Attractors: A Strategy to Foster Car Substitution

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September 23-28, 2024

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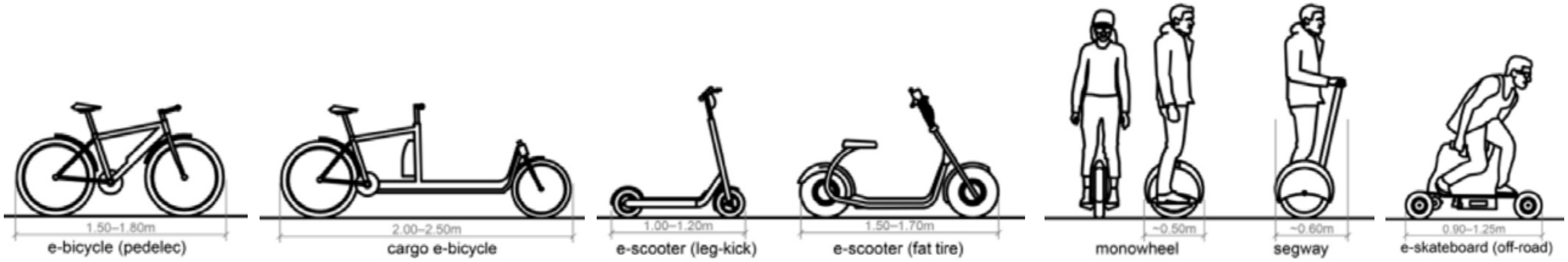
Research context

Urban attractors in micromobility: A case of design for social viscosity applied in two-wheeled electric transportation.



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Design challenge

- Elevate the riding experience of cyclist to levels of safety and comfort similar to those car drivers enjoy.
  - Protecting cyclists by **riding in swarms**
  - **Prioritizing circulation** for swarms with critical mass

- Reduce CO2 emissions by facilitating car substitution in urban settings:
  - E-bikes could **substitute 11-26% of car rides** in the United States.
  - 15% e-bike share of the total number of trips per day could amount to a **reduction of 11% of Portland's transportation emissions** (921 metric tons of CO2 per day).
  - **Impact of mode substitution** is estimated at 9.3 miles/vehicle traveled per day in the United States.

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Urban Attractors

- An urban attractor is a centrally-controlled global position that travels at an adaptive speed on bicycle paths and roads.
- Benefits:
  - Prioritized mobility
  - Increased safety
  - Elevated riding experience
  - Multimodal transit coordination

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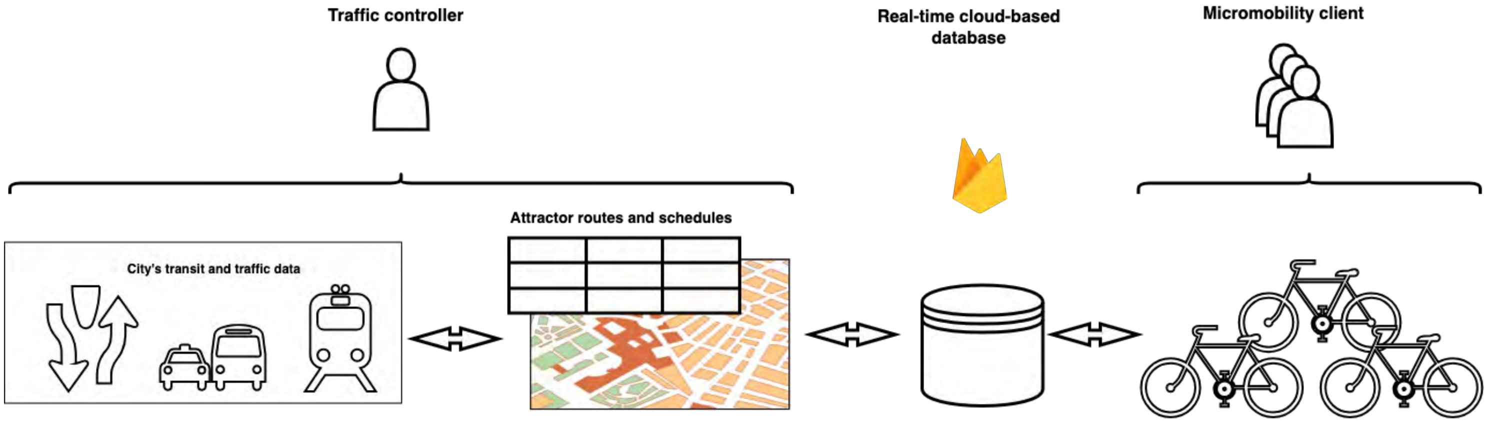
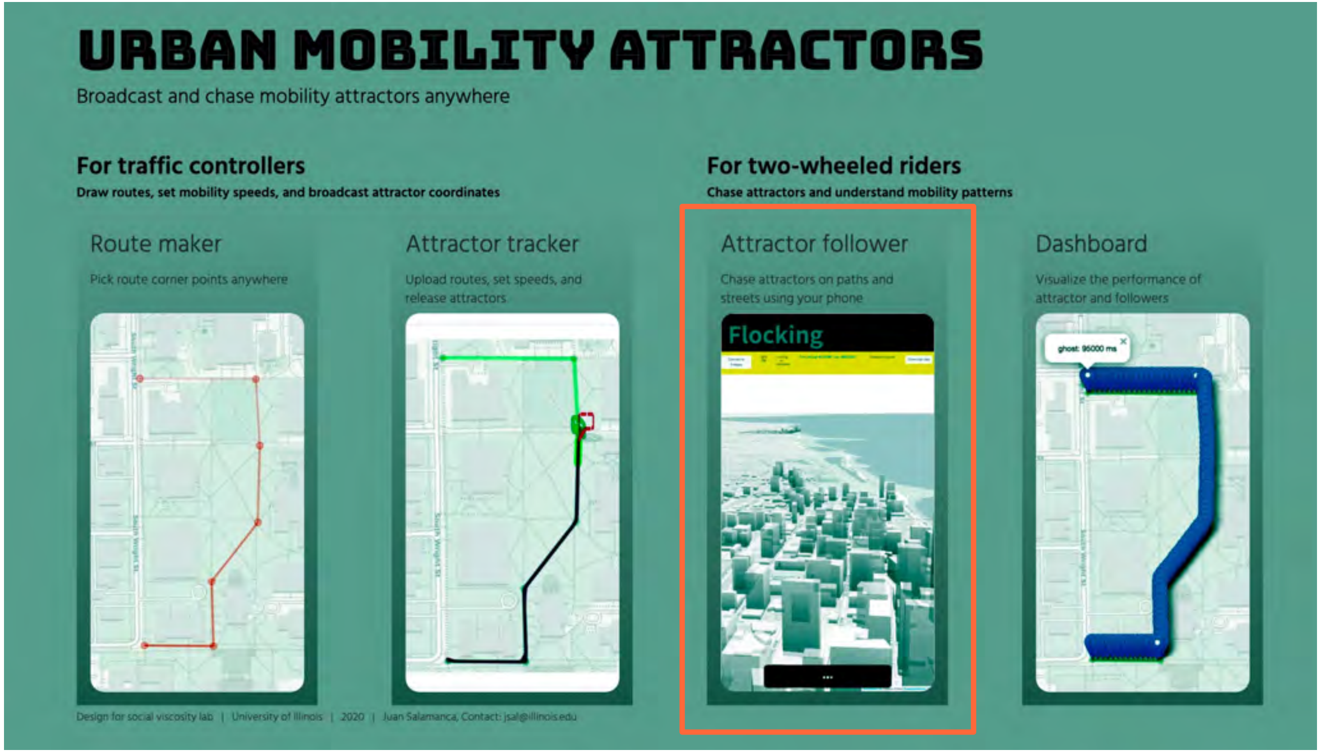
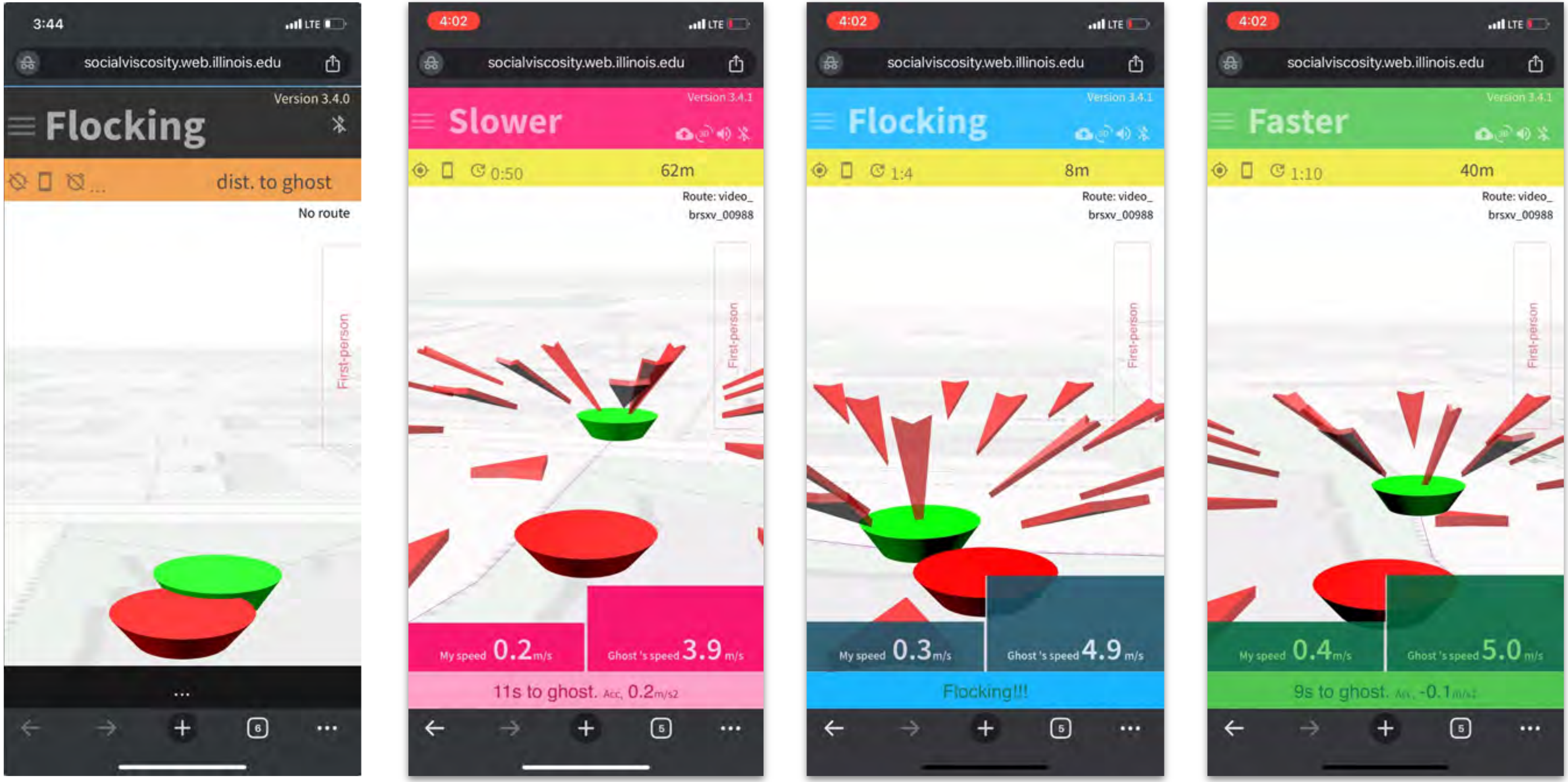
System architecture





System of applications


3:44
socialviscosity.web.illinois.edu
Version 3.4.0
Flocking
dist. to ghost
No route
First-person
4:02
socialviscosity.web.illinois.edu
Version 3.4.1
Slower
0:50
62m
Route: video_
brsxv_00988
First-person
My speed 0.2 m/s
Ghost 's speed 3.9 m/s
11s to ghost. Acc. 0.2 m/s2
4:02
socialviscosity.web.illinois.edu
Version 3.4.1
Flocking
1:4
8m
Route: video_
brsxv_00988
First-person
My speed 0.3 m/s
Ghost 's speed 4.9 m/s
Flocking!!!
4:02
socialviscosity.web.illinois.edu
Version 3.4.1
Faster
1:10
40m
Route: video_
brsxv_00988
First-person
My speed 0.4 m/s
Ghost 's speed 5.0 m/s
9s to ghost.

Research study

- To what extent can cyclists converge around the attractors?
- Does assistant pedaling affect cyclists' response to converging signals?

Study conditions

Independent variable:

- ➔ Proximity maintenance
- ➔ Time to segregation

Dependent variable:

- ➔ Type of bicycle: conventional or assisted

Participant selection:

- ➔ 7 Groups of 8 individuals, N= 56
- ➔ 32 male, 24 female, average age 28.

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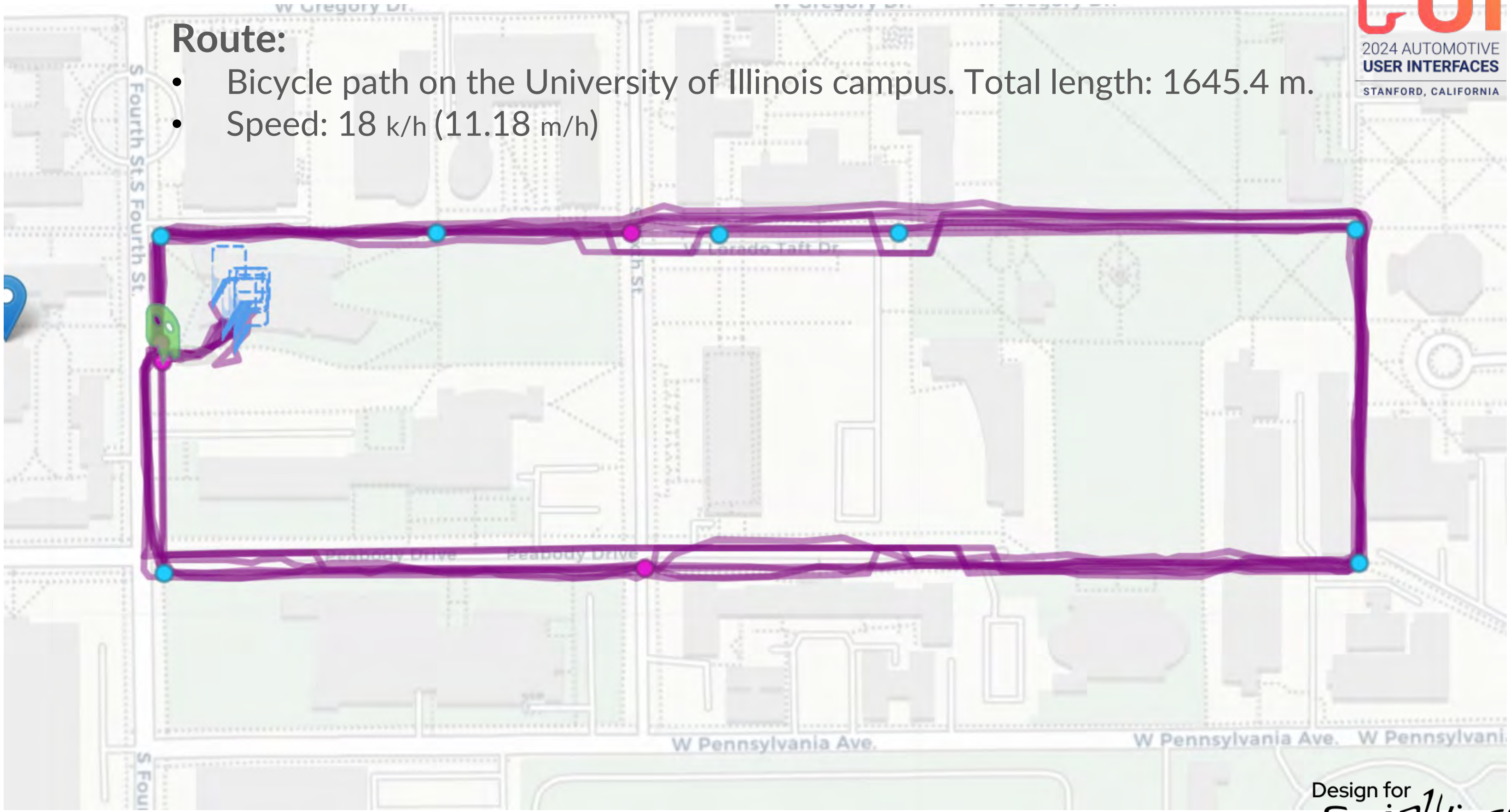
Route:

- Bicycle path on the University of Illinois campus. Total length: 1645.4 m.
- Speed: 18 k/h (11.18 m/h)



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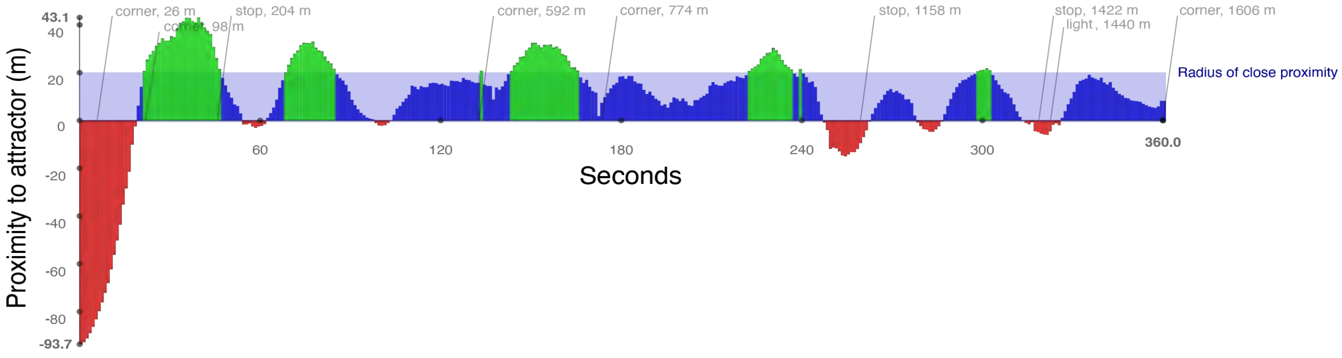
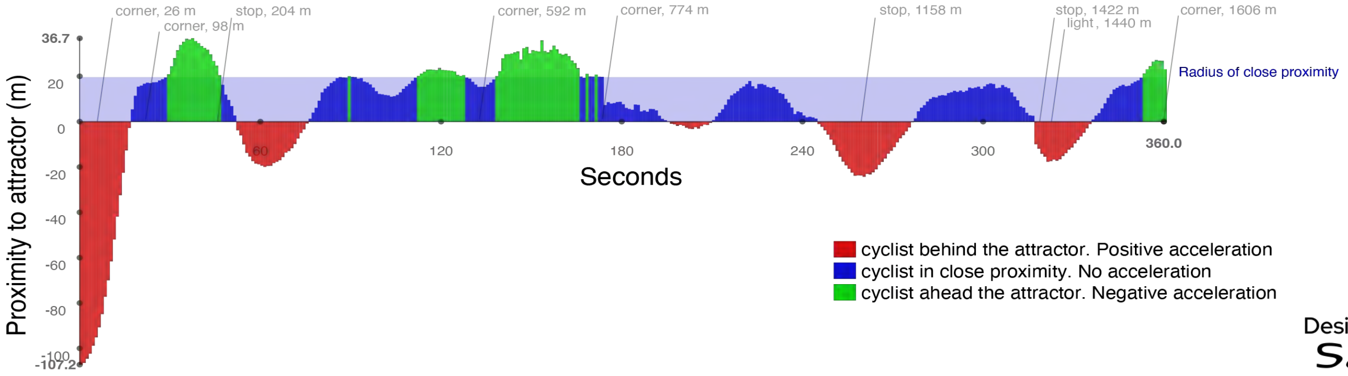
1. General behavior of cyclists

Distribution of acceleration events over the duration of the test

Electric bicycle



Conventional Bicycle



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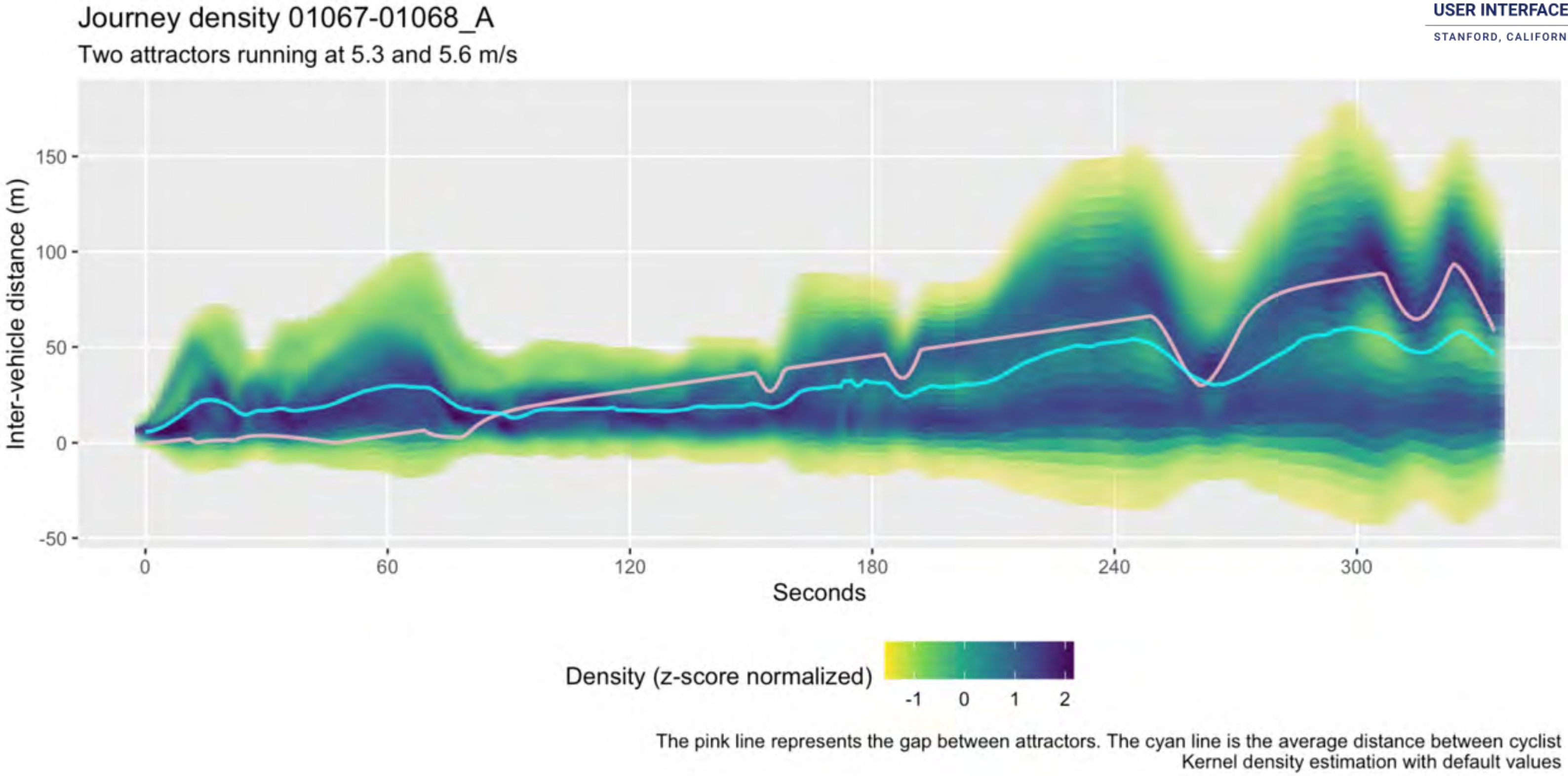
2. Analysis of time to congregation

Swarm Density
Hierarchical clustering, method complete (i.e. max distance between clusters).



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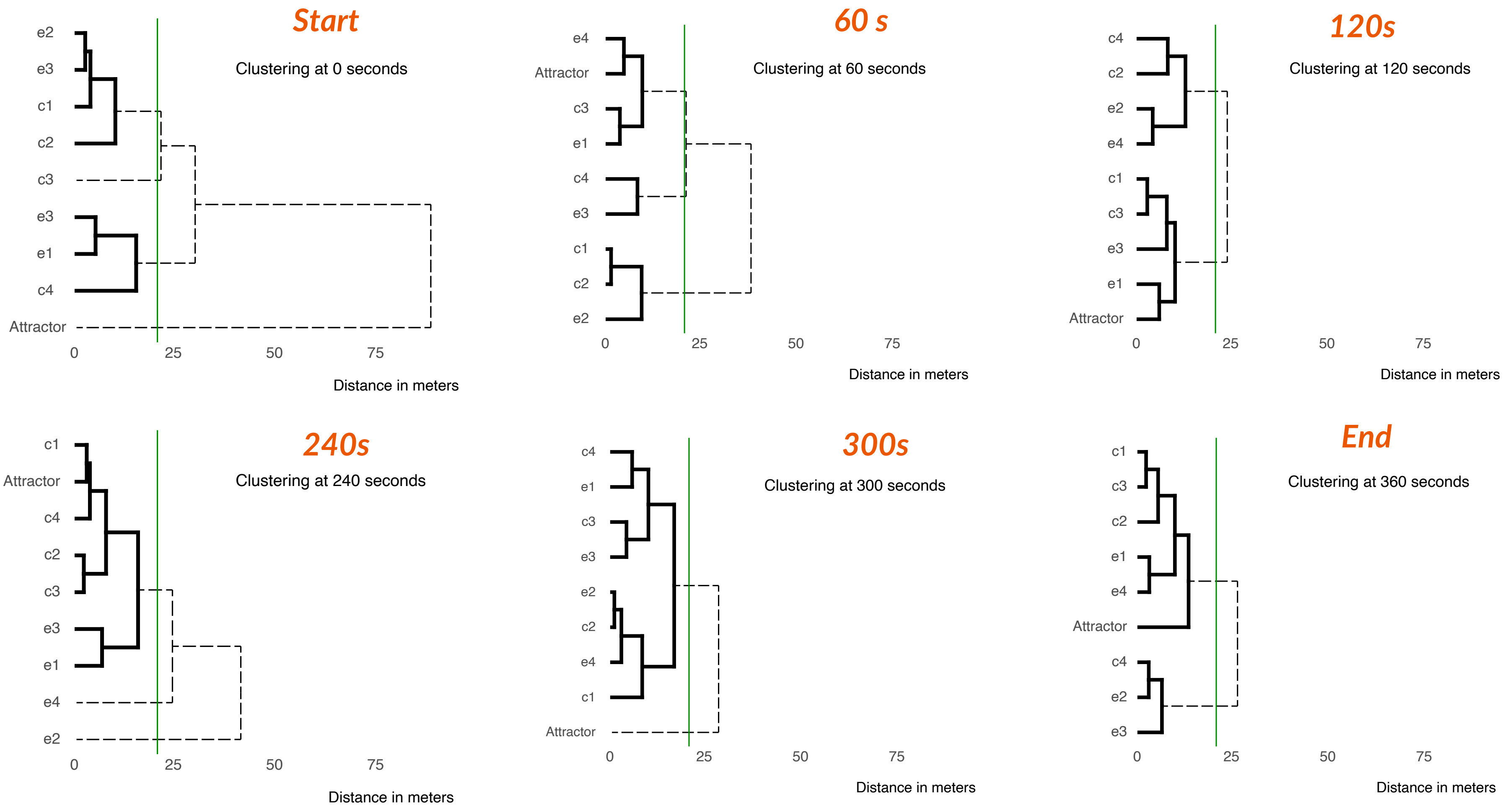
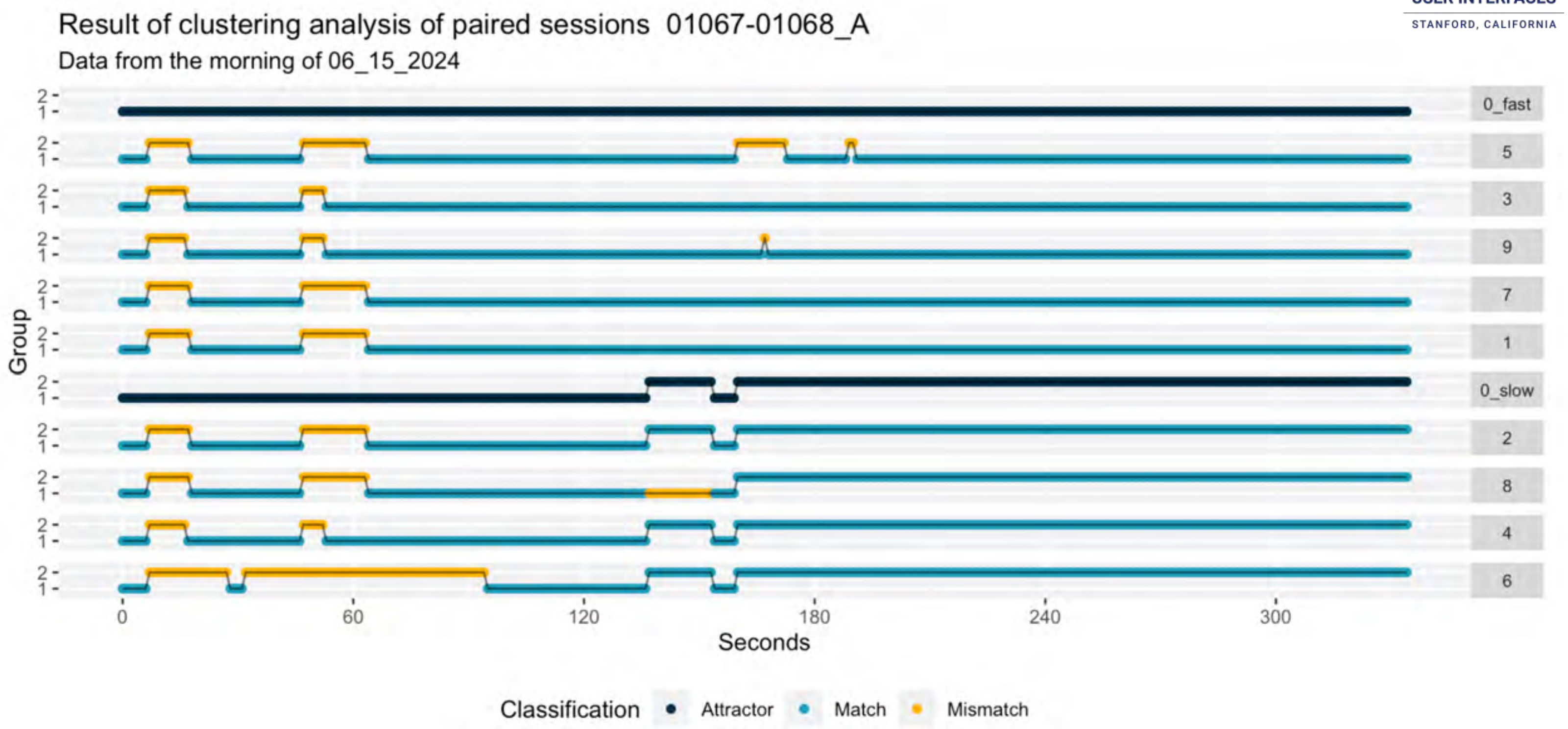

Start
Clustering at 0 seconds
e2
e3
c1
c2
c3
e3
e1
c4
Attractor
0
25
50
75
Distance in meters
60 s
Clustering at 60 seconds
e4
Attractor
c3
e1
c4
e3
c1
c2
e2
0
25
50
75
Distance in meters
120s
Clustering at 120 seconds
c4
c2
e2
e4
c1
c3
e3
e1
Attractor
0
25
50
75
Distance in meters
240s
Clustering at 240 seconds
c1
Attractor
c4
c2
c3
e3
e1
e4
e2
0
25
50
75
Distance in meters
300s
Clustering at 300 seconds
c4
e1
c3
e3
e2
c2
e4
c1
Attractor
0
25
50
75
Distance in meters
End
Clustering at 360 seconds
c1
c3
c2
e1
e4
Attractor
c4
e2
e3
0
25
50
75
Distance in meters



Result of clustering analysis of paired sessions 01067-01068_A
Data from the morning of 06_15_2024
Group
2
1
0_fast
5
3
9
7
1
0_slow
2
8
4
6
0
60
120
180
240
300
Seconds
Classification
Attractor
Match
Mismatch

Discussion

To what extent can cyclists converge around the attractors?

- Cyclists can converge around attractors and differentiate them when they are at least 45 meters apart

Does assistant pedaling affect cyclists' response to converging signals?

- Assisted bicycles help riders to achieve accurate proximities to the attractors
- Riders with powerful engines might tend to overshoot

Positive effects of impromptu grouping

- De-individuation, formation of common group identity.
- Interdependence and connectedness. Wiltermouth & Heath (2009)
- Compliance. Wiltermouth (2012)

Undesired effects of impromptu grouping

- De-individuation.
- Biasing
- Increases risk of collision

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Acknowledgement: Part of this research was done with the support of VEO micromobility.