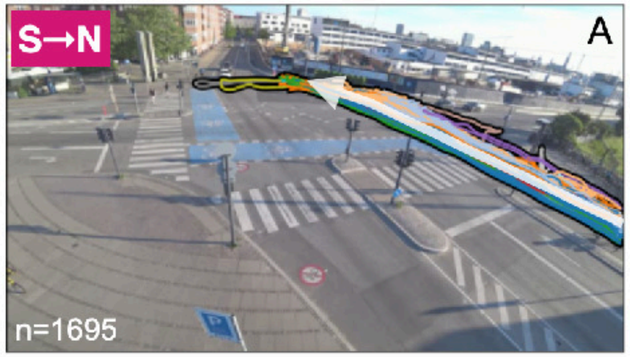
You know all the issues...

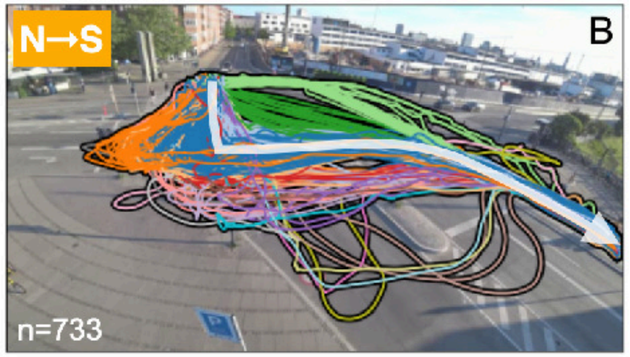
We spatially cluster trajectories into origin-destination clusters

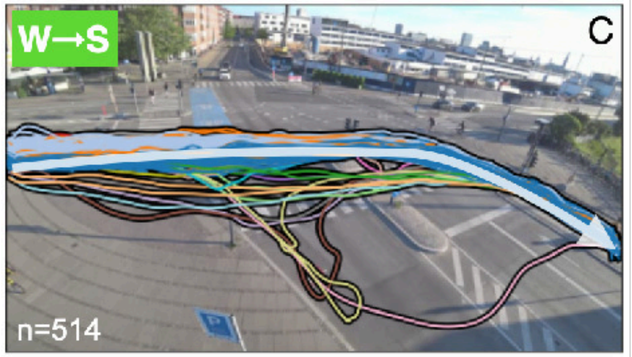


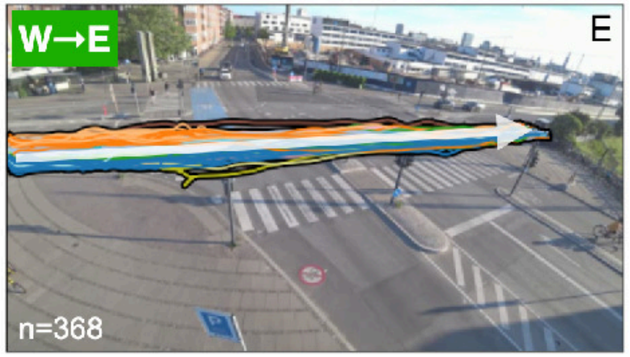
12 possible intended paths

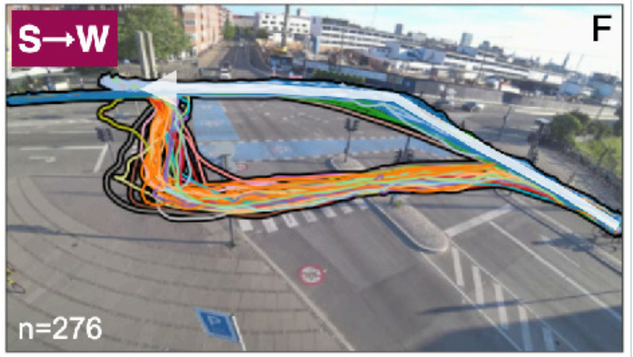
We can match 4432 trajectories to 9 origin-destination clusters







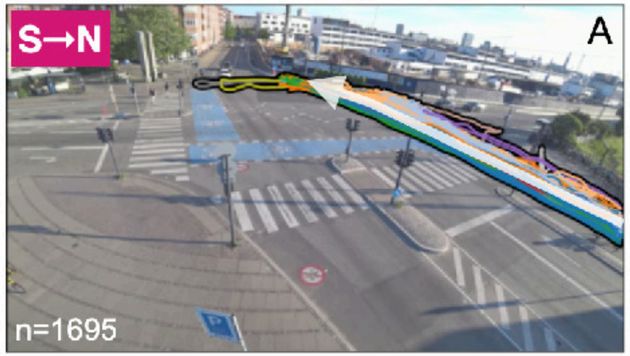


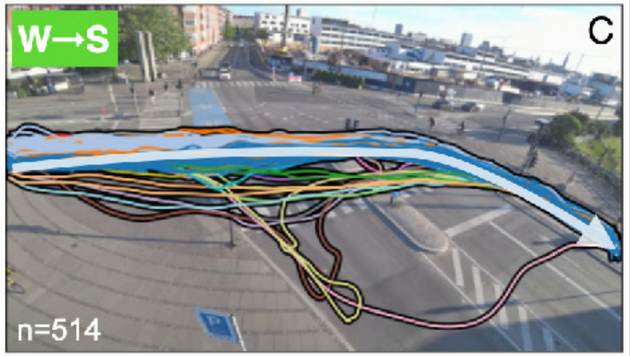


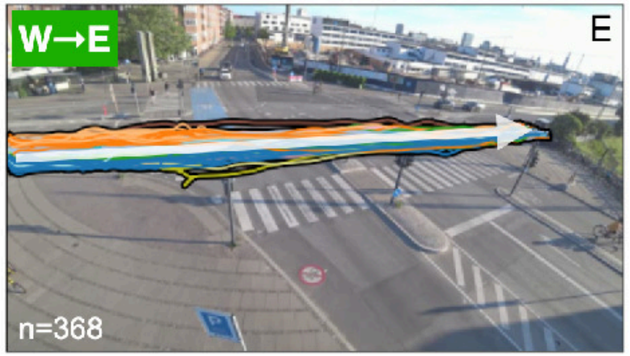
We discarded
7121 trajectories

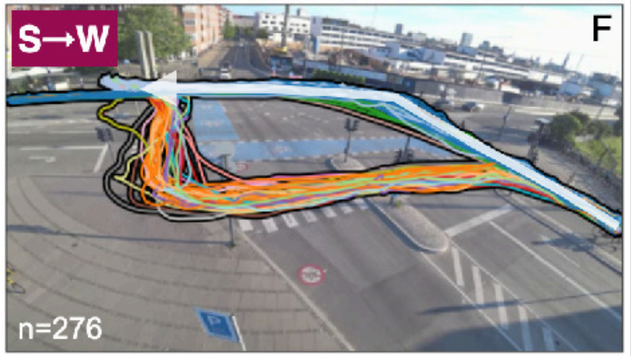
Not enough for
N→E, W→N, E→N,

Next we focus on N→S and E→S





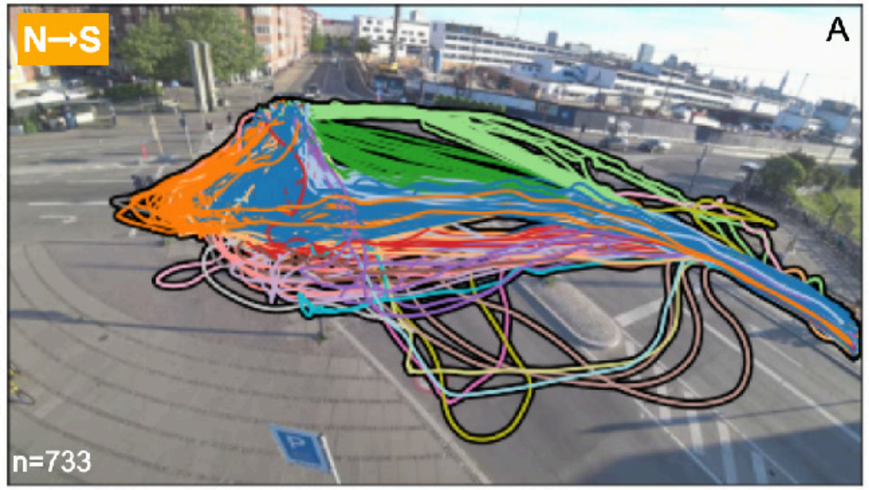


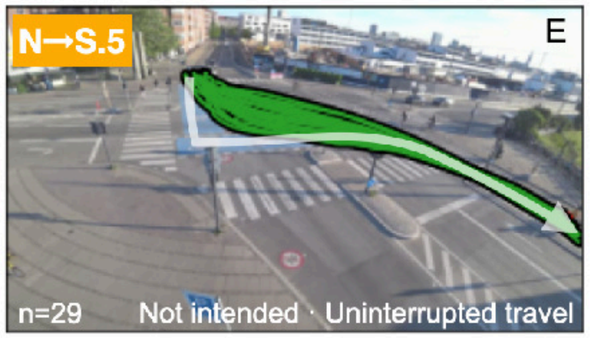


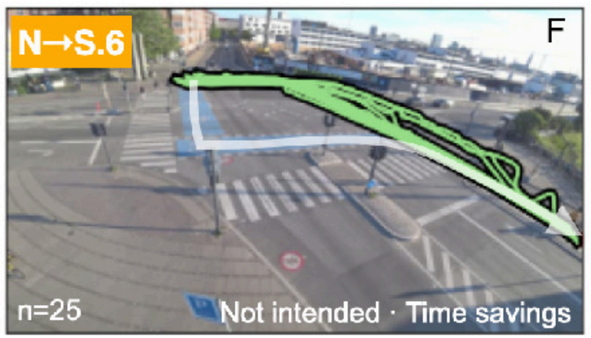
We discarded
7121 trajectories

Not enough for
N→E, W→N, E→N,

We separated trajectories into path-clusters with dynamic time warping

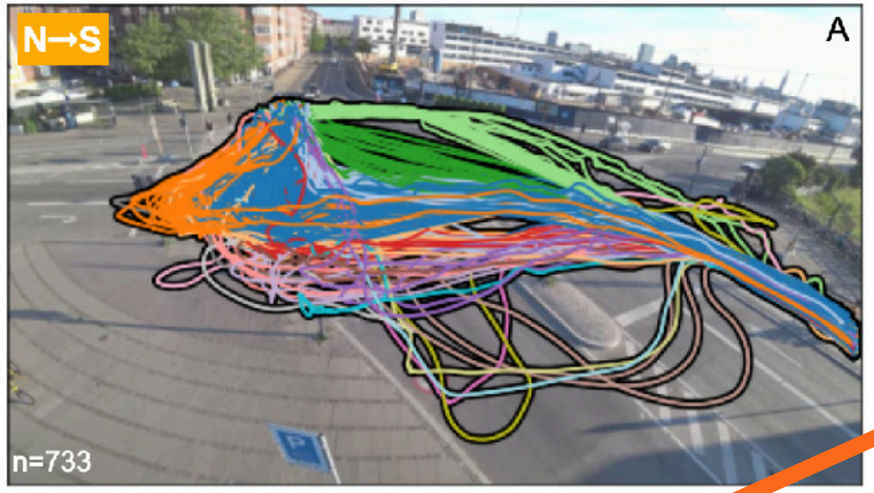




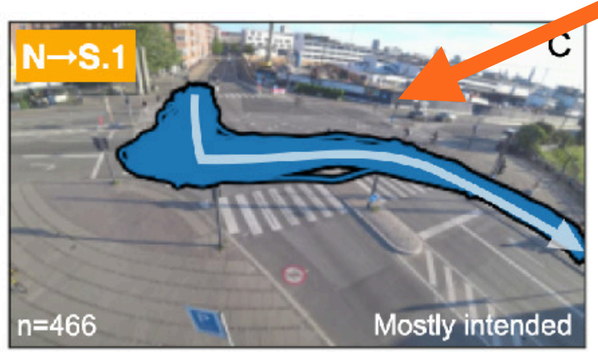


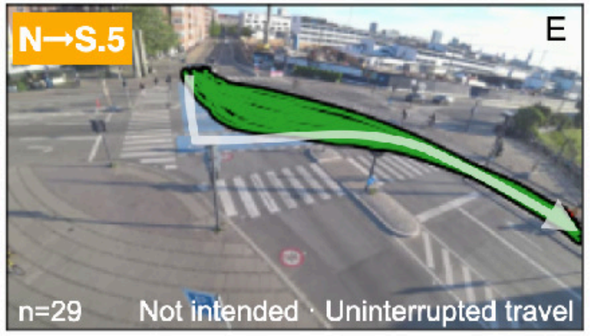
In just
1 hour!

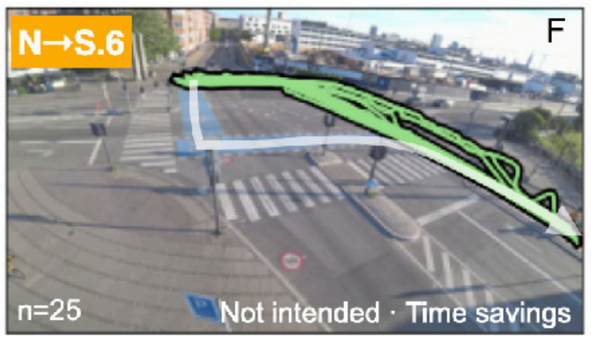
We separated trajectories into path-clusters with dynamic time warping



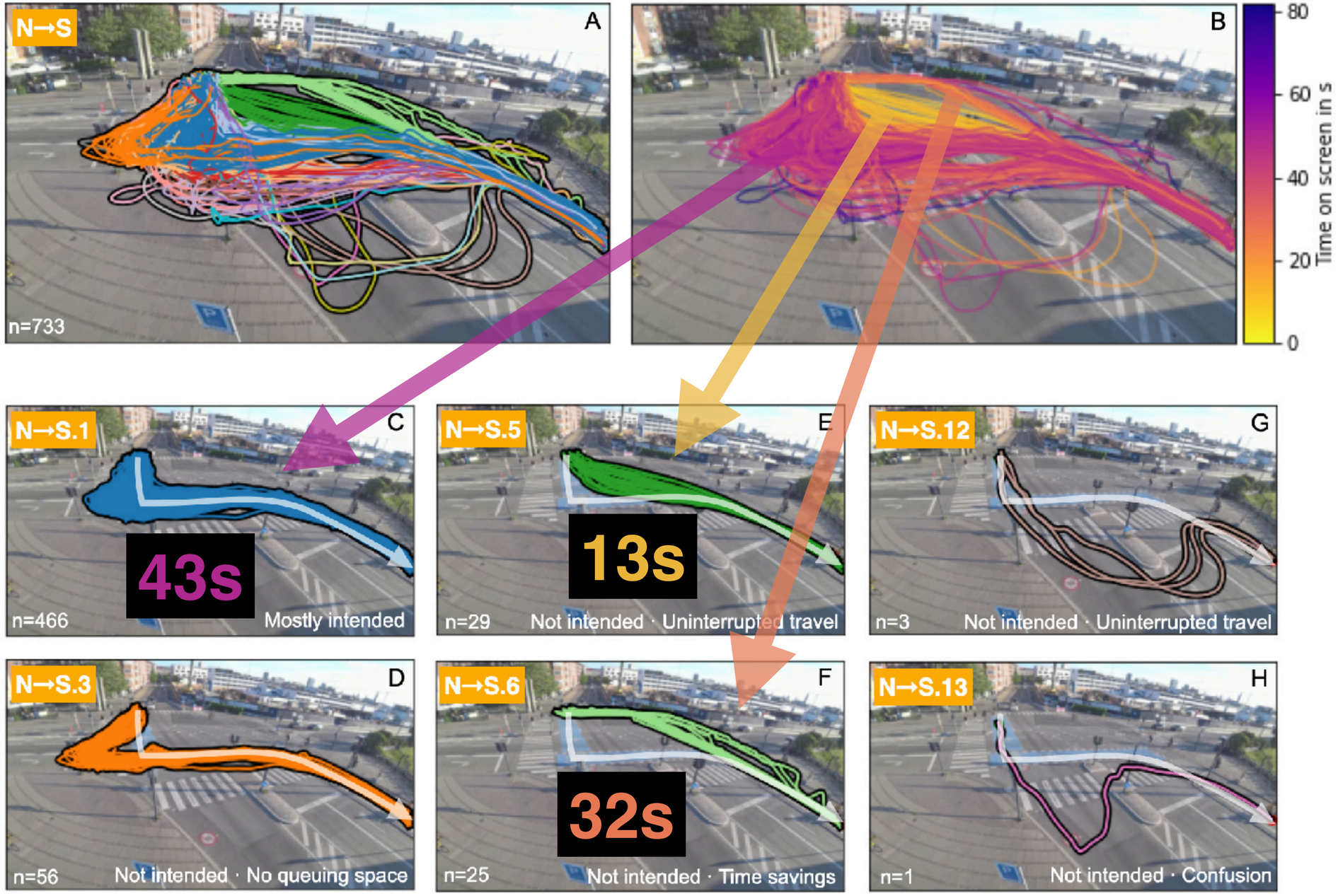
Only 466 are "mostly intended"
Mismatch: **36%**



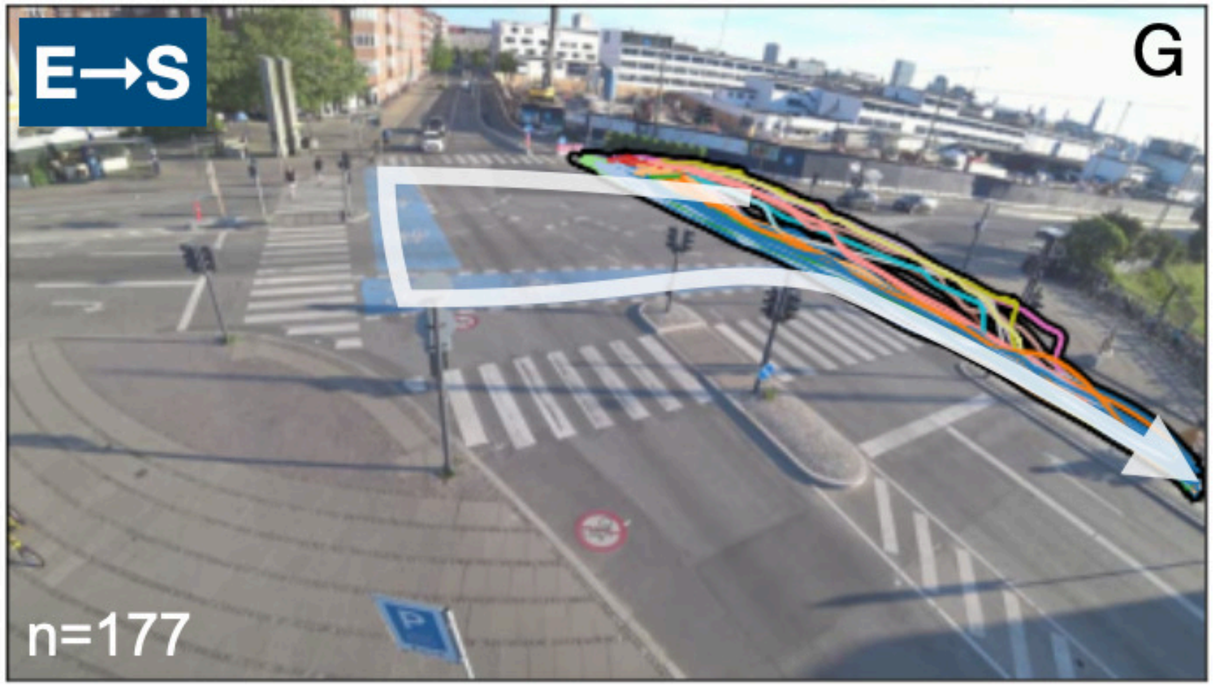


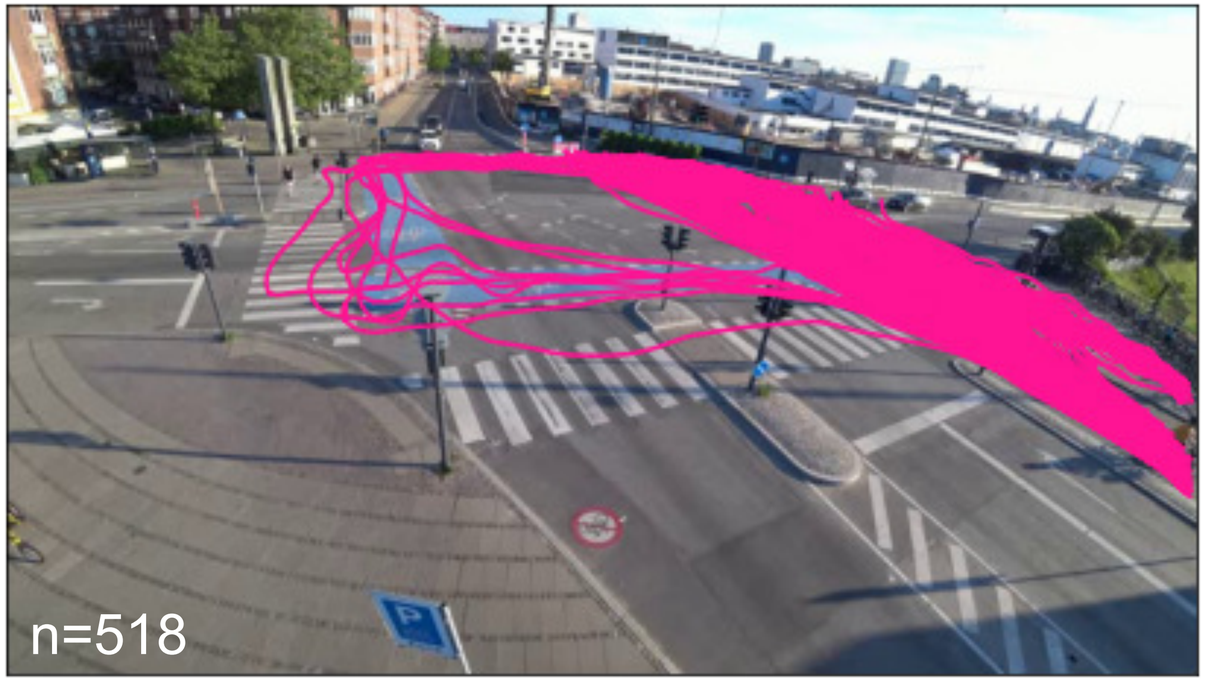


Cyclists prefer uninterrupted travel, which the intersection fails to provide



Cyclists prefer uninterrupted travel, which the intersection fails to provide

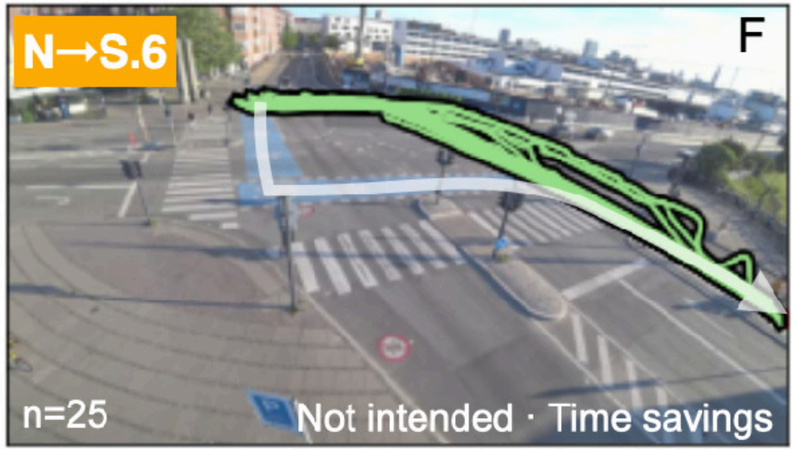


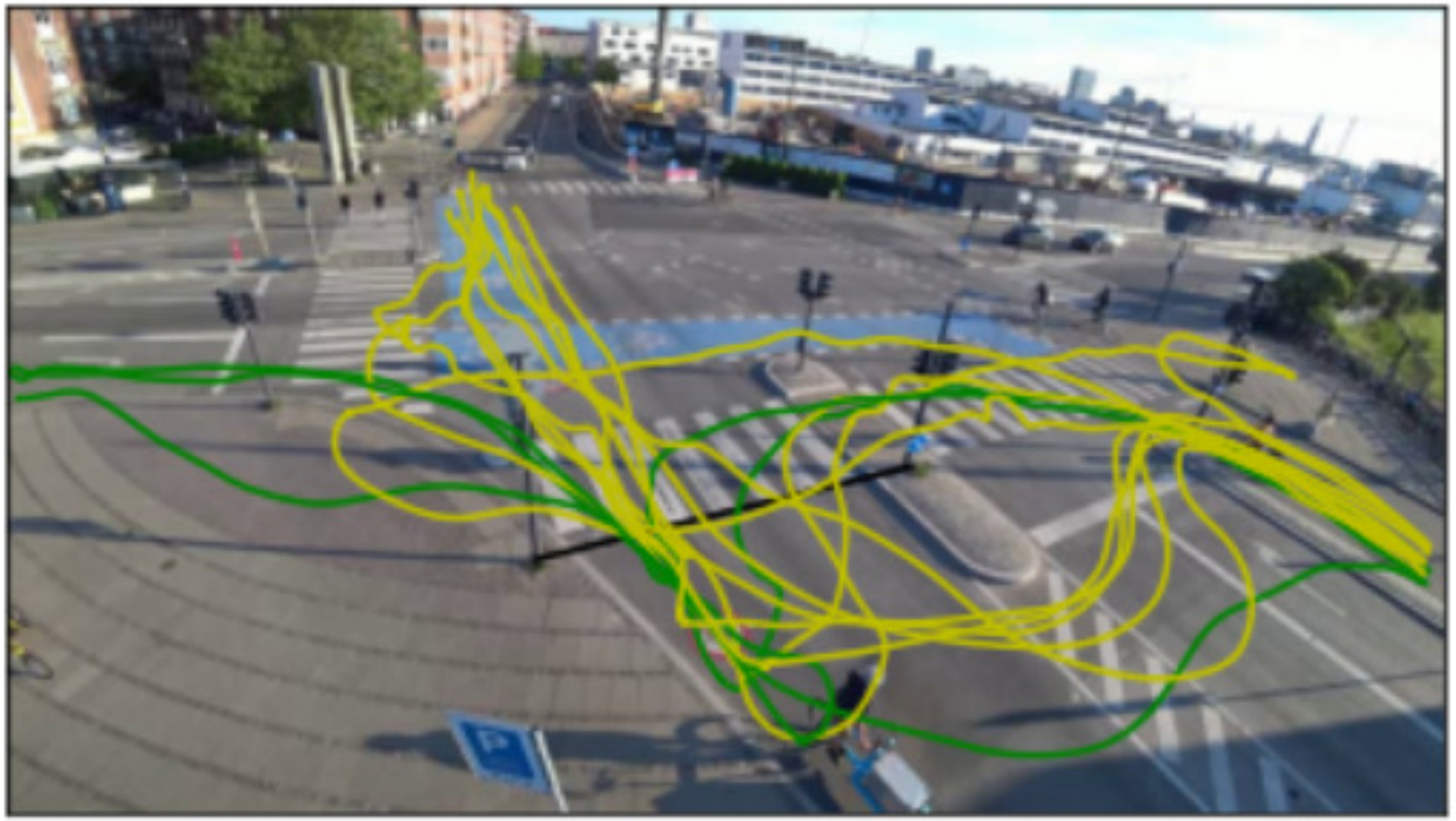


Only 9 are "mostly intended"

Mismatch: **98%**

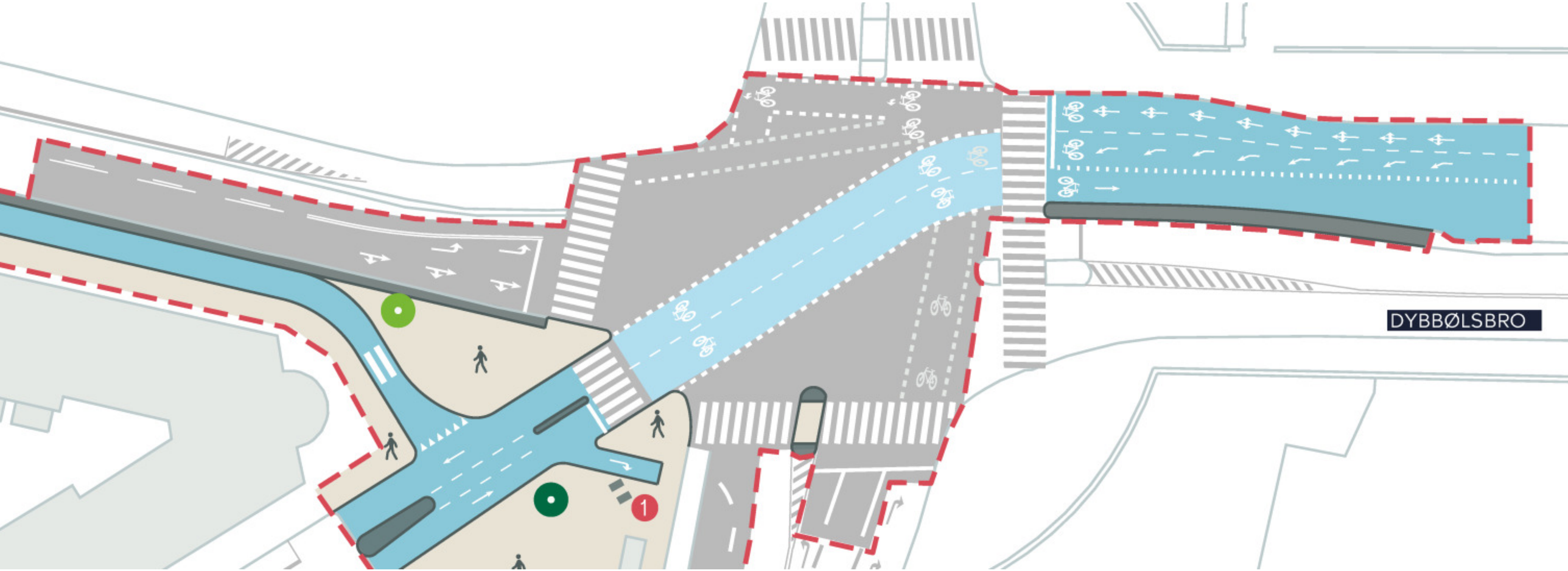
495 trajectories are not intended, potentially life-threatening





In just 1 hour!

The re-design



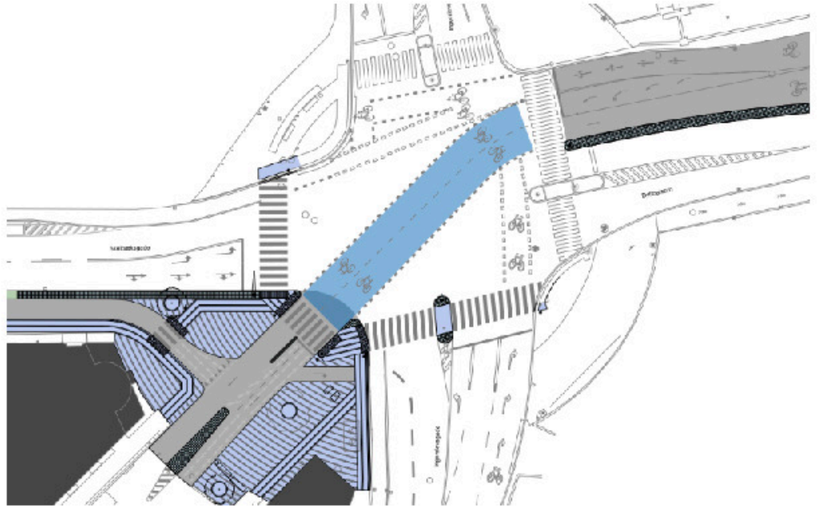
https://www.kk.dk/nyheder/ny-utraditionel-loesning-paa-vej-ved-dybboelsbro

KØBENHAVNS KOMMUNE

DOBBELTRETTET CYKELSTI I KRYDSET INGERSLEVSGADE-DYBBØLSBRO

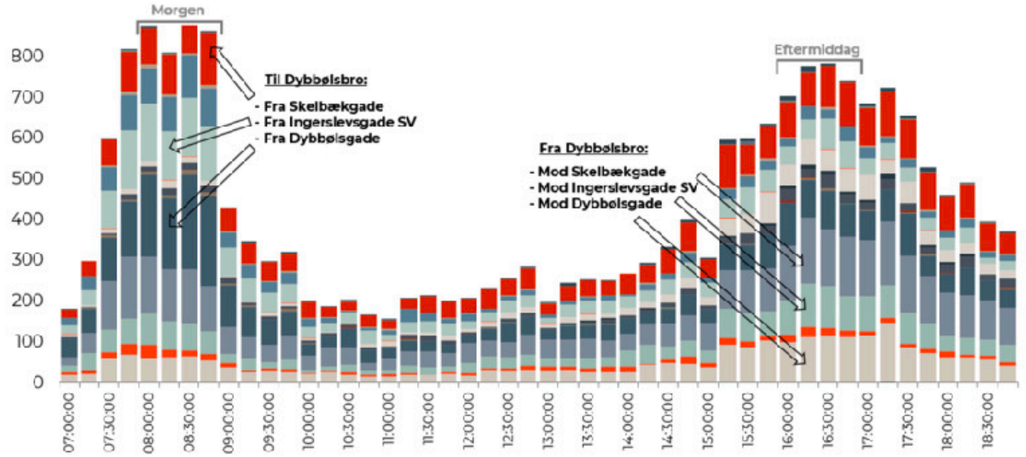
DISPOSITIONSFORSLAG

22-12-2021

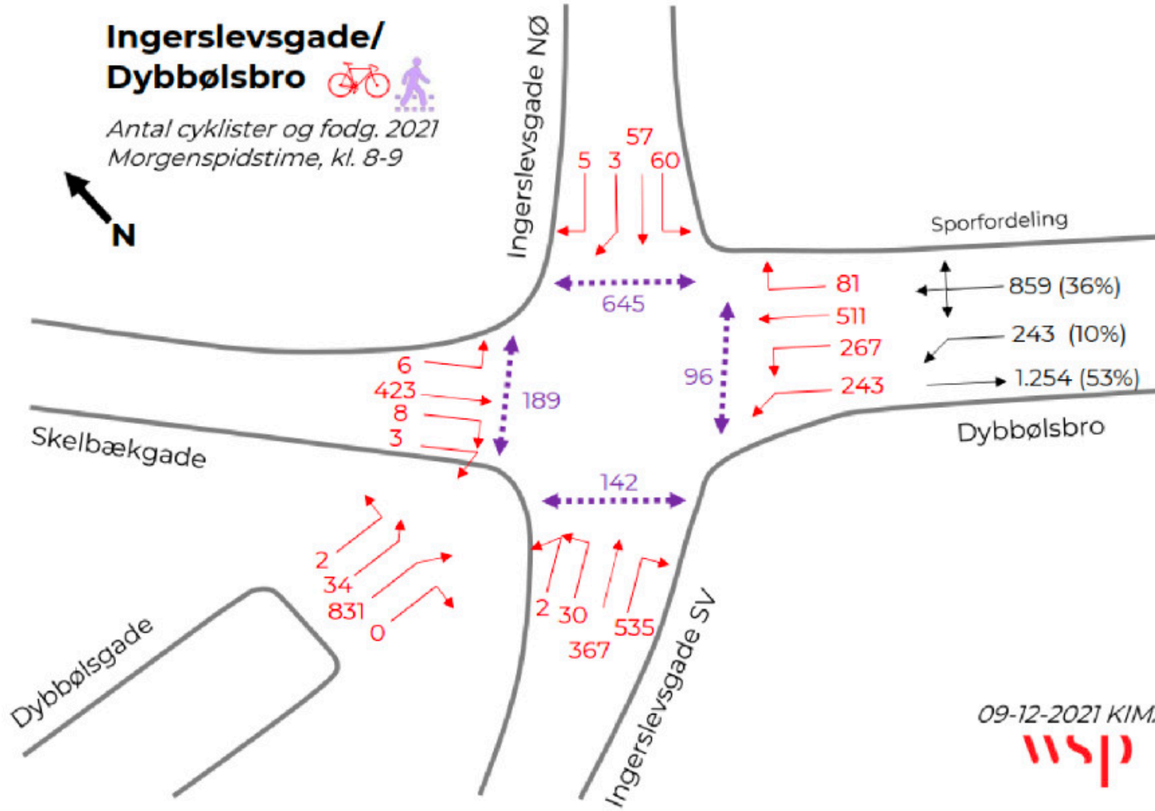


wsp

Video analysis is used only for counting trajectories

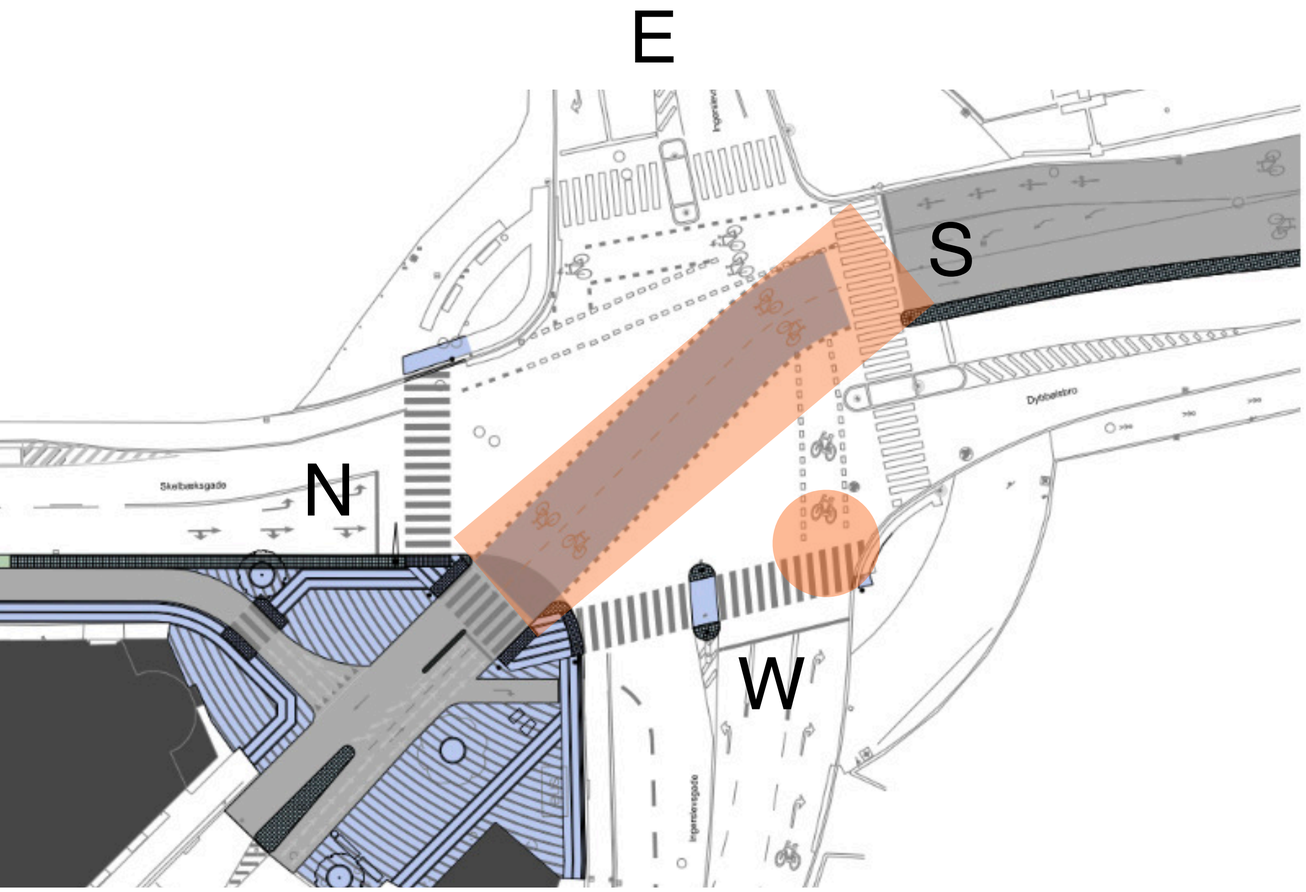


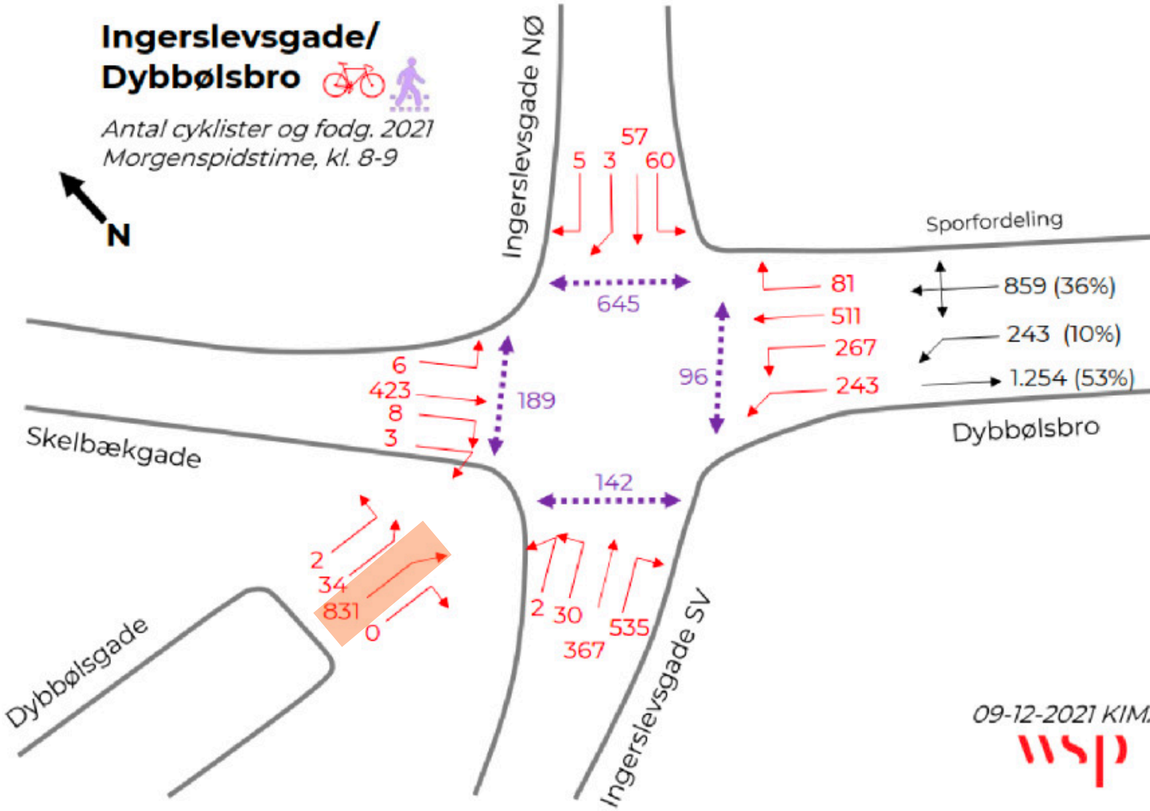
Figur 10. Antal cyklister fordelt på svingbevægelser i perioden kl. 07-19. Trafiktælling 2021. Komplet udgave af grafen visende samtlige signaturforklaringer kan ses på bilag A.



Figur 11. Antal cyklister og fodgængere i morgenspidstimen. Trafiktælling 2021.

Fixed issues

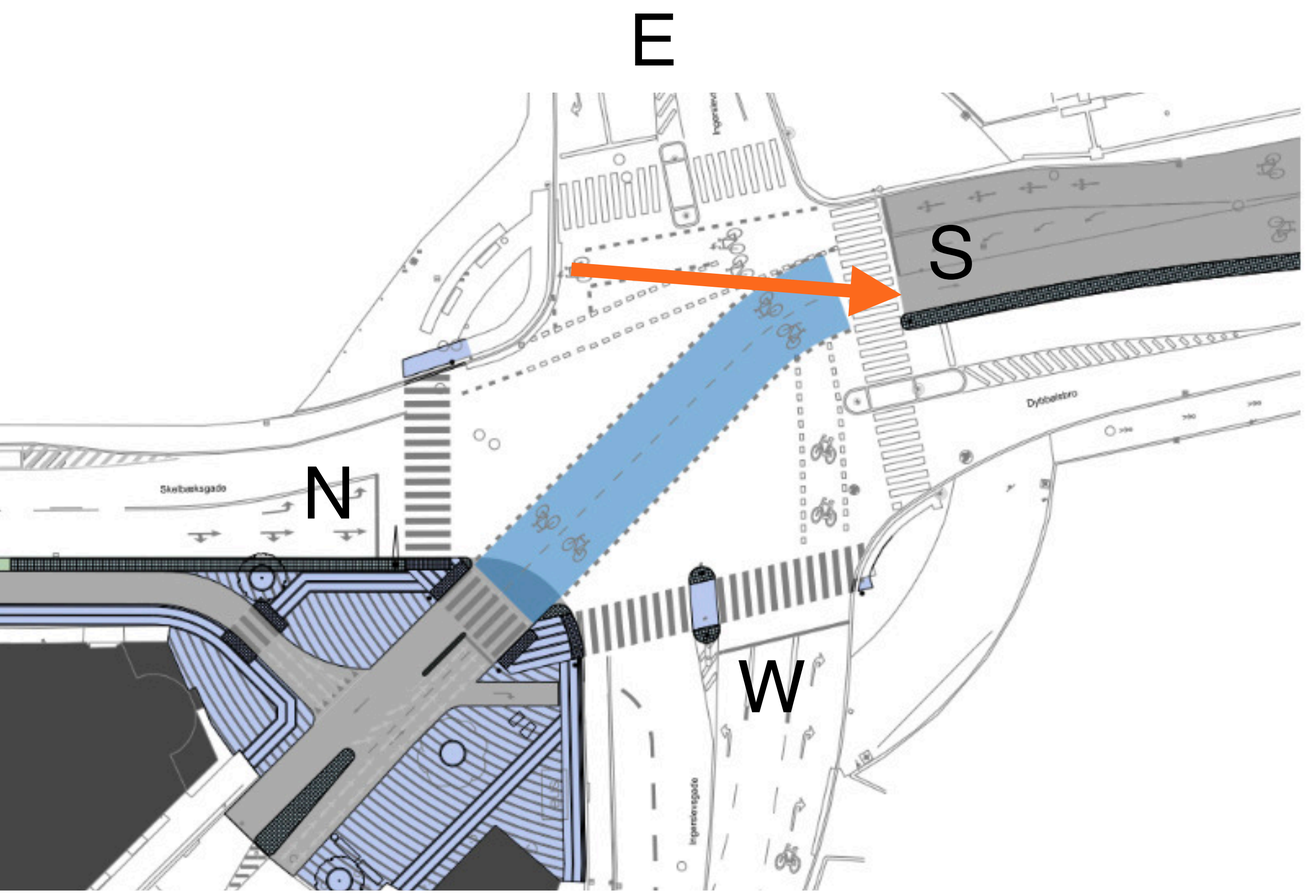


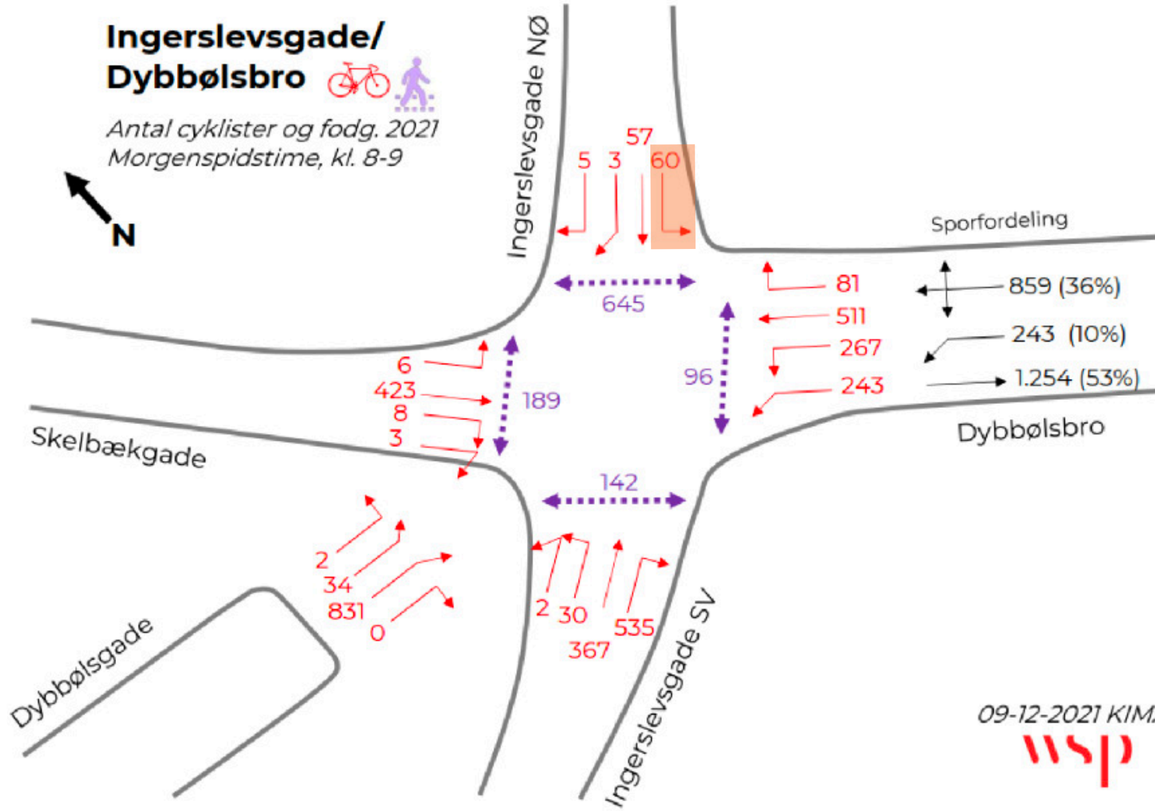


Figur 11. Antal cyklister og fodgængere i morgenspidstimen. Trafiktælling 2021.

- Diagonal lane provides uninterrupted N→S travel

Anticipated issues

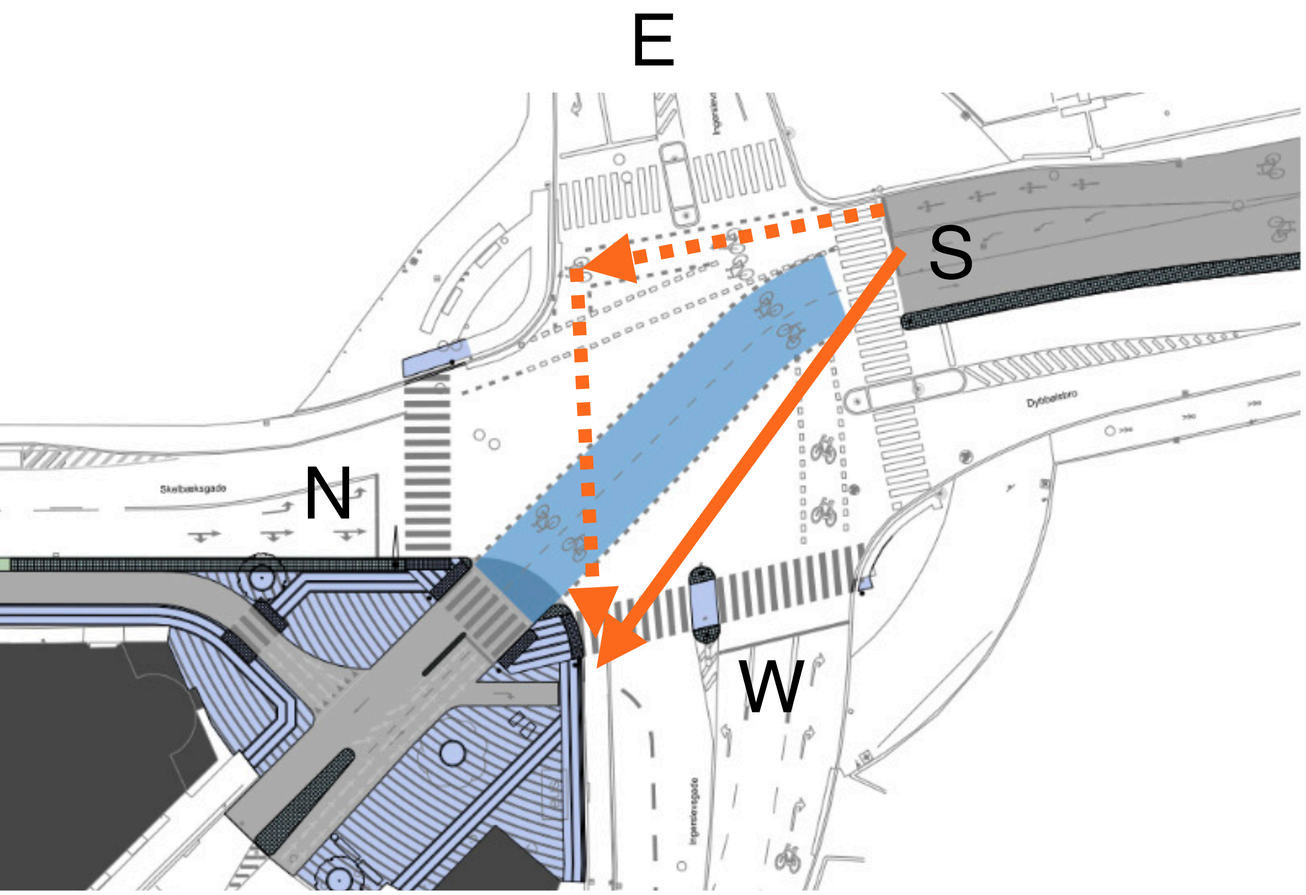


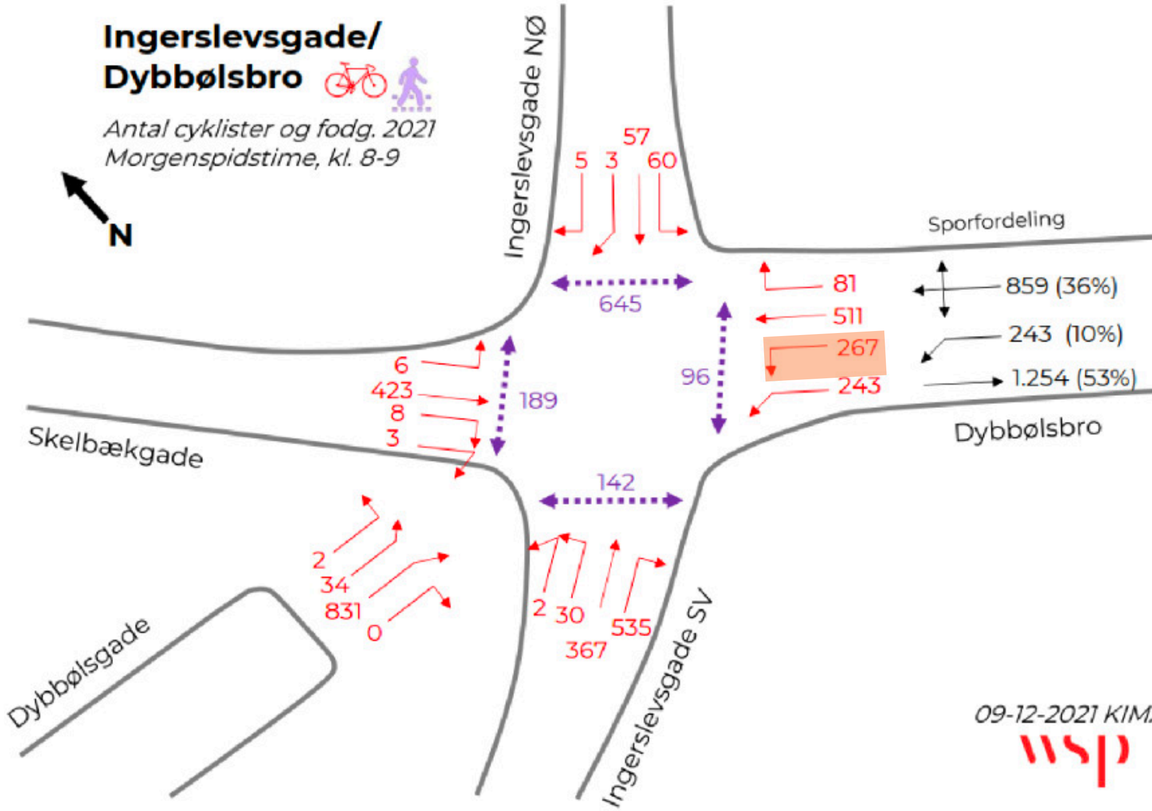


Figur 11. Antal cyklister og fodgængere i morgenspidstimen. Trafiktælling 2021.

- No solution for E→S

Anticipated issues

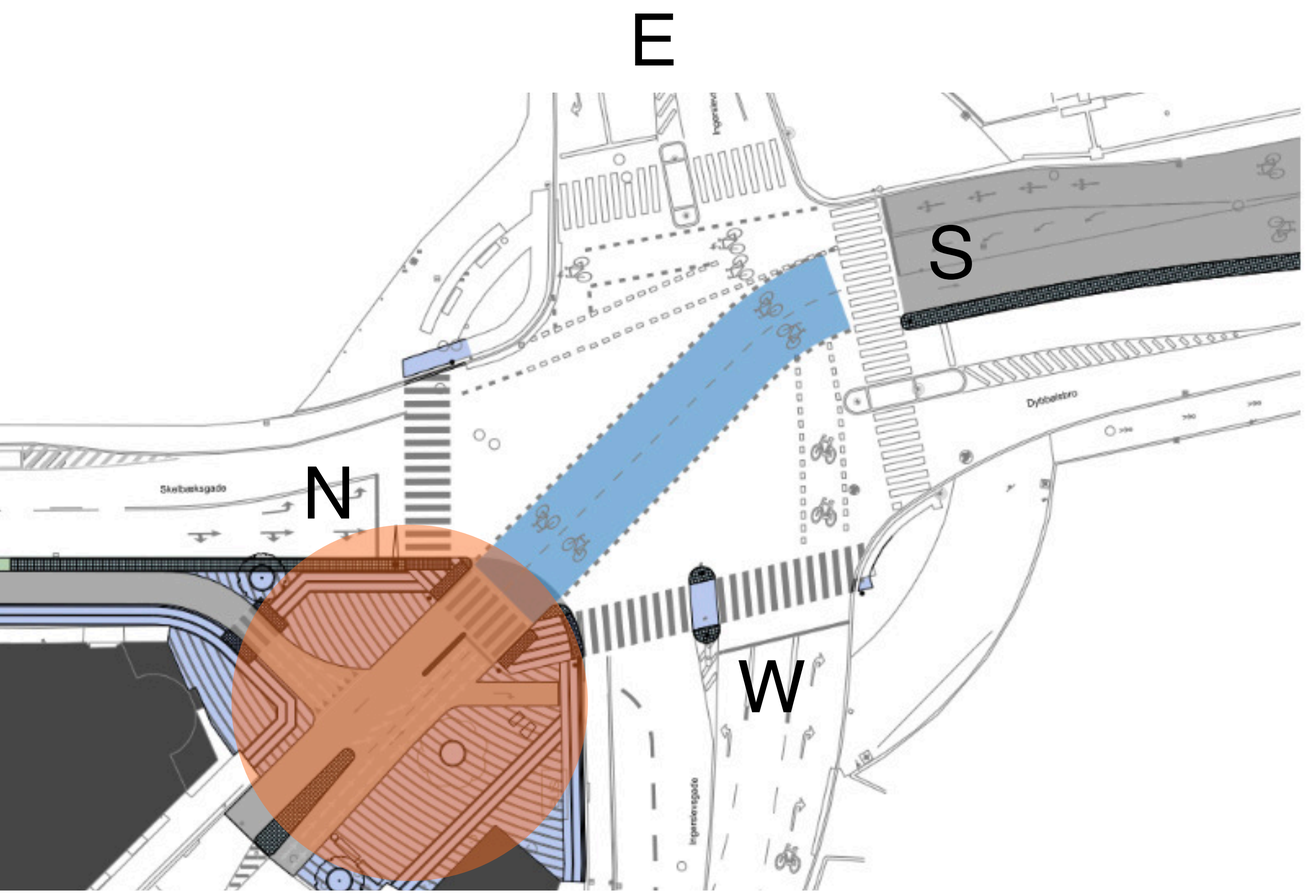




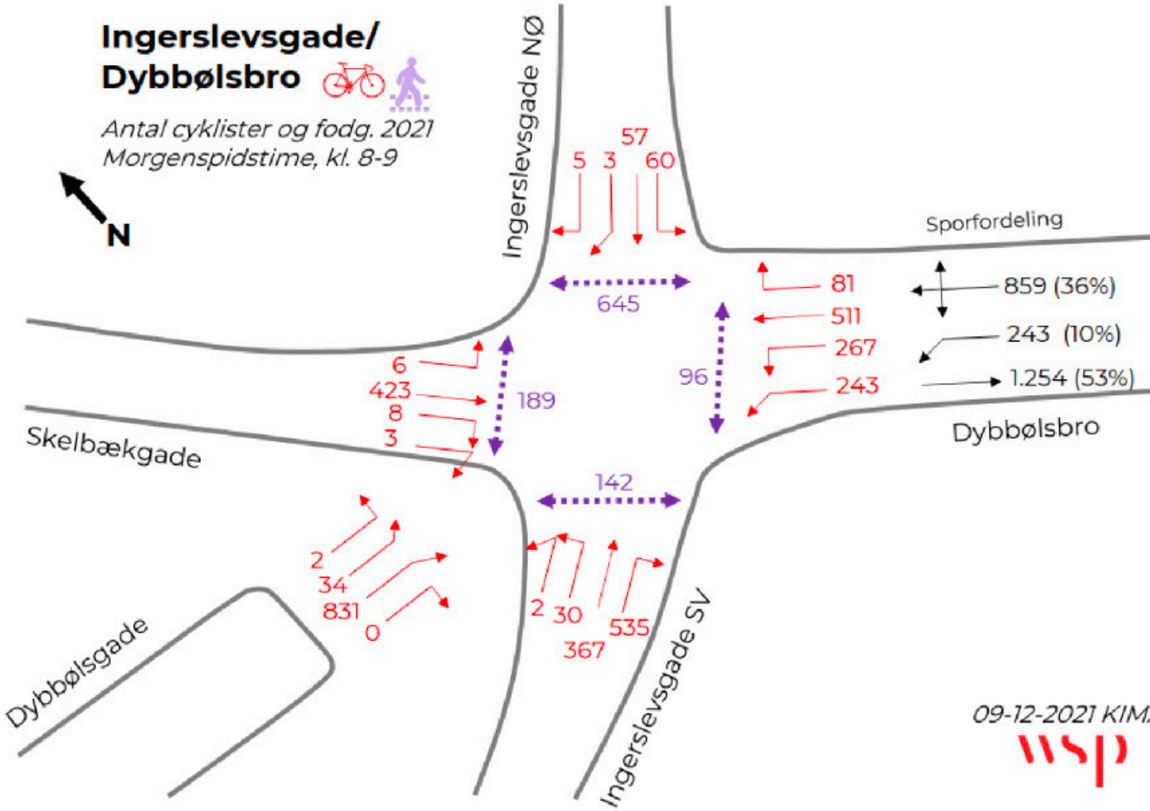
Figur 11. Antal cyklister og fodgængere i morgenspidstimen. Trafiktælling 2021.

- No solution for E→S
- New problem: S→W

Anticipated issues



- No solution for E→S
- New problem: S→W
- Increasing complexity (Yrsa plads)



Figur 11. Antal cyklister og fodgængere i morgenspidstimen. Trafiktælling 2021.

- Lack of queuing spaces
- Uni- to Bi-directional switch

Lind, A., Honey-Roses, J., & Corbera, E. Transp Let, 13(10), 728–737 (2021)

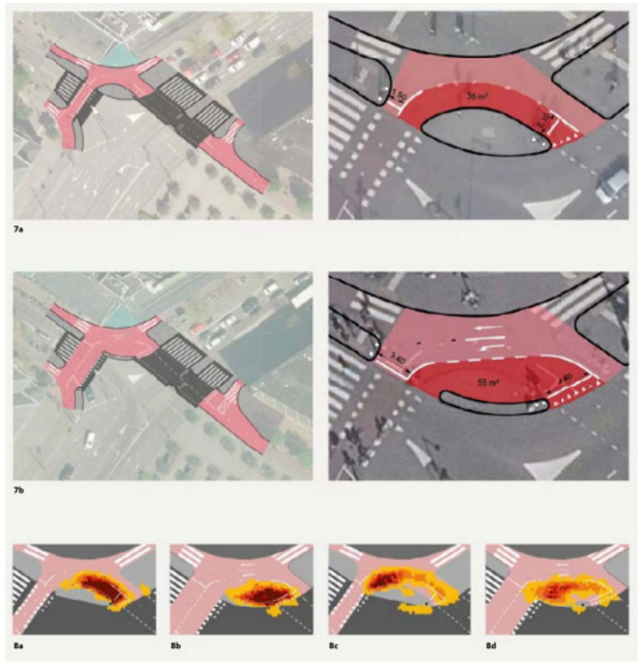
The underlying issue is car-centric design

Why is vehicular traffic flow prioritized in CPH?

Goes against science and international best practices

The underlying issue is car-centric design

Why is vehicular traffic flow prioritized in CPH?
Goes against science and international best practices



Evidence-based "agile" design of crossing/queuing spaces

Removal of traffic lights on Alexanderplein

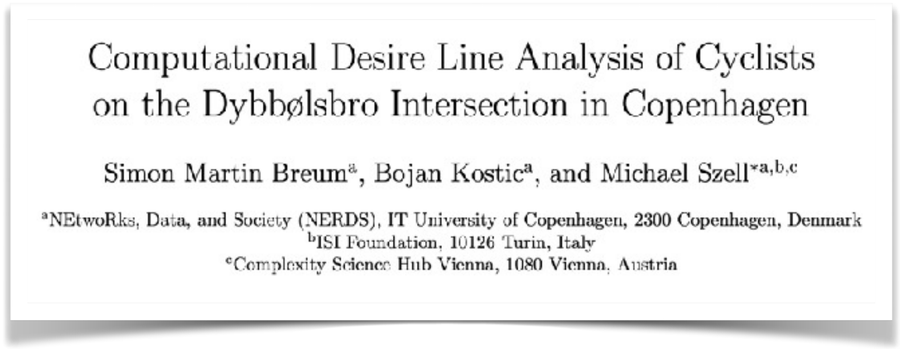
Prioritizing cycling desire lines (Oslo)

Drastic speed reductions to protect people from massive public health hazard of cars

Hahn & te Broemmelstroet, Transp Res Int P 9, 100289 (2021)
Gemeente Amsterdam (2018)
Hartmann & Abel, ITE J 90(5), 32-38 (2020)
Klanjcic, Gavin, Tizzoni, Szell, EPJ Data Sci 11, 27 (2022)

For pre/post analysis, we could re-run our study after re-design

https://arxiv.org/abs/2211.01301



Computational Desire Line Analysis of Cyclists on the Dybbølsbro Intersection in Copenhagen

Simon Martin Breum[a], Bojan Kostic[a], and Michael Szell[*a,b,c]

[a]NEtwoRks, Data, and Society (NERDS), IT University of Copenhagen, 2300 Copenhagen, Denmark
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Future research/improvements:

Videos for counting already recorded, add our algorithms

Extend algorithms: Near-misses

Use multiple cams to prevent occlusion/bias

Scale up to many intersections

Citizen science: like Telraam

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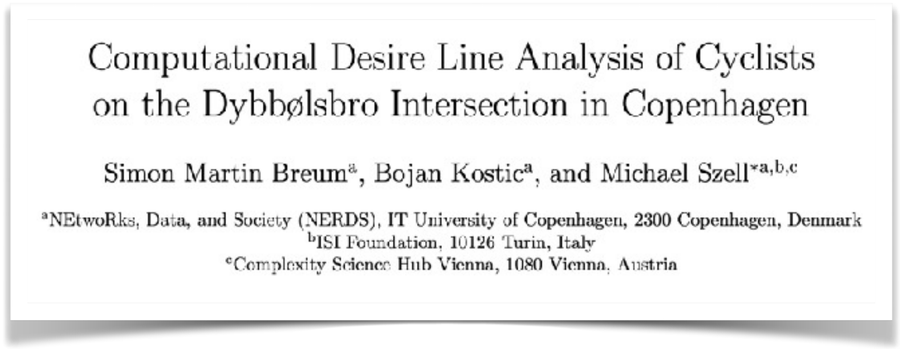
For pre/post analysis, we could re-run our study after re-design

https://arxiv.org/abs/2211.01301



Computational Desire Line Analysis of Cyclists on the Dybbølsbro Intersection in Copenhagen

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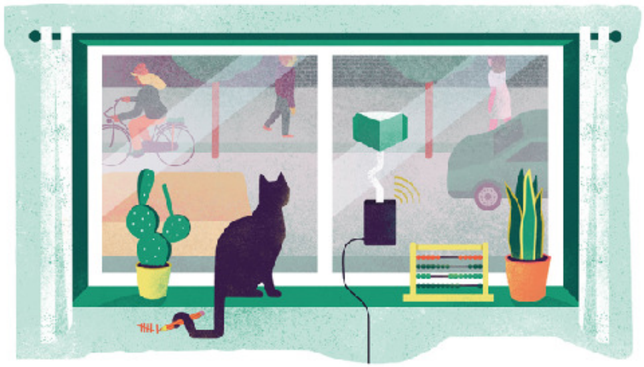

Bottleneck: Funding

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