

Power and efficiency – a question for cyclists and infrastructure

(from vehicle dynamics perspective)

Malte Rothhämel at Cycling & Society (2026-08-25)

Malte Rothhämel

- Associate Professor in the Vehicle Dynamics group at KTH, specializing in Vehicle System Technology.
- Research interests
  - bicycles, with a particular focus on their vehicle dynamics.
  - vertical dynamics (comfort)
  - longitudinal dynamics (energy consumption)
- Otherwise
  - human-machine interaction in vehicle steering and fail-safe chassis architectures for autonomous operation

What deters people from utility-cycling?

- Comfort on bicycles (vertical dynamics)
- Tyre rolling resistance
- Energy modelling (longitudinal dynamics)



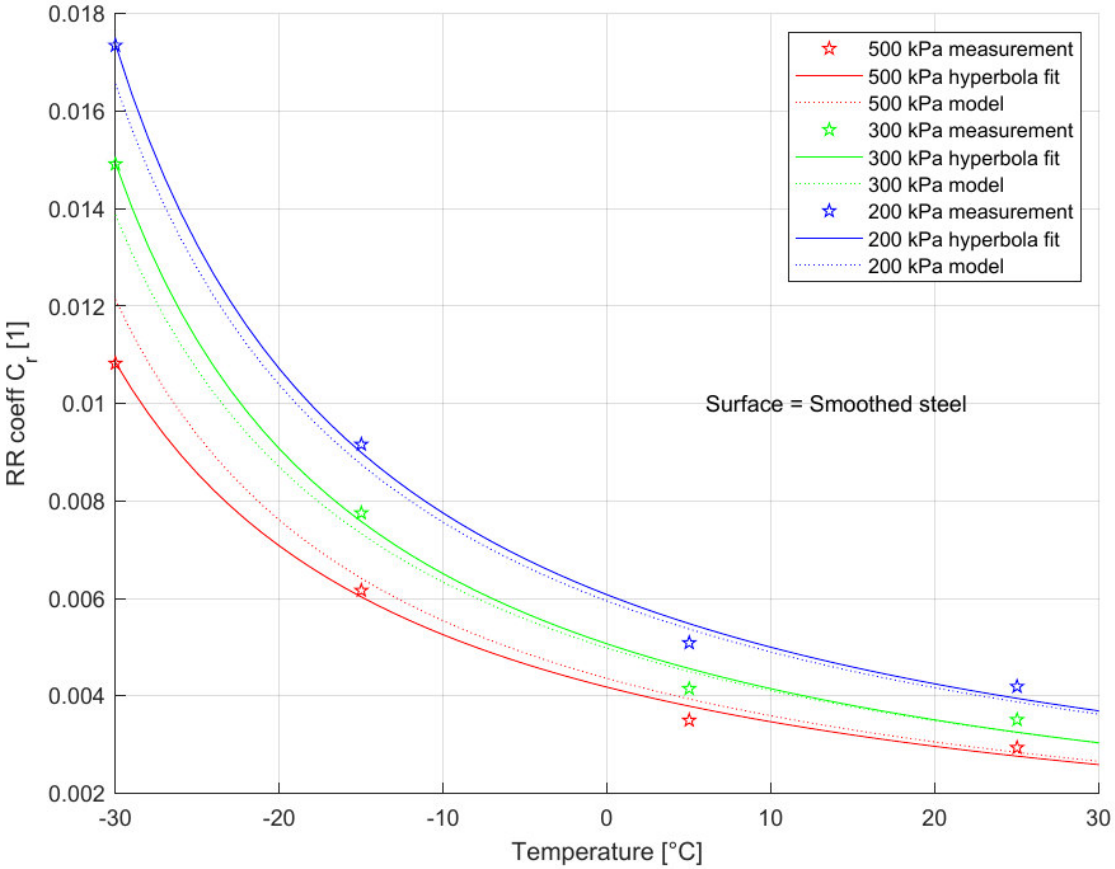
What deters people from utility-cycling?

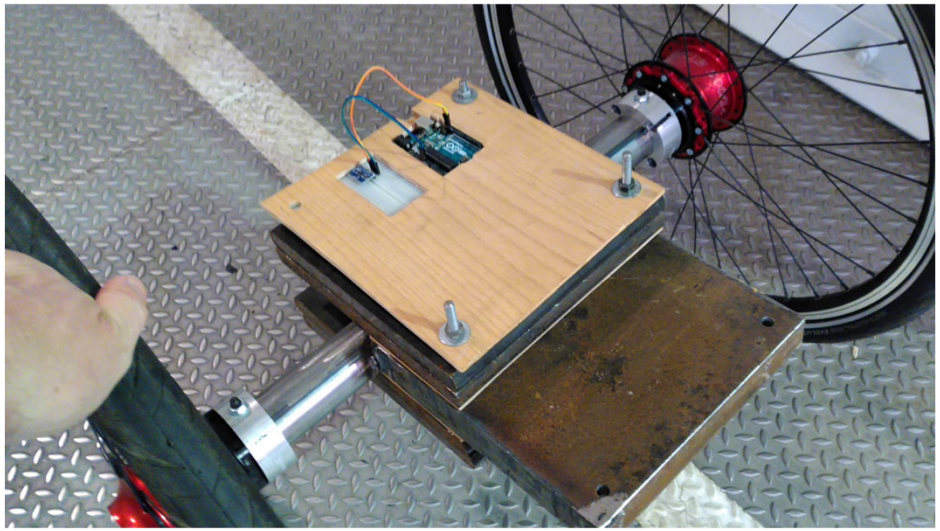
- Bicycle theft
- On site infrastructure
- Policies
- etc.

- Bicycle safety
- Lightweight structure
- Crash compatibility
- etc.



Bicycle rolling resistance – temperature





DOI: 10.1504/IJVSMT.2023.132317

Motivation

https://tyrens.maps.arcgis.com/apps/MapTour/index.html?appid=cb4f1430b97648fc937fab4d70dfa98e#

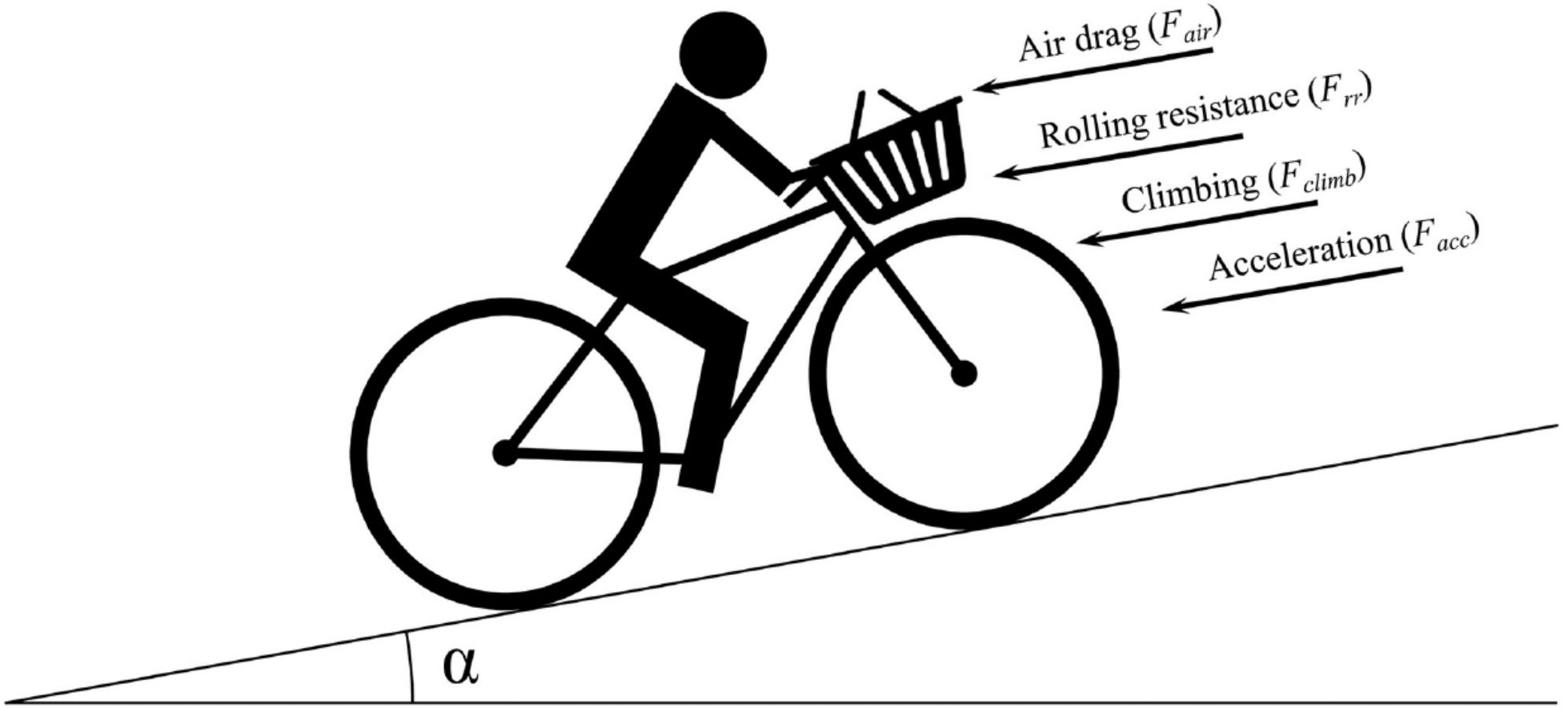


Example V259 in the south of Stockholm, connection to E4. (subject to possible changes)

Potential use



Bicycle Power

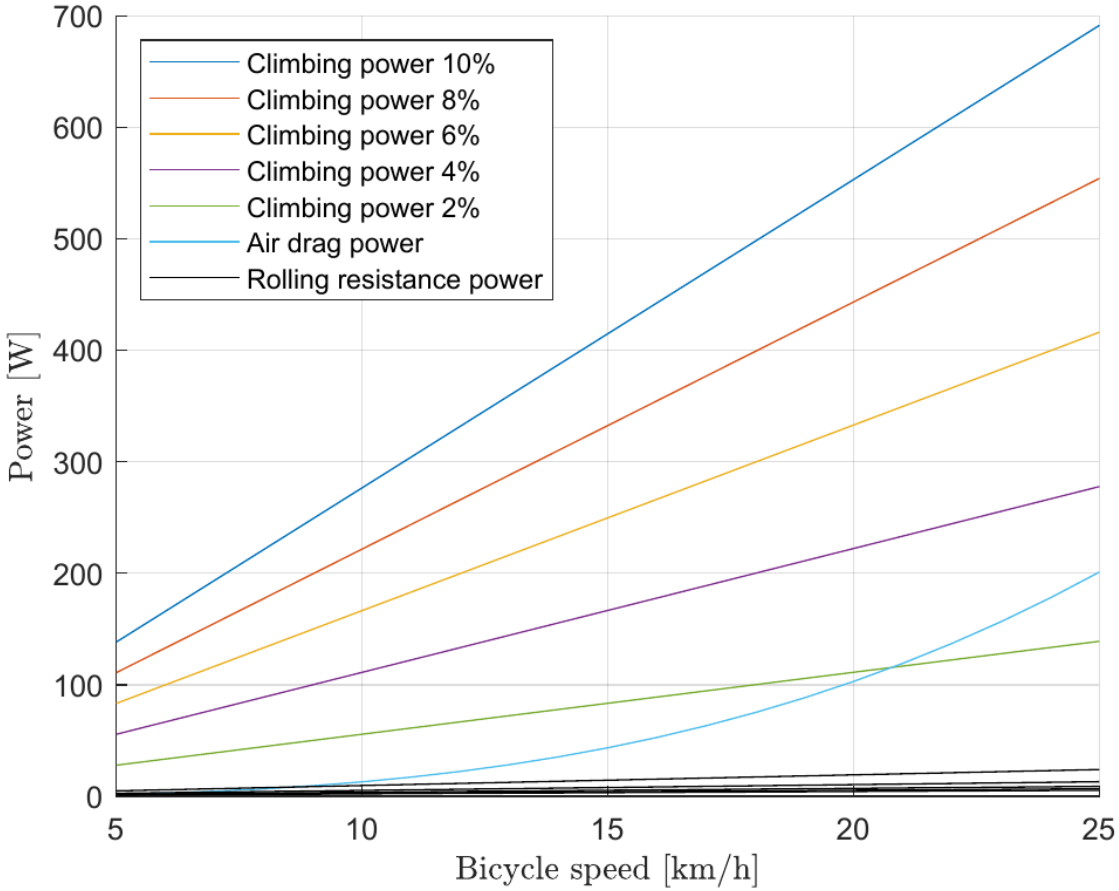


Bicycle energy modelling





Bicycle Power



Cyclist Power – human power conversion

VO_2 max

Männer[6]

Alter [Jahre]	Dezil								
	10 %	20 %	30 %	40 %	50 %	60 %	70 %	80 %	90 %
20…29	32,9	35,91	38,95	40,5	41,9	45,0	46,55	49,5	52,3
30…39	31,3	34,4	37,4	38,9	40,5	41,9	46,0	48,1	49,5
40…49	29,8	32,9	34,4	37,4	40,5	41,9	43,5	46,6	48,1
50…59	28,4	29,8	32,9	34,4	35,9	37,4	41,9	41,9	46,6

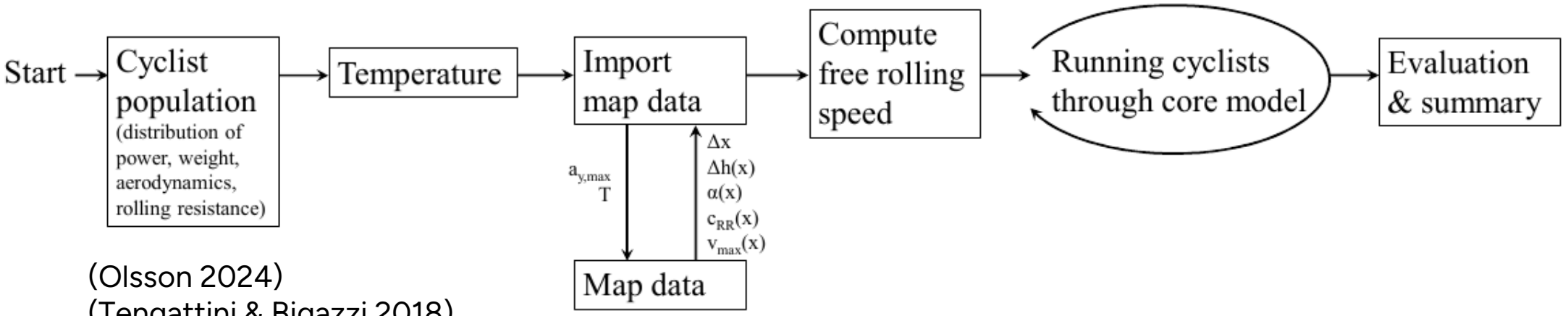
65% P_{max}
(Olsson 2024)

Table 1. Correlation of mechanical work rate on a bicycle and oxygen intake for women and men [44].

VO_2 to work rate (by Olsson)

	Work rate [W]	VO_2 [l/min]		Work rate [W]	VO_2 [l/min]
Men	100	1.45	Women	50	0.81
Men	150	2.09	Women	100	1.39
Men	193	2.65	Women	140	1.91

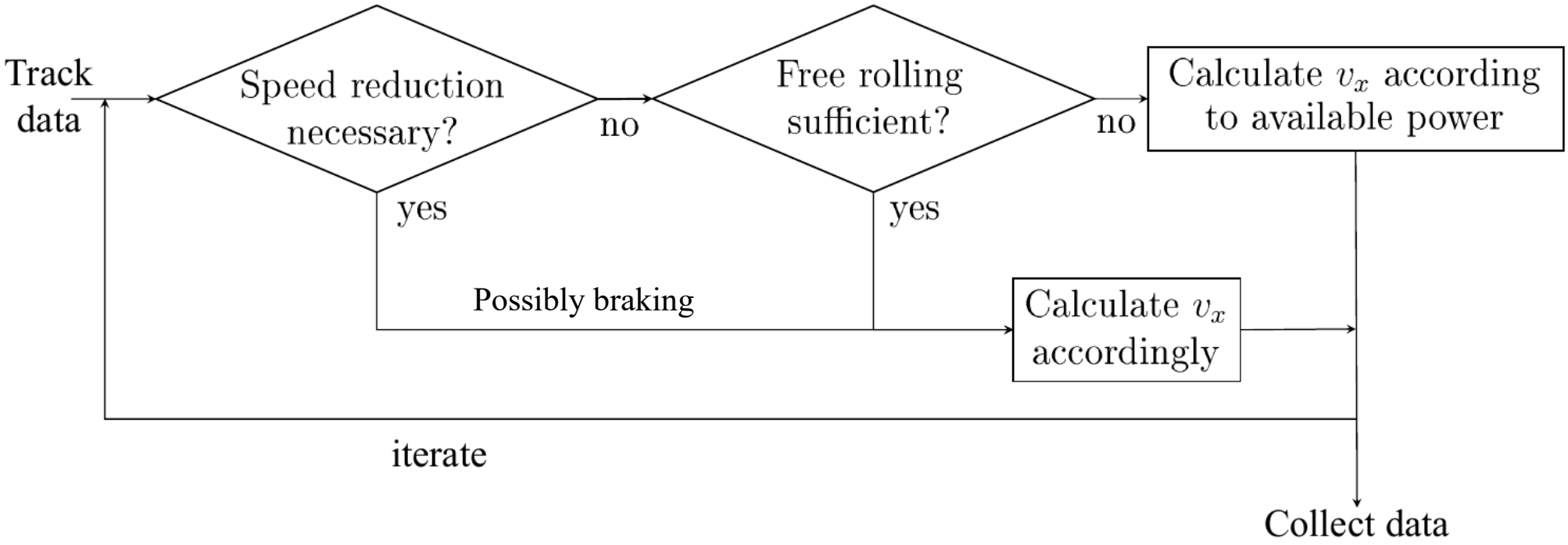
Cyclist Power



(Olsson 2024)
(Tengattini & Bigazzi 2018)

An Energy-Based Model for the Micro-Simulation of a Synthetic Population of Free Cyclists
DOI: 10.3390/su17030931

Cyclist Power



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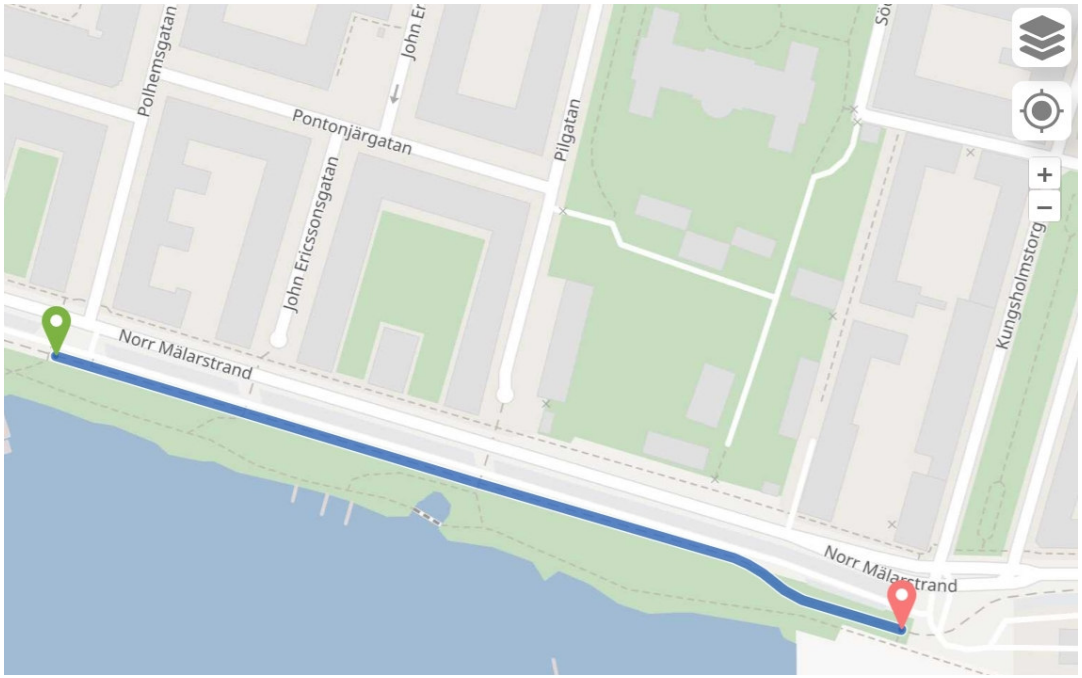
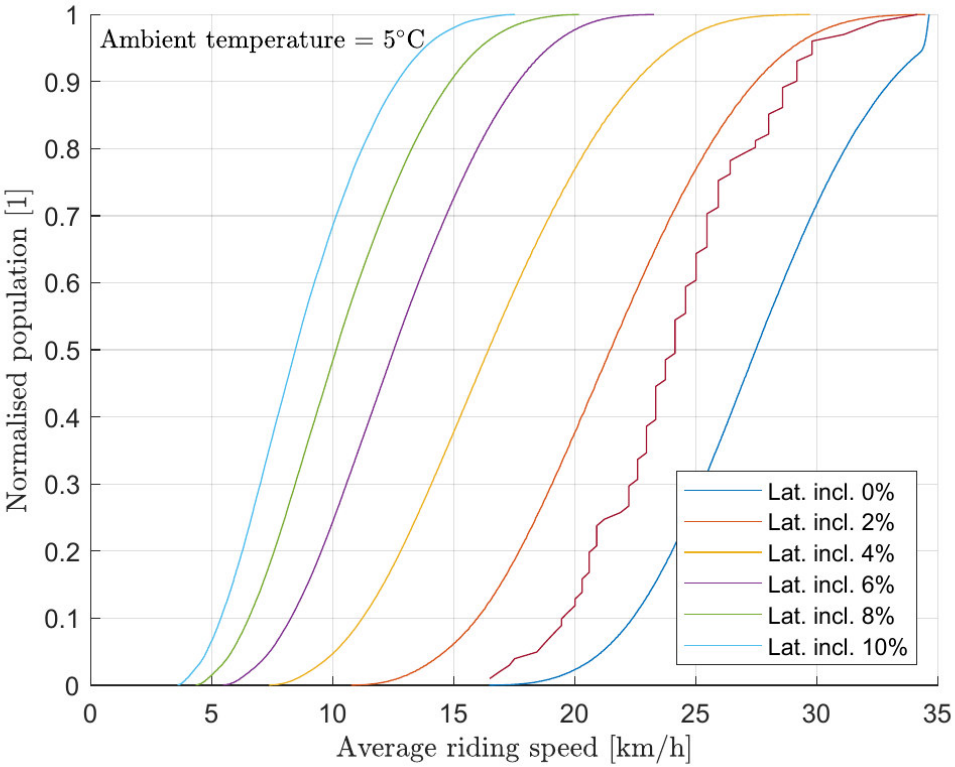
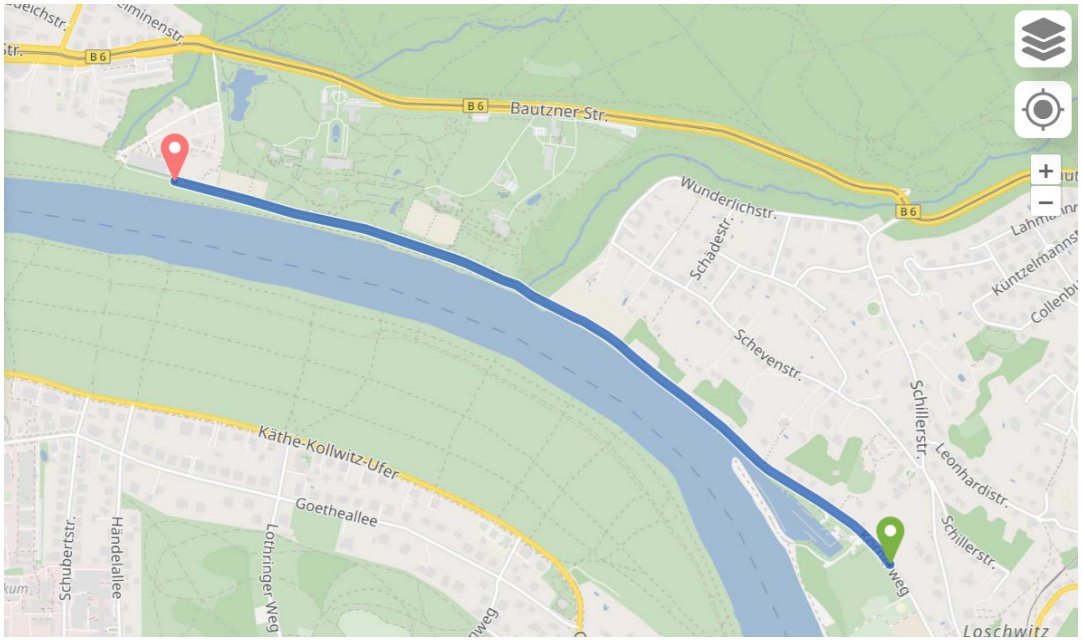
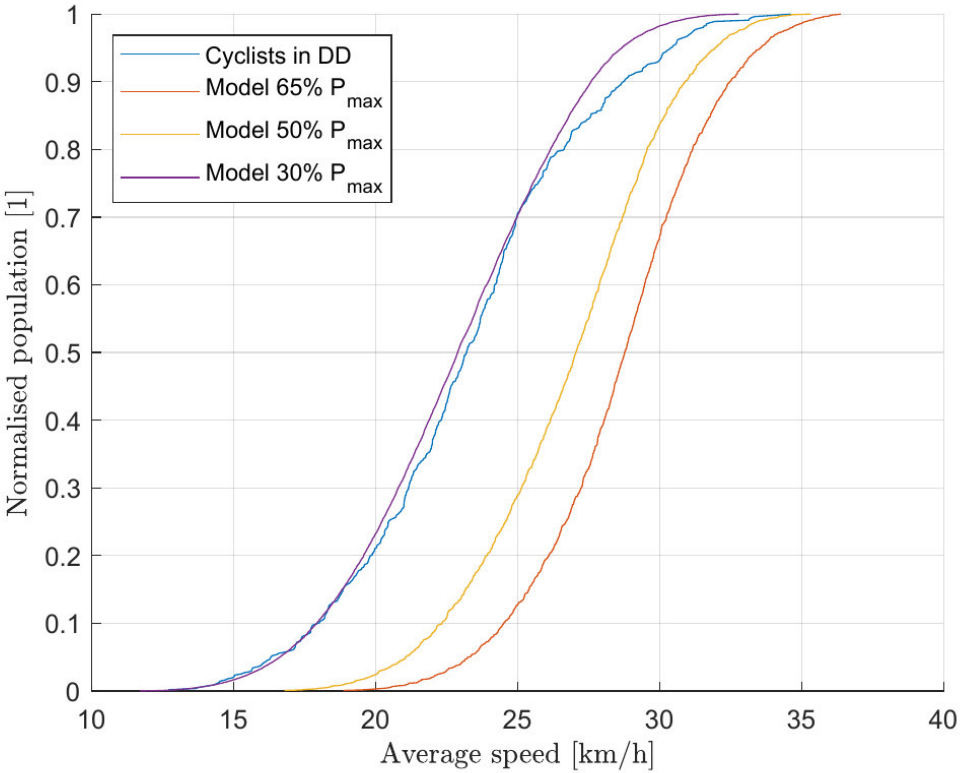
Cyclist Speed





Cyclist Power





Cyclist Power – future work

- 65% representative?
- Max downhill speed / max lateral acceleration?
- Further validation (up / down / stops)
- Pedelecs / eBikes
- GIS implementation -> line-of-sight obstruction
- Distribution of drive line losses
- Simplification?

Outside this model:

- Qualitative aspects (road surface/comfort, absence of car traffic, green surroundings, …)



Interested in collaboration?

Questions?

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