



Cyclist's Performance Prediction

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optimization DNN



BACKGROUND

DATA ANALYSIS

MODEL RESULTS

FURTHER WORK



- Performance
 - = The amount of energy transferred or converted per unit time
 - = POWER in Watt
- A human traveling on a bicycle at 16–24 km/h using only the power required to walk → is the most energy-efficient means of human transport
- On firm, flat ground, a 70 kg person requires about 60watts to walk at 5 km/h. That same person on a bicycle, on the same ground, with the same power output, can travel at 15 km/h, so in these conditions the energy expenditure of cycling is one-third that of walking
- From a mechanical viewpoint, up to 99% of the energy delivered by the rider into the pedals is transmitted to the wheels (clean, lubricated new chain)

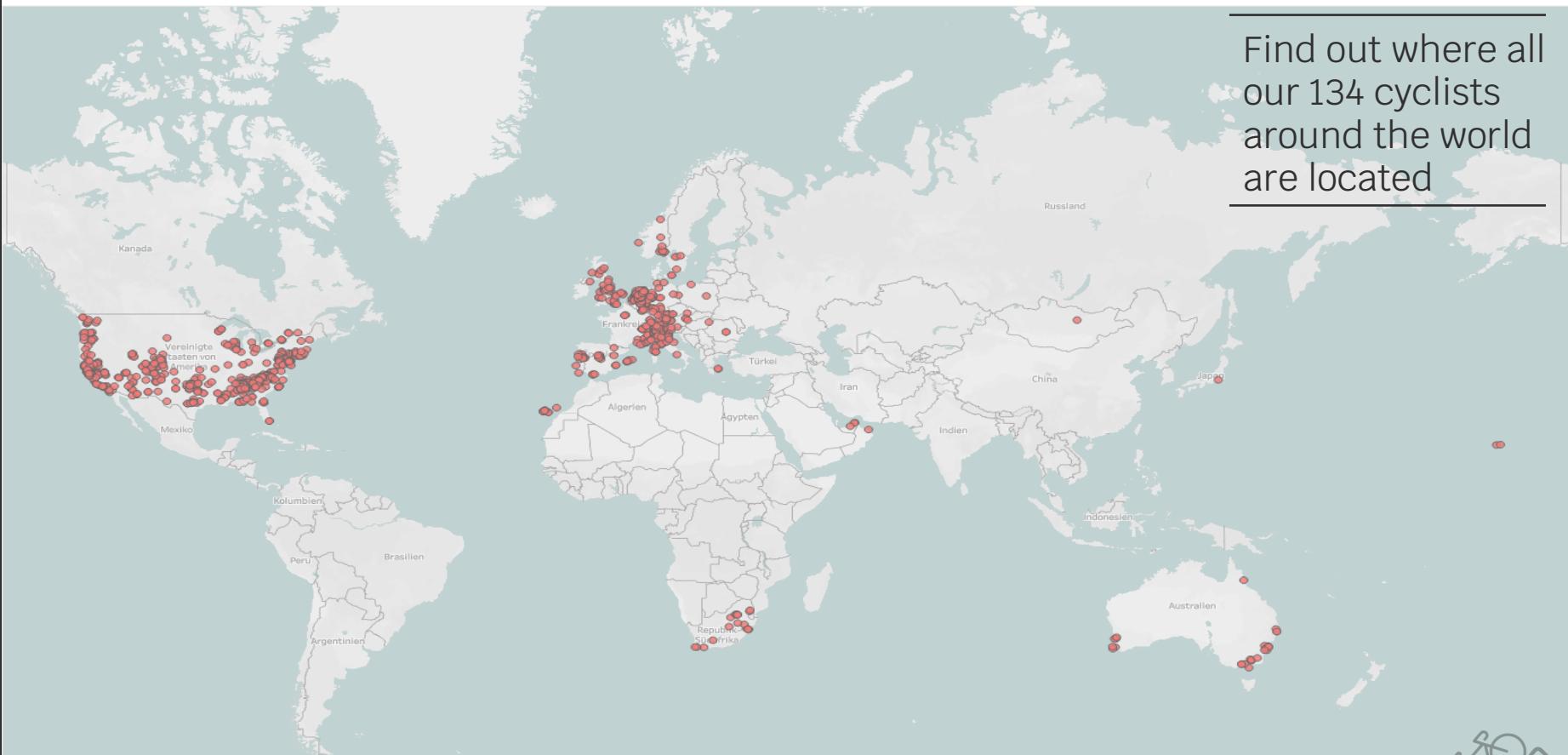
- Sports are developing towards increasingly scientific training methods with increasing amounts of data being collected from training sessions, bike packing trips, ultra races and competitions
- In cycling, it is standard to equip bicycles with small computers recording data from sensors such as power-meters, in addition to heart-rate, speed, altitude etc.
- Collected over time it becomes a lot of data that can be used to design training programs and follow up training loads with target to peak performance with reduced risk of overreaching, which otherwise may result in injuries, sickness, and degraded performance



BACKGROUND DATA ANALYSIS MODEL RESULTS FURTHER WORK



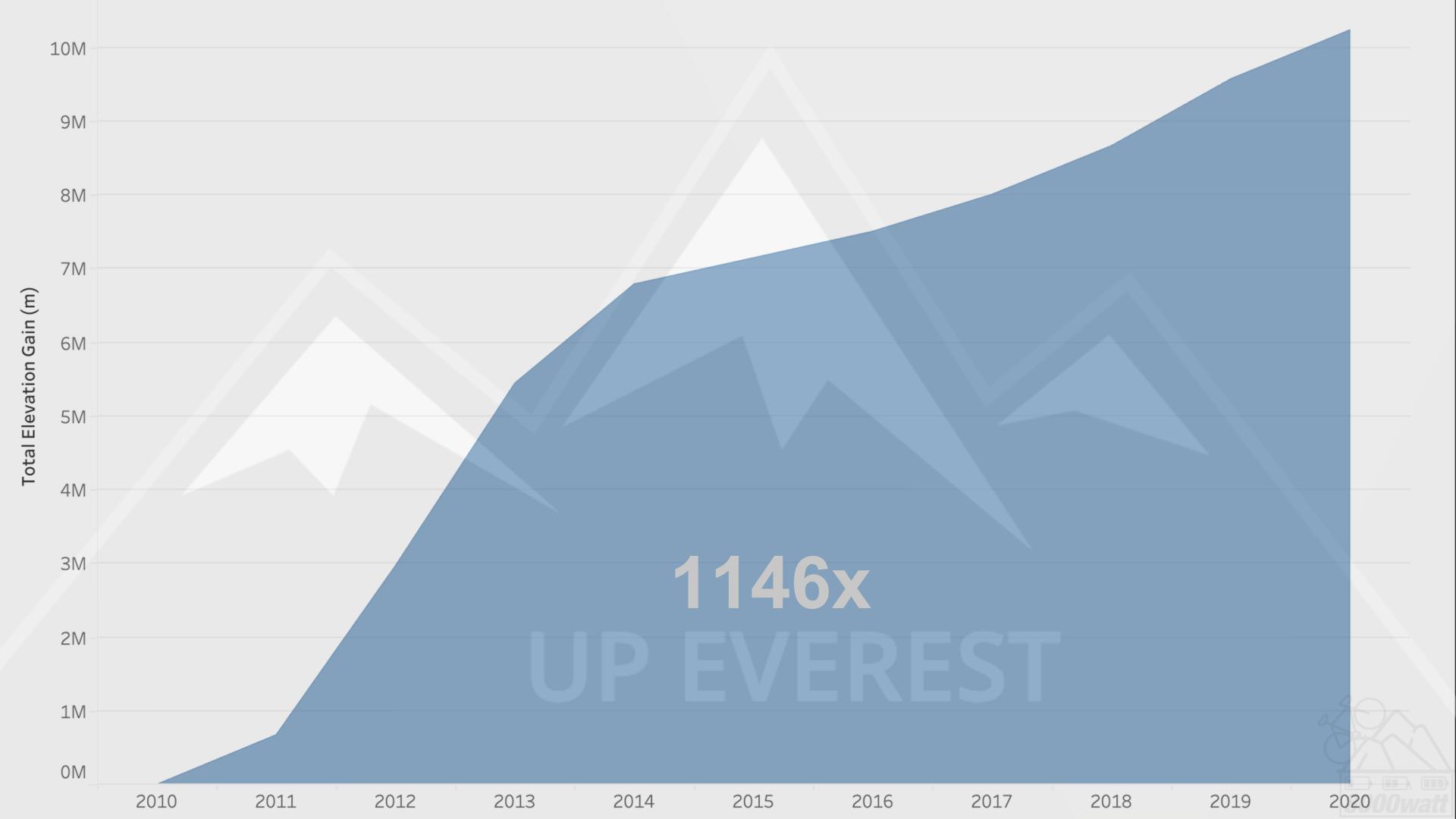
World map



Find out where all our 134 cyclists around the world are located

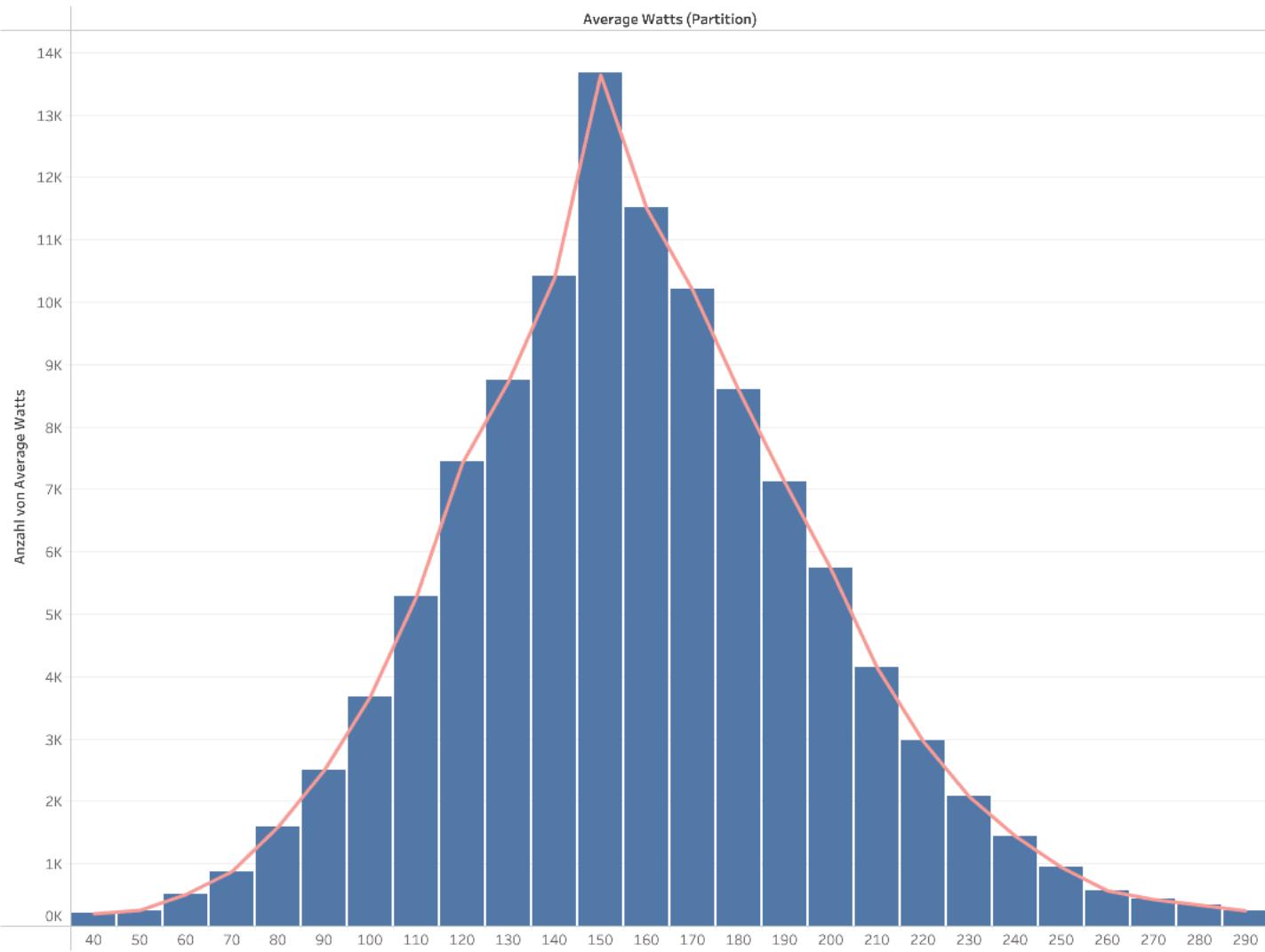
Awesome DATA ANALYSIS

- Started with 279.288 unique observations from 134 cyclists
- Started with 93 different features
- Data is provided in it's raw state (i.e. all in metres and seconds)
- Data frame goes from: 30/12/**1989** 16:00:00 to 31/03/2021 10:35:49
- Longest ride: **3192.1km**
- 20.658 observations with **ZERO** elevation





Average Watts (Partition)



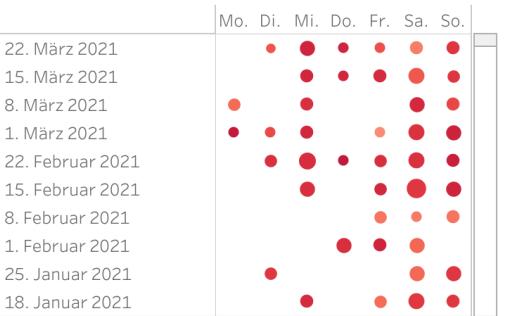
Athlete Name
95Select Year(s)
Mehrere Werte

Year(s)

2020

2021

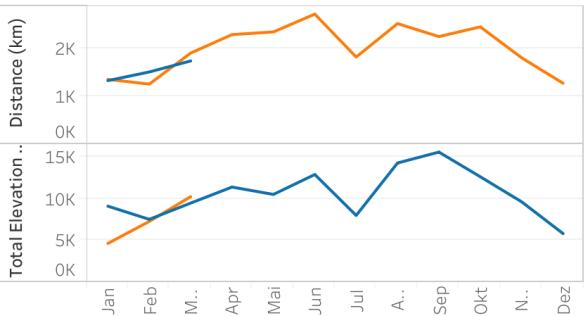
Training per Day



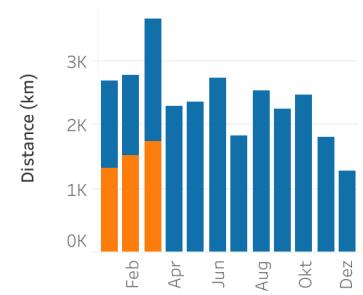
Average Distance per Month



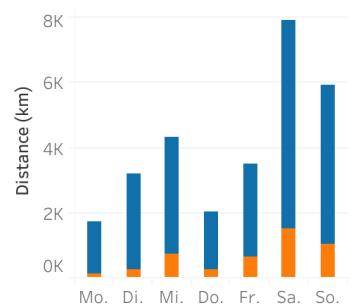
Total Distance & Elevation per Month



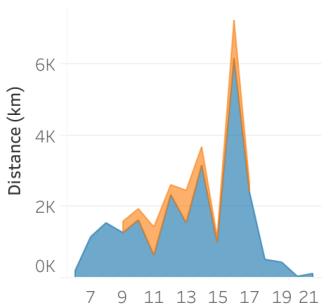
Training Density per Month



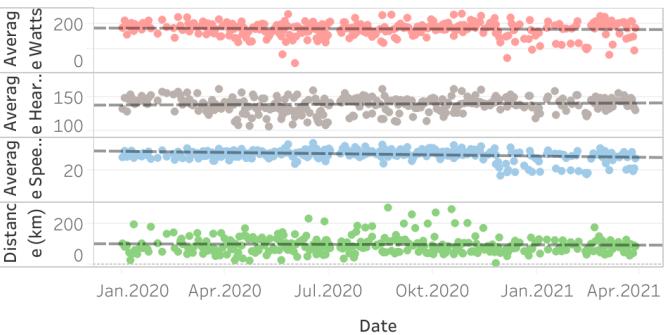
Training Density per Weekday



Training Density per Daytime



Fitness & Pace

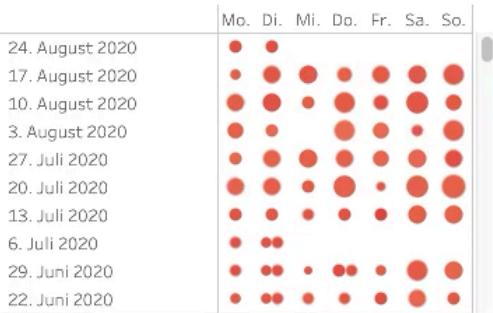


Ride History

Date	Distance (km)	Total Elevation Gain (m)	Average Speed	Average Speed (km/h)	Average Heart Rate (bpm)
28.03.2021	90,8	797m	02:12	27,2	131bpm
27.03.2021	95,54	769m	02:50	21,1	134bpm
26.03.2021	57,49	594m	03:05	19,4	139bpm



Training per Day



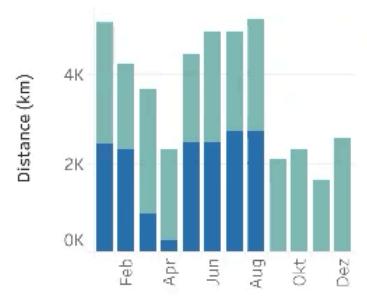
Average Distance per Month



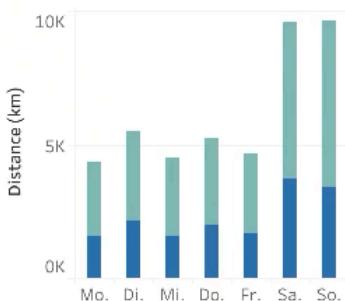
Total Distance & Elevation per Month



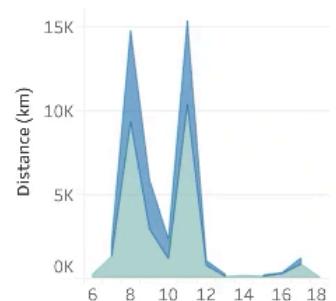
Training Density per Month



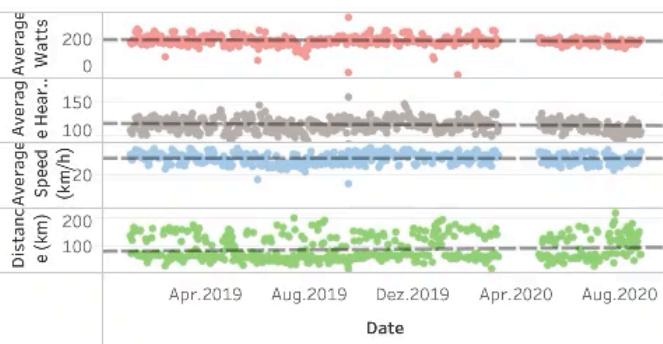
Training Density per Weekday



Training Density per Daytime

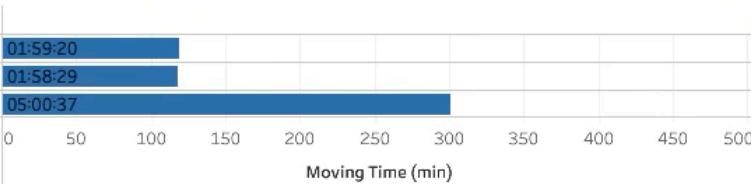


Fitness & Pace



Ride History

Date	Distance (km)	Total Elevation Gain (m)	Average Speed	Average Speed (km/h)	Average Heart Rate (bpm)
25.08.2020	66,68	122m	01:47	33,5	106bpm
24.08.2020	65,99	110m	01:48	33,4	102bpm
23.08.2020	151,09	1.924m	01:59	30,2	107bpm



Athlete Name
9

Select Year(s)

(Mehrere W...)

Year(s)

2019

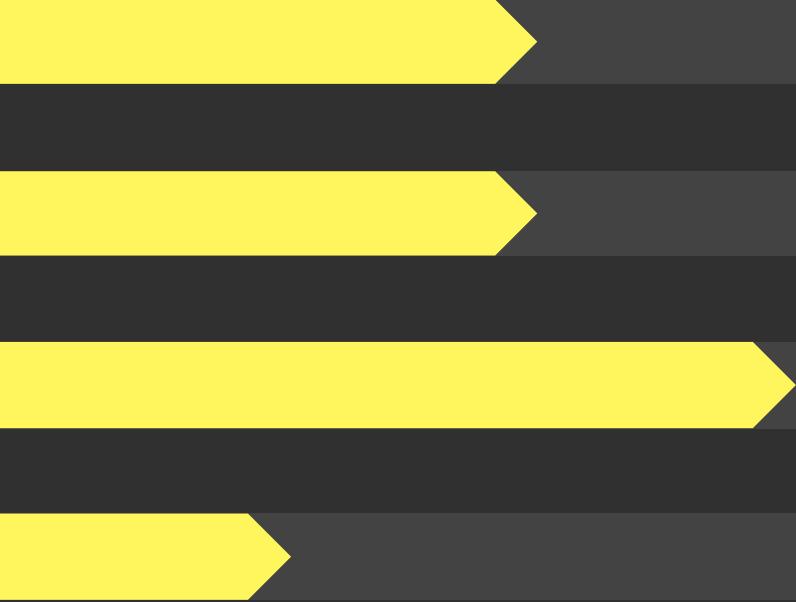
2020

410 Watts

The greatest weight-related power measured in competition was recorded for the former Italian professional cyclist Marco Pantani, who conquered the legendary L'Alpe d'Huez* climb in 1997 with 7.2 watts/kg in 37:35 minutes.

That results in an average power of 410 watt.





BACKGROUND

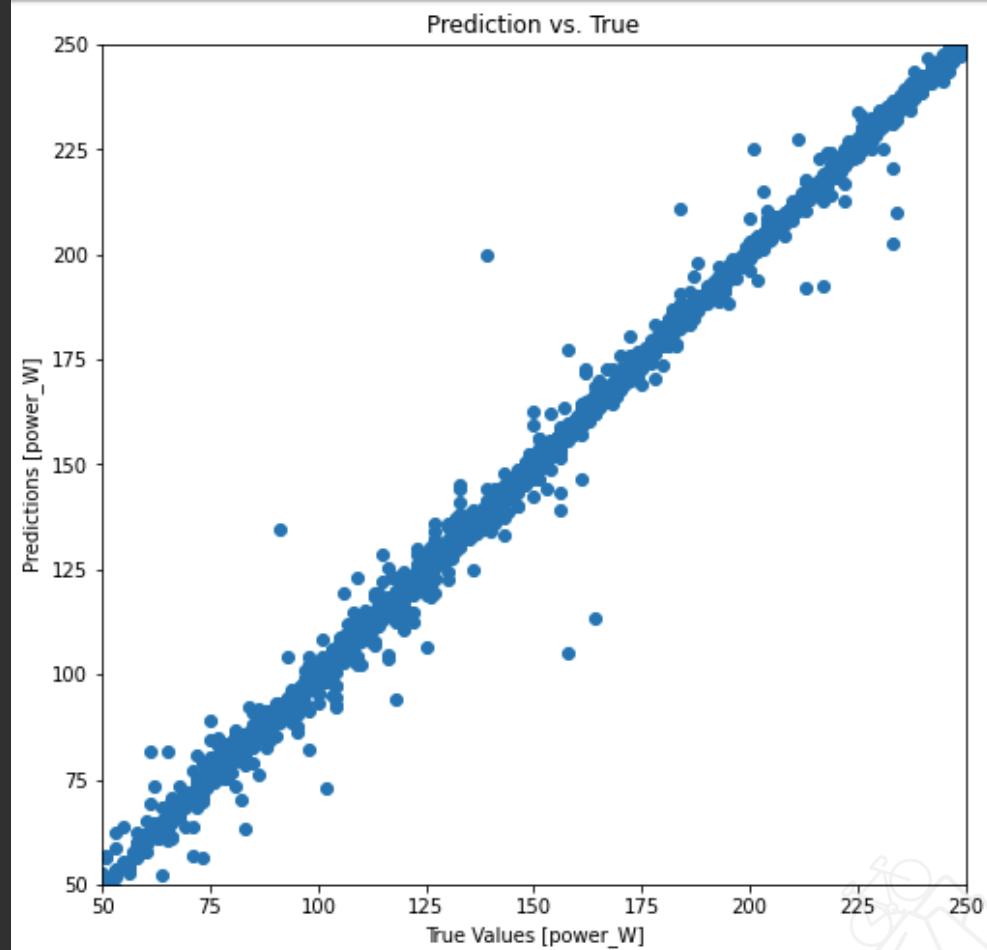
DATA ANALYSIS

MODEL RESULTS

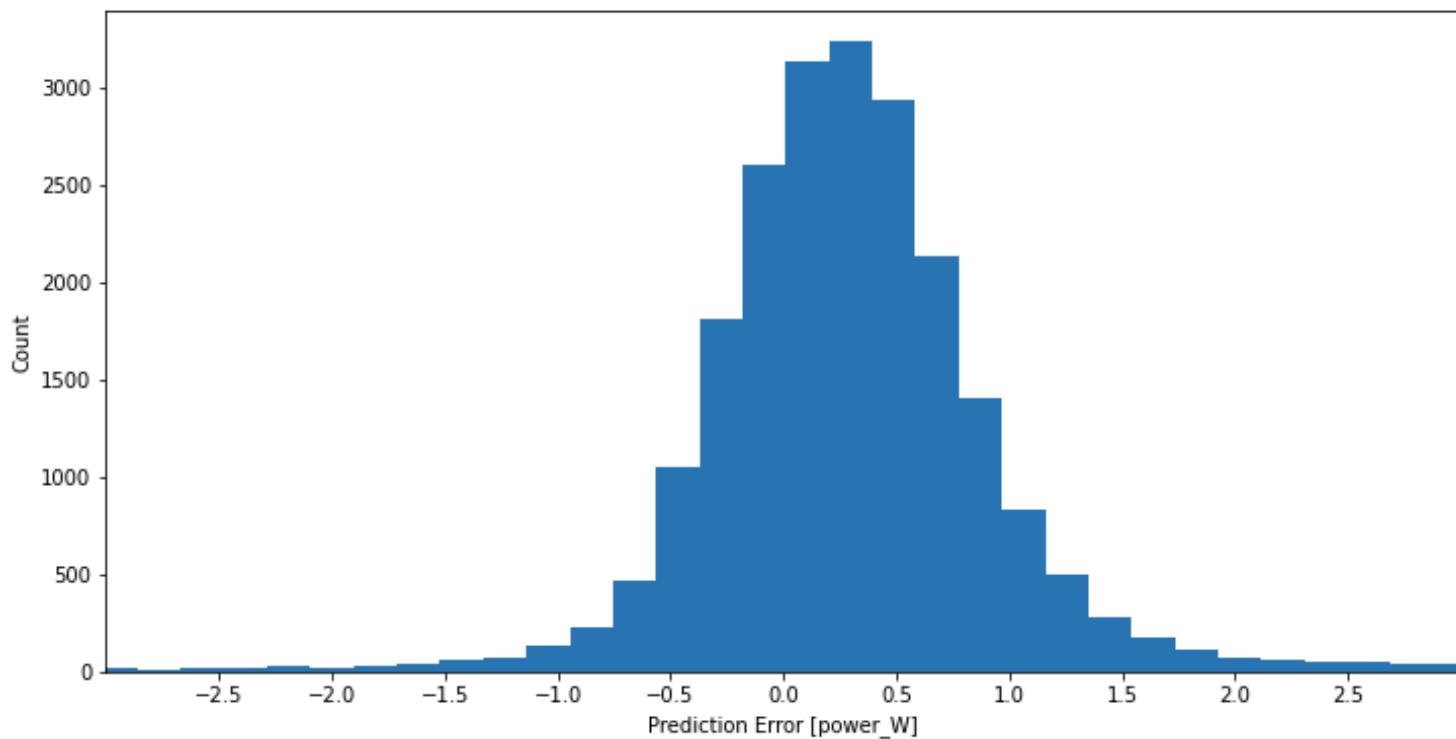
FURTHER WORK

Input variables:

- distance in km_km
 - elvation gain in m
 - elapsed time in s
 - moving time in s
 - start time in s
 - average speed in km/h
 - cadence (pedal strokes/minute)
 - average heart rate in bpm
 - elvation high in m
 - elvation low in m
 - average temperature in °C'
 - date
 - power in Watts
-



Error distribution



- The trained DNN obtained a final Mean Squared Error (MSE) of 39.98 on the test set
- Main fault tolerance the is between -1.5 watt and 2 watts

BACKGROUND DATA ANALYSIS MODEL RESULTS **FURTHER WORK**



- Split data into training and validation set based on cyclists
- Add additional data based on 'limitations'
 - Unknown information about cyclists: gender, weight, size, age
 - normal heights (height above sea level) and related oxygen content
 - Unknown bike information: weight, tire width and related rolling resistance
- Include the FTP (Functional Threshold Power)

End. Thanks! Questions?

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Johannes Pfohl

- More than 4 years working experience as Key Account Manager & Project Manager @Lufthansa Technik
- Degree in Business Administration (major fields of study: International Management & Marketing)
- Diploma Thesis: Development of an online-based marketplace for aircraft materials under the management of Lufthansa Technik AG

**„Full force voraus,
8000Watt und immer großes
Blatt!“**