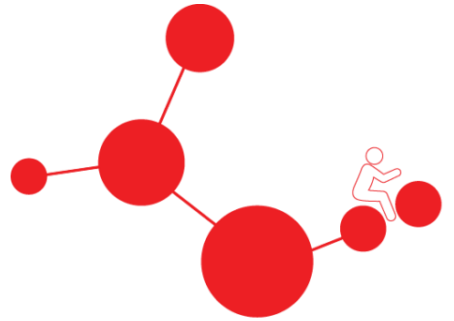
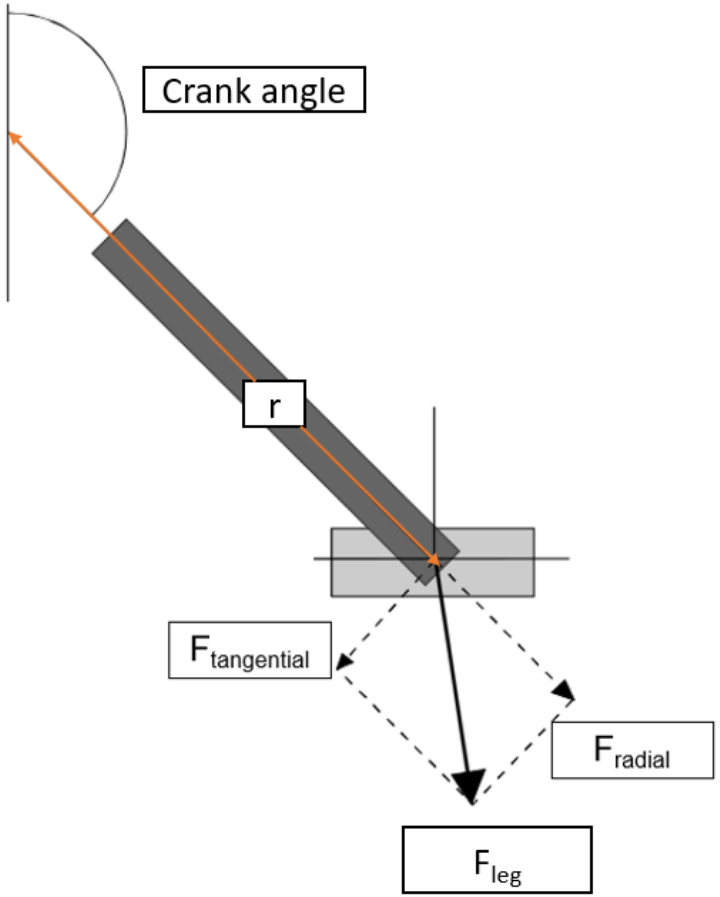
Torque behaviour during cycling sprints from different pedaling frequencies



By Felix Imbery, Peter Leo, John Wakefield and Ulrich Schoberer

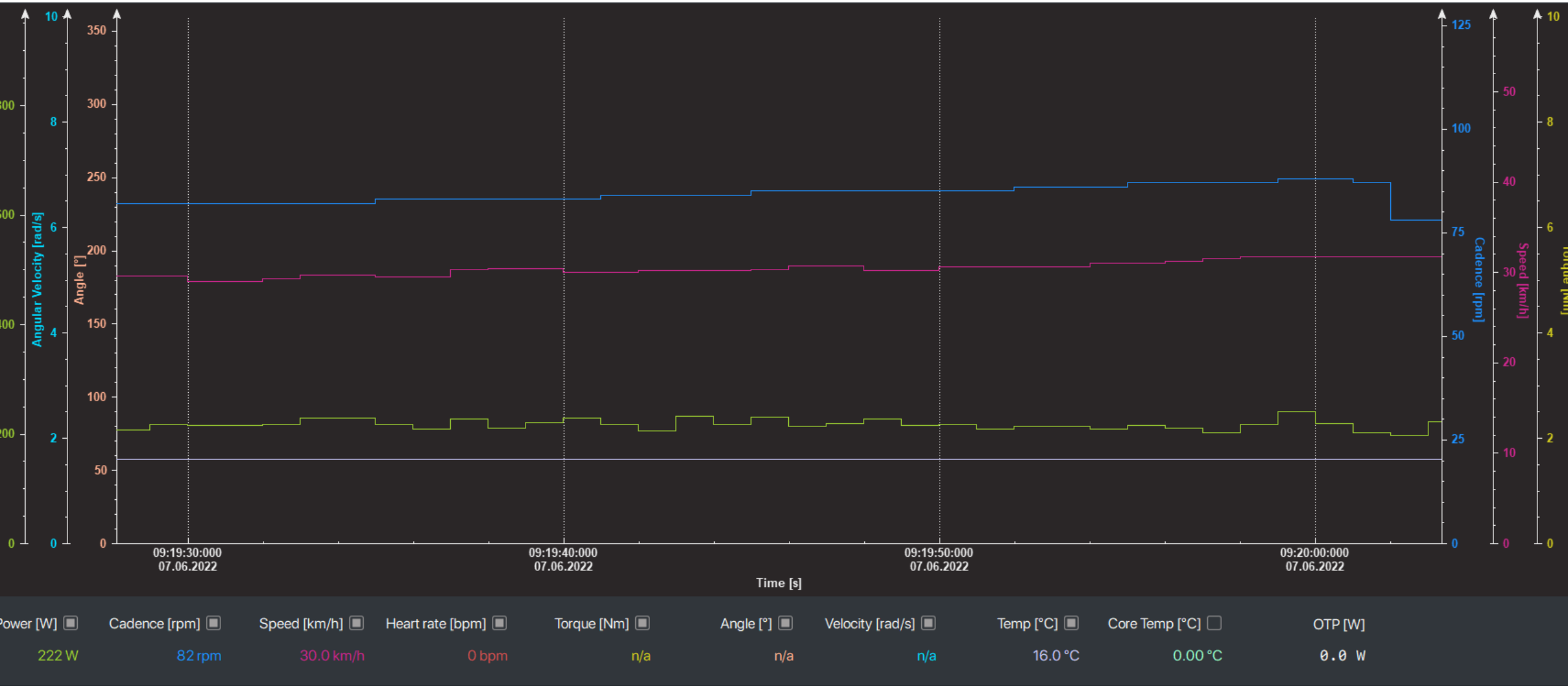
SRM

Power output capabilities



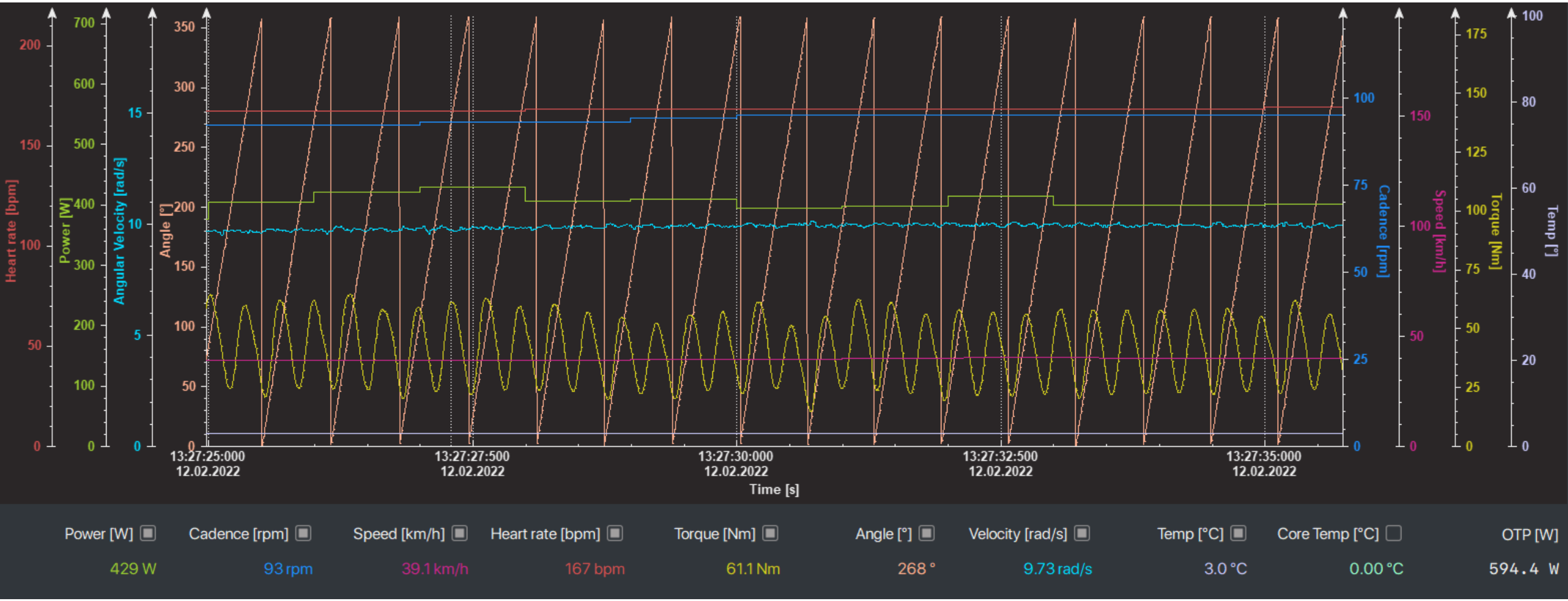
$T = F_t * r$	Perpendicular applied force on a pedal with crank as a lever
Research interest	Power outputs of >1.200W in cycling sprints
Power components	Torque [Nm] Velocity [Rad/s]

Data acquisition – then



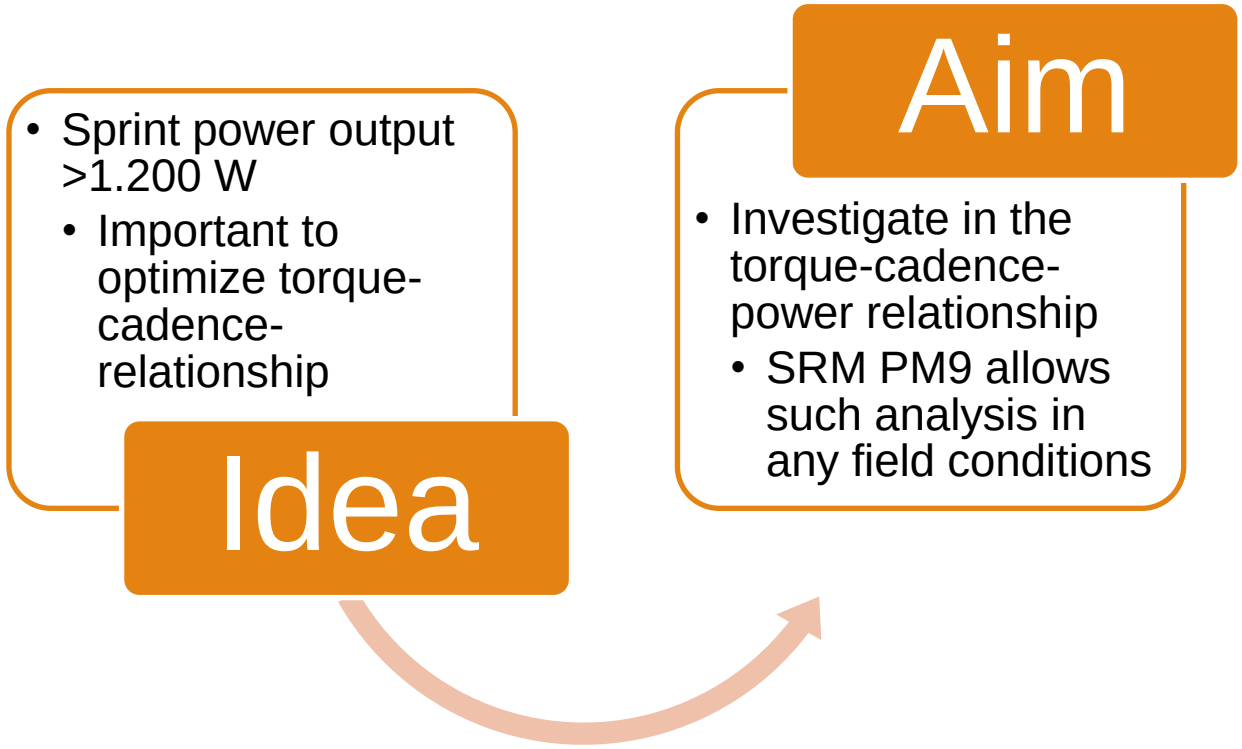
1 Hz data acquired with SRM PM7 - Software: Fit File Viewer (SRM GmbH)

Data acquisition – now

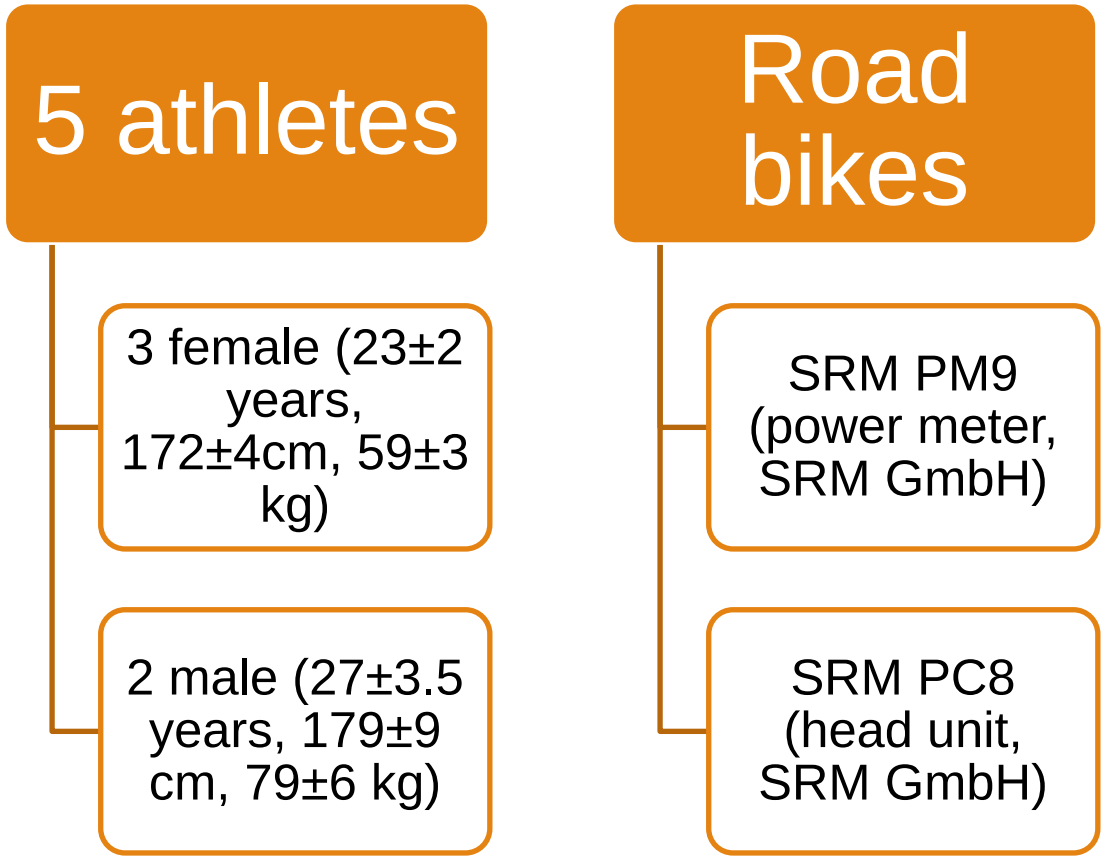


200 Hz data acquired with SRM PM9 - Software: Fit File Viewer (SRM GmbH)

Idea and aim


Idea
• Sprint power output >1.200 W
• Important to optimize torque-cadence-relationship
Aim
• Investigate in the torque-cadence-power relationship
• SRM PM9 allows such analysis in any field conditions

Subjects and equipment



Design

Warm Up

- 20 min @3/10 RPE with two short activation sprints

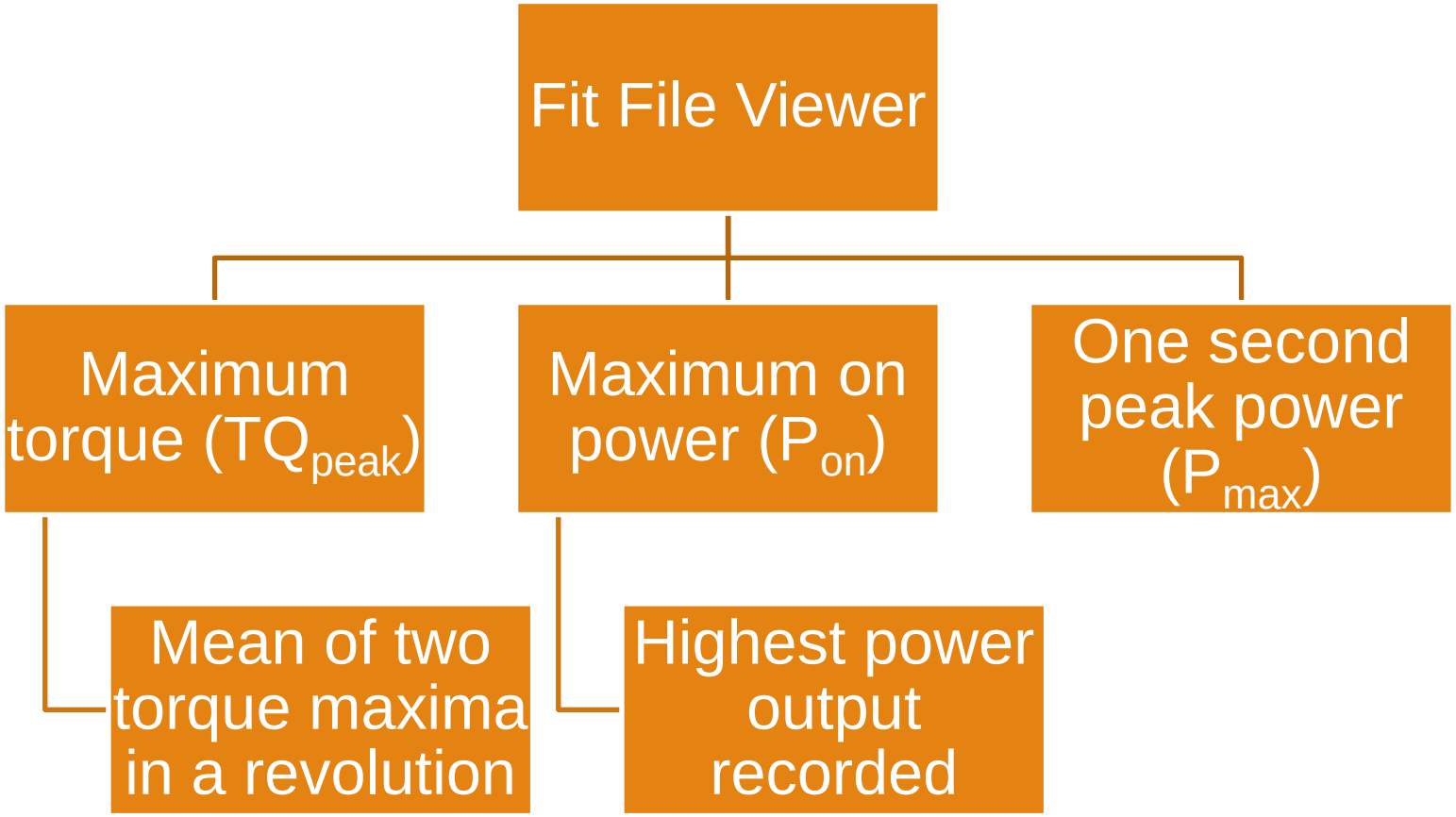
Sprints

- 6-10 seconds
- Starting from 60, 80, 100, 110, 120 rpm

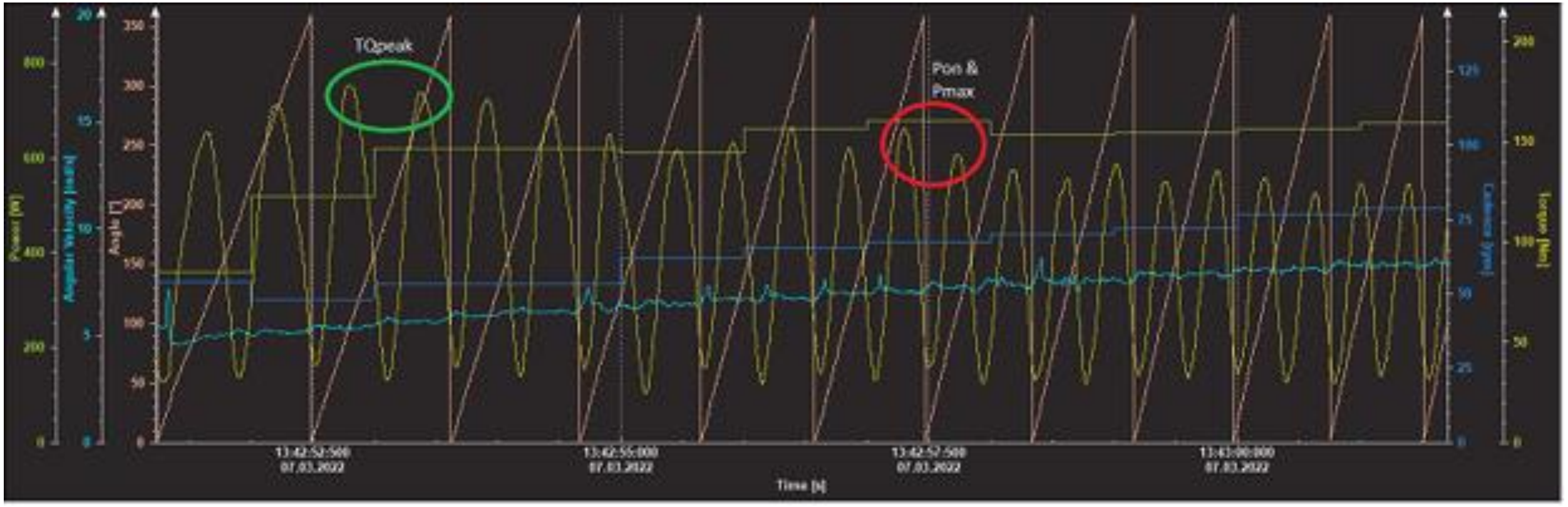
Rest

- >10 min @2/10 RPE

Data analysis



Data analysis



Example graph for graphical inspection of TQ_{peak}, P_{on} and P_{max}

Results
Data - Females

Female athletes					
Cadence (rpm)	TQ_{peak} (Nm)	P_{on} (W)	P_{max} (W)	Ang_{left} (°)	Ang_{right} (°)
60	153 ± 18	1104 ± 111	716 ± 63	115 ± 2	116 ± 3
80	126 ± 14	1130 ± 66	747 ± 56	122 ± 2	121 ± 5
100	94 ± 17	1031 ± 148	708 ± 51	117 ± 9	112 ± 15
110	86 ± 25	905 ± 177	650 ± 114	124 ± 3	112 ± 10
120	80 ± 28	909 ± 220	638 ± 117	124 ± 2	114 ± 13

Results
Data - Male

Male athletes					
Cadence (rpm)	TQ_{peak} (Nm)	P_{on} (W)	P_{max} (W)	Ang_{left} (°)	Ang_{right} (°)
60	177 ± 1	1510 ± 1	1037 ± 24	116 ± 6	113 ± 2
80	153 ± 6	1554 ± 12	1008 ± 15	118 ± 4	119 ± 6
100	135 ± 3	1536 ± 43	1037 ± 21	121 ± 7	115 ± 3
110	124 ± 5	1502 ± 65	982 ± 160	122 ± 4	121 ± 4
120	108 ± 8	1440 ± 123	972 ± 80	121 ± 12	121 ± 9

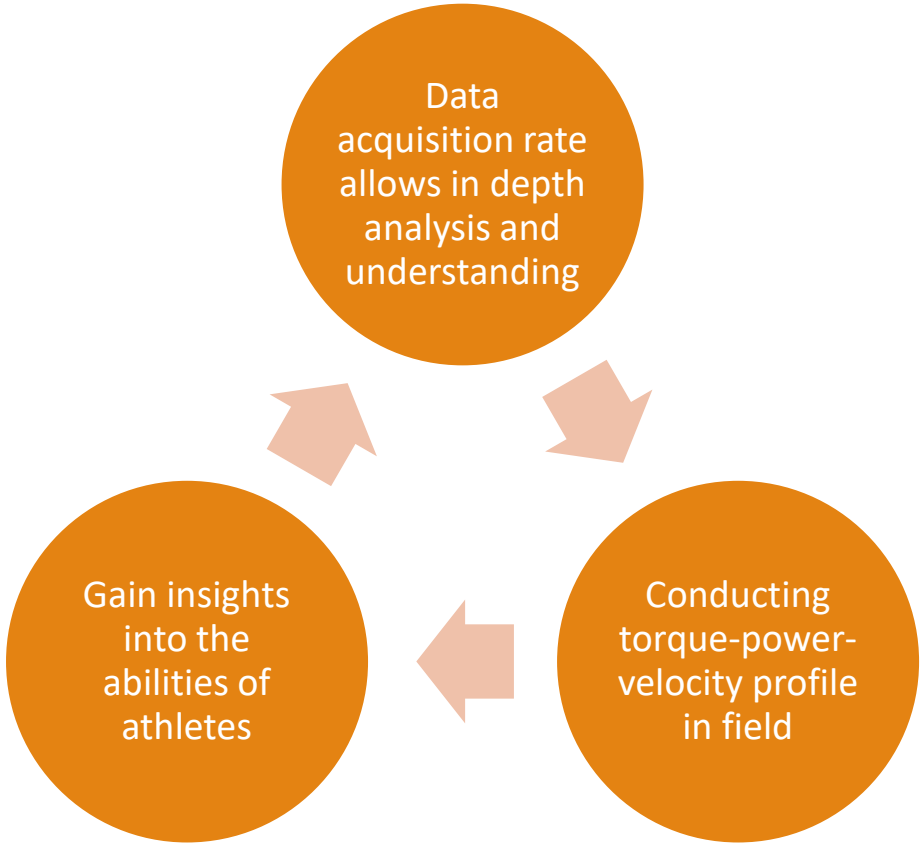
Results
Effectsize

Starting cadence				Sex differences	
TQ_{peak} (Nm)	P_{on} (W)	P_{max} (W)	Angle (°)	TQ_{peak} (Nm), P_{on} (W), P_{max} (W)	Angle (°)
large effect (d=1.4 to 4.0, Δ: 25 to 72 Nm)	large effect (d=.3 to 1.1, Δ: -16 to 189 W)	small to large effect (d=.1 to 0.96, Δ: 11 to 100 W)	small effect (d=.07 to 0.3, Δ: 1 to 4°)	Large effect (d=2.3 to 3.2)	Small effect (d=.2 to .3)

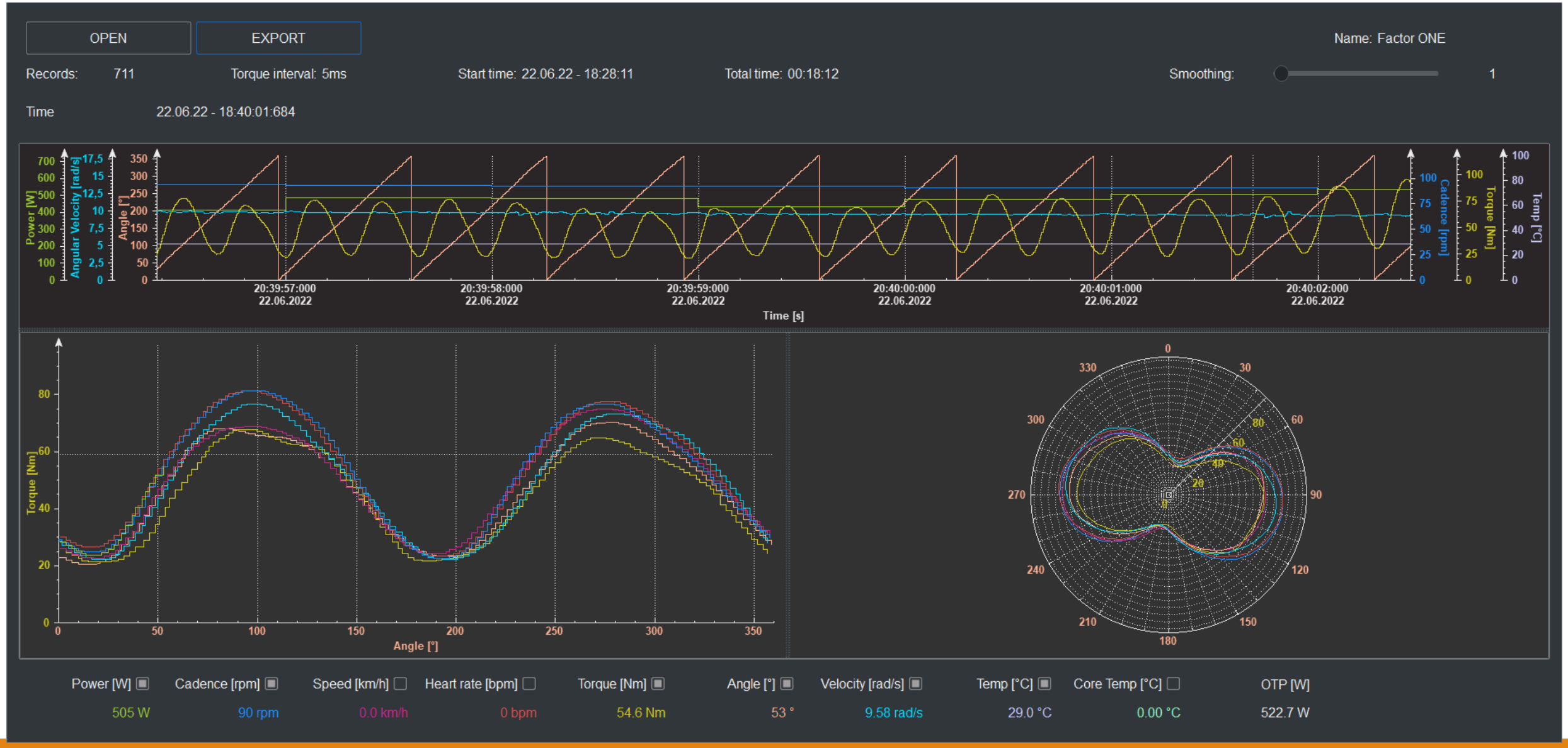
Discussion

Torque	Decreases nearly linear with increase of initial cadence
Power output (P_{max})	Does not follow any recognisable pattern
Maximal on power (P_{on})	Shows real peak power in a revolution
Torque-power-velocity profile	Established without additional equipment in field Interesting for track cycling as limited to single gear
Further research	Taking i.e., non-shifting, longer sprint durations or smaller steps in starting cadence into account

Conclusion

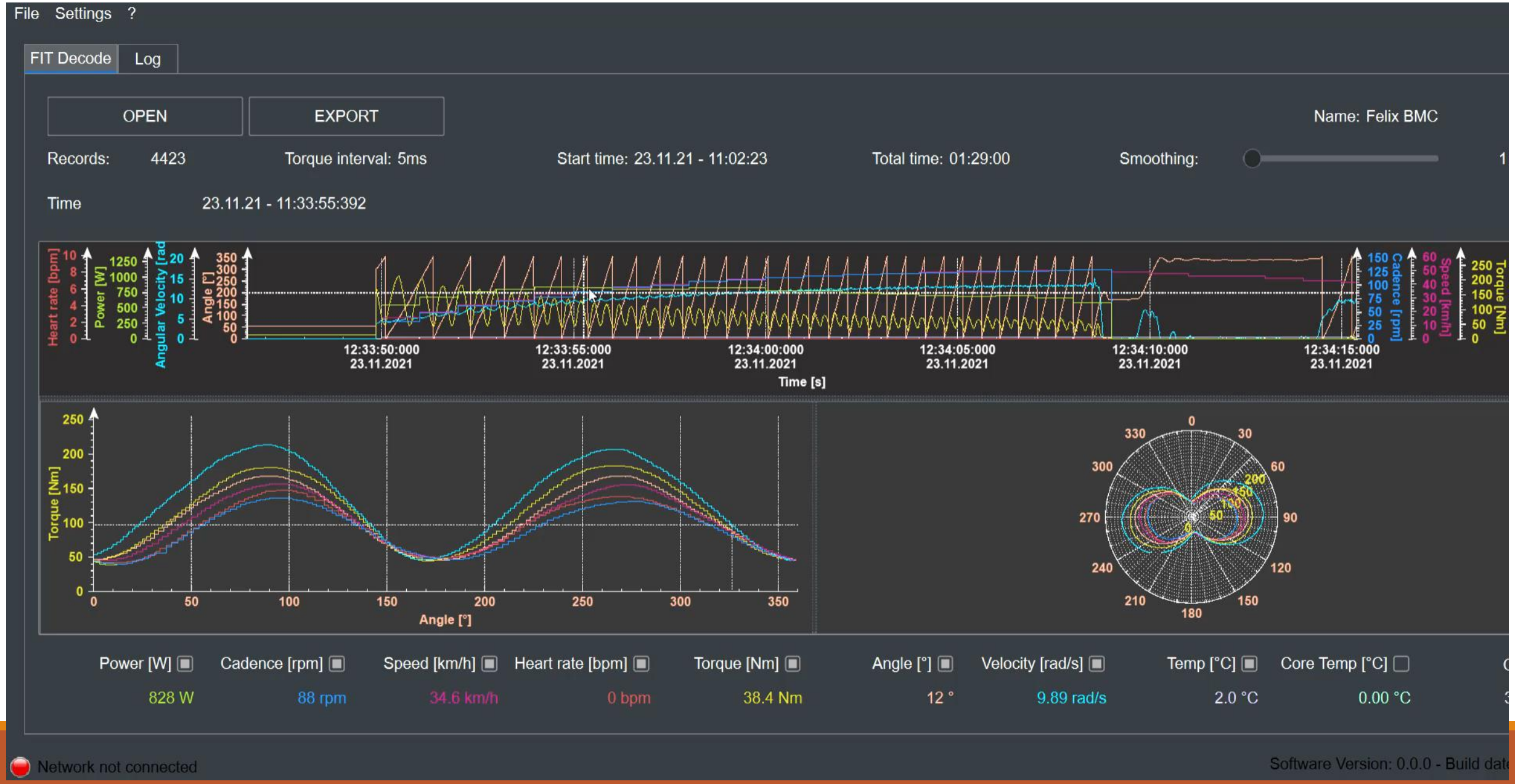

Data acquisition rate allows in depth analysis and understanding
Conducting torque-power-velocity profile in field
Gain insights into the abilities of athletes

What‘s to come, where to go to?



SRM Torque Analysis Software 0.0.0
Raw data = Smoothing 1

What‘s to come, where to go to?



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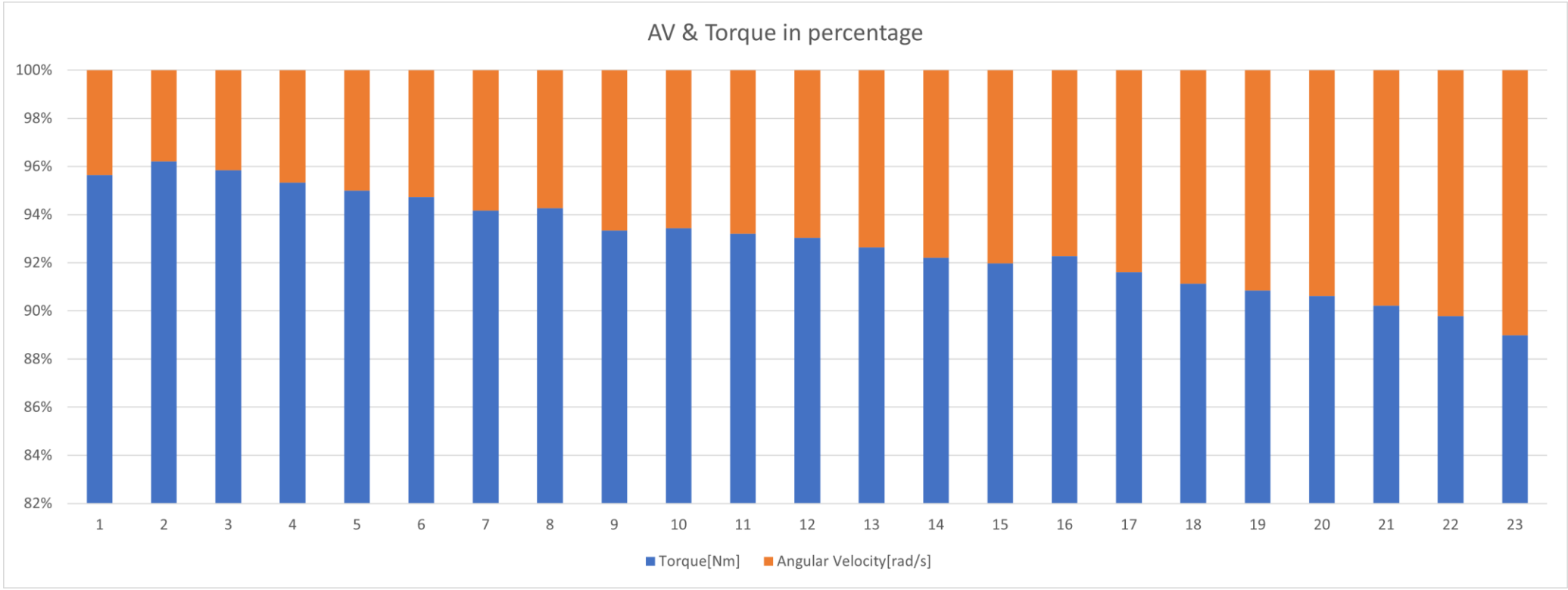
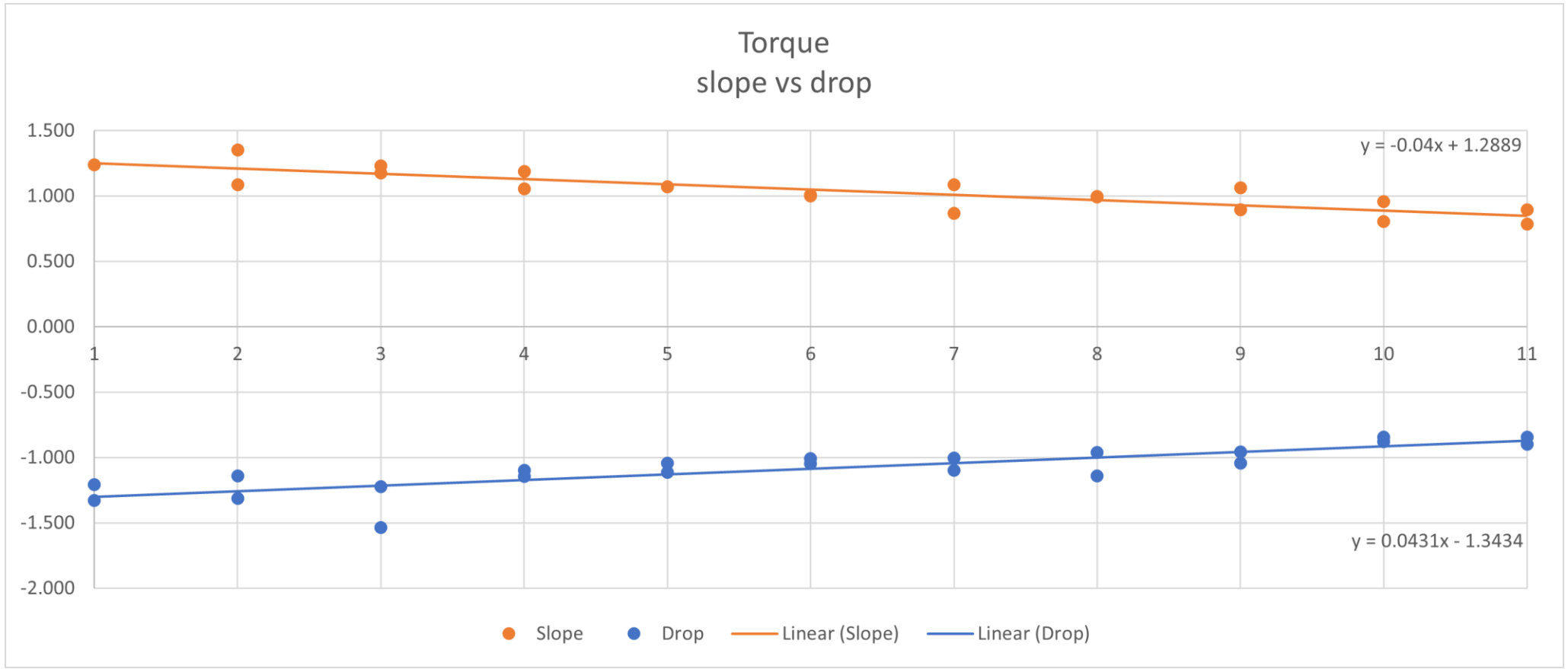


What‘s to come, where to go to?



Thanks for your attention

Come and have a look at our stand!