# A ML based model for time trial prediction for Team INEOS

Team INEOS (formerly Team Sky from 2010–2019) is a British professional cycling team that competes at UCI World Team level and is the most successful cycling team in modern cycling, The team is known for his focus on marginal gains, as stated by the team leader Sir Dave Brailsford: "The whole principle came from the idea that if you broke down everything you could think of that goes into riding a bike, and then improve it by 1 percent, you will get a significant increase when you put them all together."

The race to marginal gains in professional cycling dramatically increased in the past years and equipment is starting to play a dramatic role in athlete performances. However, in order to be able to evaluate, choose and design the right equipment for the riders, accurate race predictions are needed.

While some factors can be estimated with physical models (gravity, power production, air resistance to mention a few), some other factors are complex to estimate and they are often rider dependent (braking, ability to ride in the curves) or weather dependent (temperature, humidity, wind) or even dependent on the physiological shape of the rider (peak training, end season, etc.).

In particular, one of the models currently developed produces good results in the straight and flat parts of the course but fails to estimate the rider's velocity in the downhill parts.
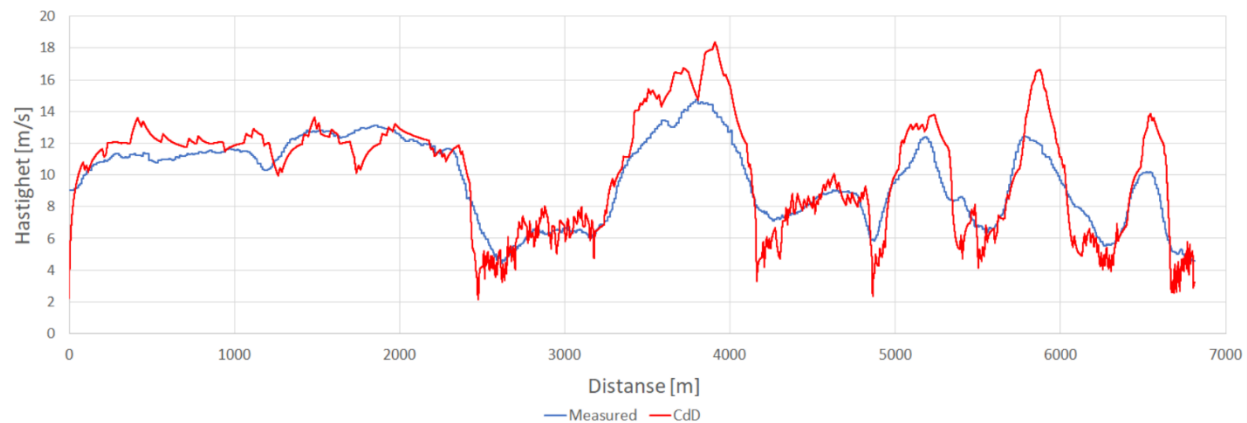
While the trends are well captured, further work is needed in order to correctly predict the riders performances with the ultimate goal of delivering a rider-tuned model. With Team INEOS being at the forefront when look for improvements, the attention towards machine learning approaches which would result in rider-specific time trial simulators is very high.

The present work will then be targeted towards a product that can better estimate the performances individual riders, learning from simulated time trial performance and training data gathered by the athletes during the training season and from time trials races.

The project will consist of three phases:
1- Develop a fully data driven simulator and compare it with the deterministic model currently used by the team
2- Develop a hybrid model where the predictions of the deterministic model currently used by the team are improved by a data-driven add-on
3- Discover features that lead to predicting rider performance

Team INEOS will provide the anonymized data needed for the development of the model and will follow the development having an active role.

Support: Robby Ketchell, current Performance Scientist for Team INEOS, has been working within sport technology and data science for a decade. Robby Ketchell has also experience with ML algorithms and their use in performance prediction. Luca Oggiano, aerodynamicist consultant for Team INEOS through NablaFlow, has been working with deterministic modelling in a number of disciplines, including cycling.

Data availability and data type: data will be provided by the team. The data provided will be sorted in two: Rider dependent/External.

The rider dependent data can be split in two: General/Static (measured usually pre-race and not in race/training) and Dynamic (measured in race with sensors)

General/Static.
　　　Anthropometric values: weight, BMI, height, etc.
　　　Physiological values: V02max, Max Power generated, etc.

Dynamic.

       Torque/power at the crank.

       Speed

       Heart rate

       CdA (maybe)

The external data can also be split in two

General/Static.

       Generic weather data: (temperature, humidity).

Dynamic (measured or estimated in race/training)

       Weather: wind, temperature

       Course: altitude, gradient, curves

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