# Power-velocity curve: relevance of the SRM Ergometer for simulated cycling performance and constant duration tests

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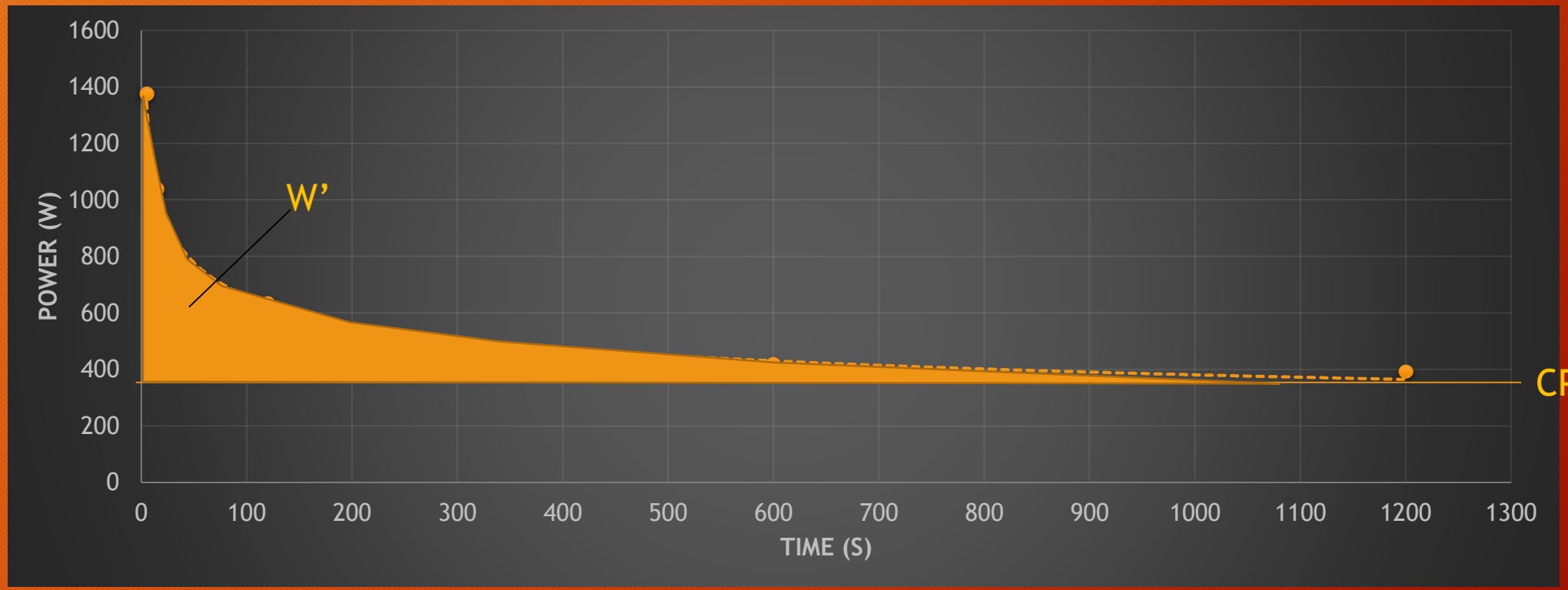
# Introduction

# Power Profile and Critical Power




$P = W' / T_{lim} + CP$

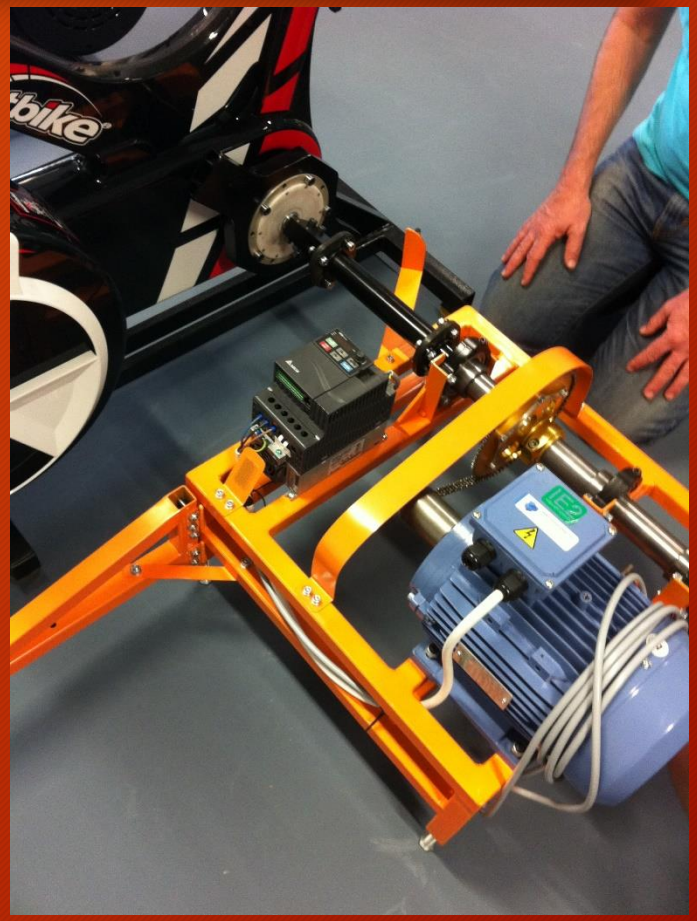
# Ergometer time trial

- Laboratory setting
  - Valid and reliable (Currell and Jeukendrup 2008)
  - Poor agreement between lab and field time trials (Smith, Davison et al. 2001)(Jobson, Nevill et al. 2008)
- *Free choice of gear ratio* ☺
- *Non-linear relationship air-friction and velocity* **?**
- *Changes in kinetic energy* ☺

- *SRM ergometer*
  - *"Open End Test"*
- *Goal: to determine the relationship between mechanical power output and the velocity in the SRM ergometer and compare this with cycling on a velodrome.*

# Methods: Ergometer test

- SRM Ergometer
  - “Open End Test”
  - 2 Hz
  - Power output
  - Velocity
- Dynamic calibration rig
  - 60-160 rpm, 10 rpm/step
  - Rohloff nave gears 7-12



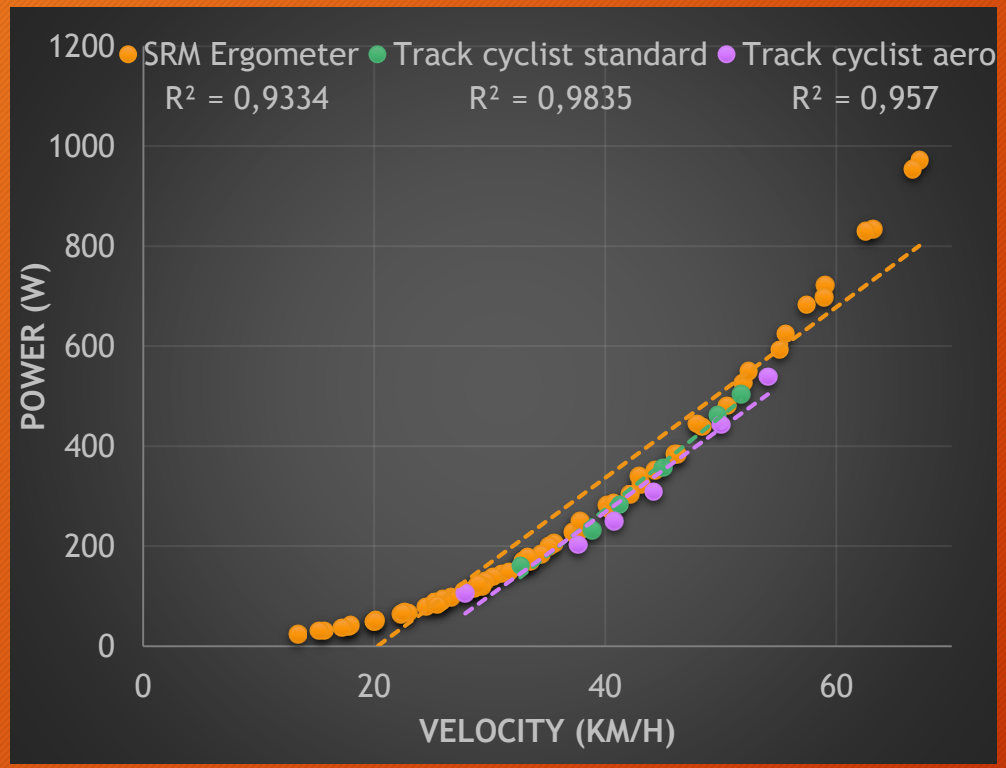
# Methods (2): Field test

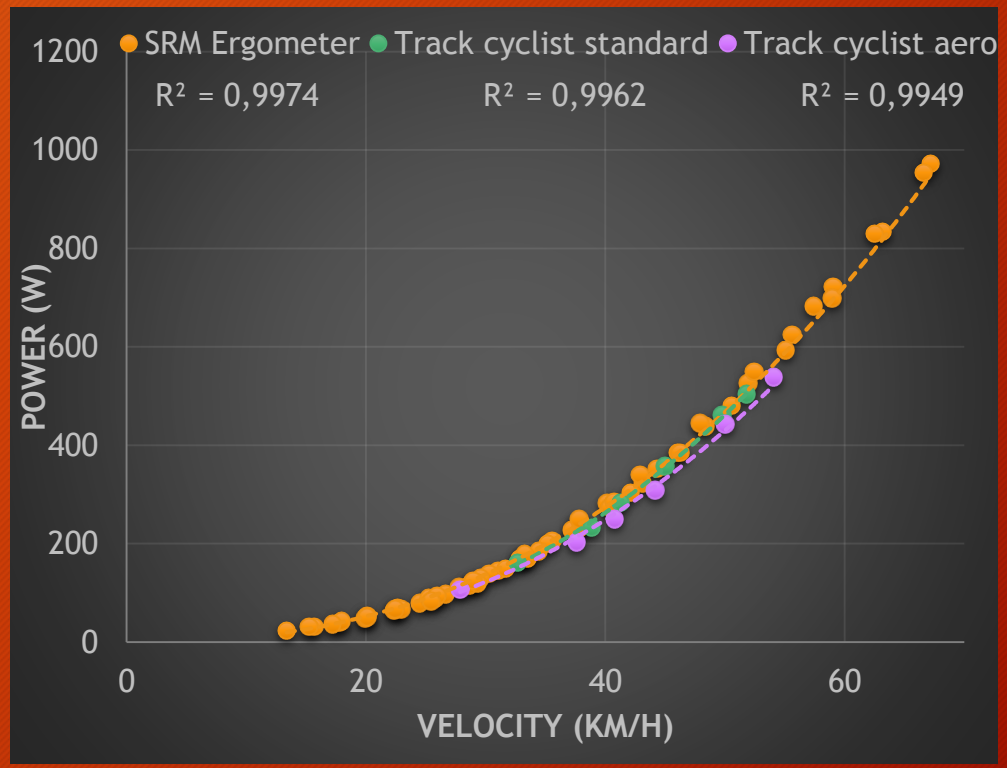
- Field test
  - Indoor velodrome (250 m)
  - Air density 1.20 kg.m$^3$
- 2 Elite track pursuit cyclist
  - Body mass + bike = 89,3 kg (standard position)
  - Body mass + bike = 98.1 kg (aero position)
- 6 velocities
  - 2 laps
  - 30-55 km/h
- SRM 7 track system (2 Hz)

# Methods (3): Analysis

- Trend lines and coefficients of determination
- Predicted power output at fixed speeds (25-60 km)
- Pearson product-moment correlation
- Absolute and relative differences

# Results


SRM Ergometer
Track cyclist standard
Track cyclist aero
R² = 0,9334
R² = 0,9835
R² = 0,957
POWER (W)
VELOCITY (KM/H)
0
200
400
600
800
1000
1200
0
20
40
60


SRM Ergometer
Track cyclist standard
Track cyclist aero
R² = 0,9974
R² = 0,9962
R² = 0,9949
POWER (W)
VELOCITY (KM/H)
0
200
400
600
800
1000
1200
0
20
40
60

# Results (2)

| Velocity (km/h) | Power output SRM Ergometer (W) | Power output standard position (W) | Power output aero position (W) | Difference SRM Ergo - standard (%) | Difference SRM Ergo - aero (%) |
|---|---|---|---|---|---|
| 25 | 89 | 80 | 78 | 11.3 | 13.7 |
| 30 | 137 | 126 | 122 | 9.0 | 12.3 |
| 35 | 199 | 185 | 179 | 7.1 | 11.2 |
| 40 | 274 | 259 | 248 | 5.5 | 10.2 |
| 45 | 363 | 348 | 332 | 4.1 | 9.3 |
| 50 | 467 | 454 | 430 | 2.9 | 8.5 |
| 55 | 586 | 576 | 544 | 1.8 | 7.8 |
| 60 | 722 | 717 | 674 | 0.8 | 7.2 |

# Discussion

- SRM “Open End Test” mode = Non-linear relationship between power and velocity(Power equation)
- $P = 0.5\ \rho\ Ap\ Cd\ v^3 + \mu\ N\ v$
- $\approx c\ v^{2.5}$ (our field measurements)
- SRM ergometer: $P = 0.04\ v^{2.4}$
- SRM Ergometer improved: $P \approx 0.025\ v^{2.5}$
- One size fits all
- Difference SRM Ergometer less with standard position

# Discussion (2)

- Time trial studies:
  - 4-8% differences in velocity between road en lab (Jobson, Nevill, George, Jeukendrup, & Passfield, 2008; Jobson et al., 2007)
  - Kingcycle ergometer (wind-braked)
  - Body size:
    - Road speed (km/h) = lab speed (km/h) + 24.9 – 0.0969 m (kg) – 10.7 h (m)
- Racermate Velotron
  - Body weight
  - Drag Factor
- Free University Amsterdam Ergometer
  - Body weight
  - Height
  - Rolling coefficient
  - Drag coefficient

# Conclusions

- SRM Ergometer in “Open End Test”
  - Non-linear breaking  algorithm
  - Power trend line between power output and velocity
- Real world cycling on a velodrome
  - Power trend line between power output and velocity
- SRM Ergometer overestimates power output at given speed
  - Difference is less in standard position
- Body size and bike postion will determine differences between ergometer and real world cycling
- SRM Ergometer “Open End Test” improved by input of
  - Body size (weight and height)
  - Bike position

# Acknowledgements

www.albertwot.nl