MEP PRO

For Bikefitting & Biomechanic Labs

MEPstudio v2018.2

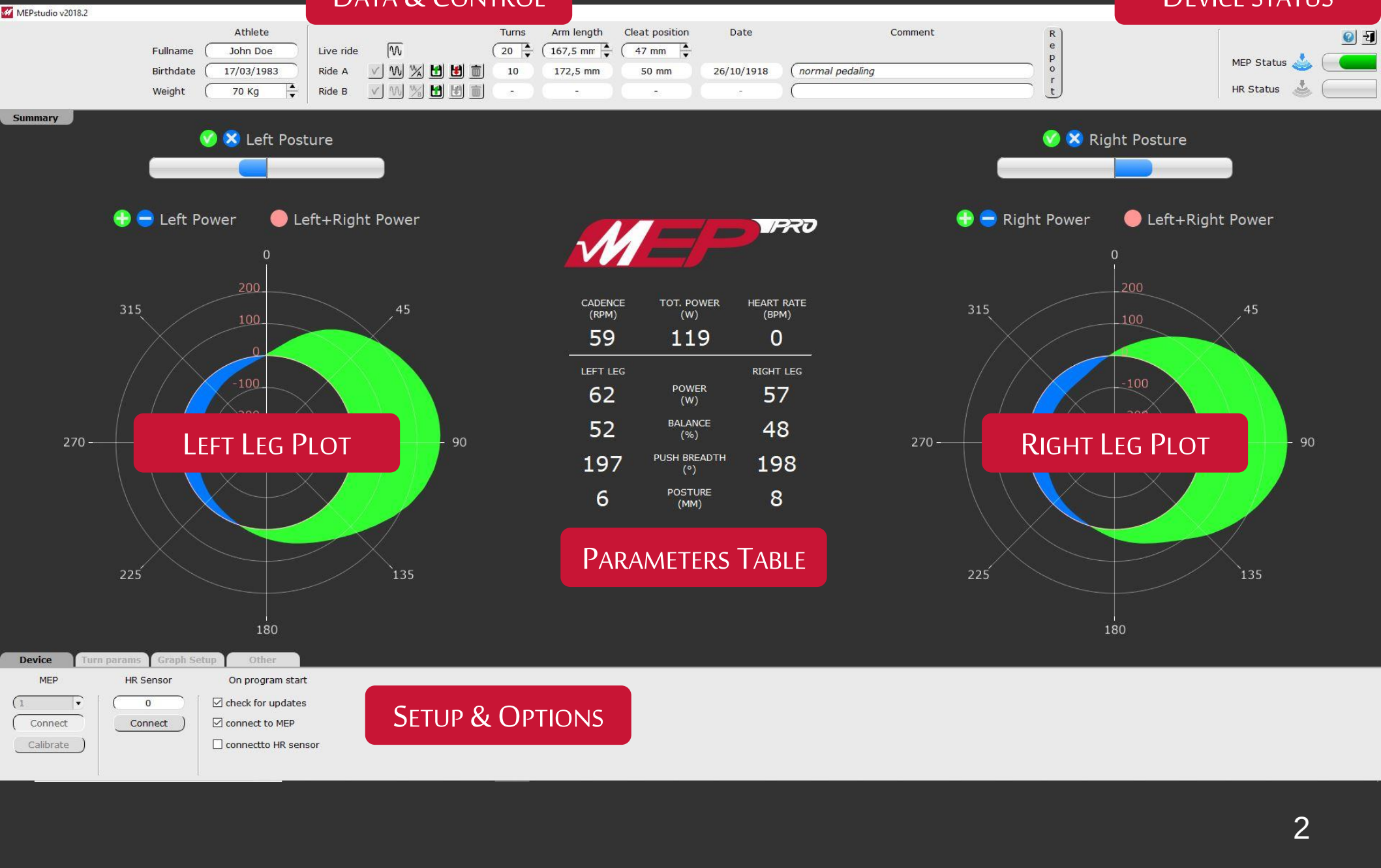
Paolo Brivio - PhD

Studio AIP srl

Technology Patented by Studio AIP srl

05TH December 2018

MEPstudio 2018.2 – Interface organization



MEPstudio 2018 – Summary

A) Customizable turn parameters visualization — V 2018.0

B) Posture visualization — V 2018.0

C) Cartesian & Polar Plots — V 2018.0

D) Plot options: positive&negative Power, Smoothness profile, leg contribution to Left+Right Power — V 2018.1

E) Angle-wise average — V 2018.2

F) Angle-wise comparisons — V 2018.2

G) GDPR-ready data storage — V 2018.2

H) PDF report generation — V 2018.2

MEPstudio 2018 – Basics

Defined for each leg		Number of values per turn
Angle	Position (rotation) of the crank arm during the revolution	360
Force Intensity	Amount of Force exerted on the pedal w.r.t. each angle	360
Angle-wise Power	Amount of Power developed w.r.t. each angle	360
Turn	List of all [Angle, Power] tuples of a full pedal revolution	360
Peak Power	Value of the maximum angle-wise Power of the Turn	1
Positive Power	Average of all Power values > 0 belonging to the same Turn	1
Negative Power	Average of all Power values < 0 belonging to the same Turn	1
Turn Power	Average of all Power values belonging to the same Turn	1
Left+Right Power	Amount of Left & Right Power developed w.r.t. each angle	360

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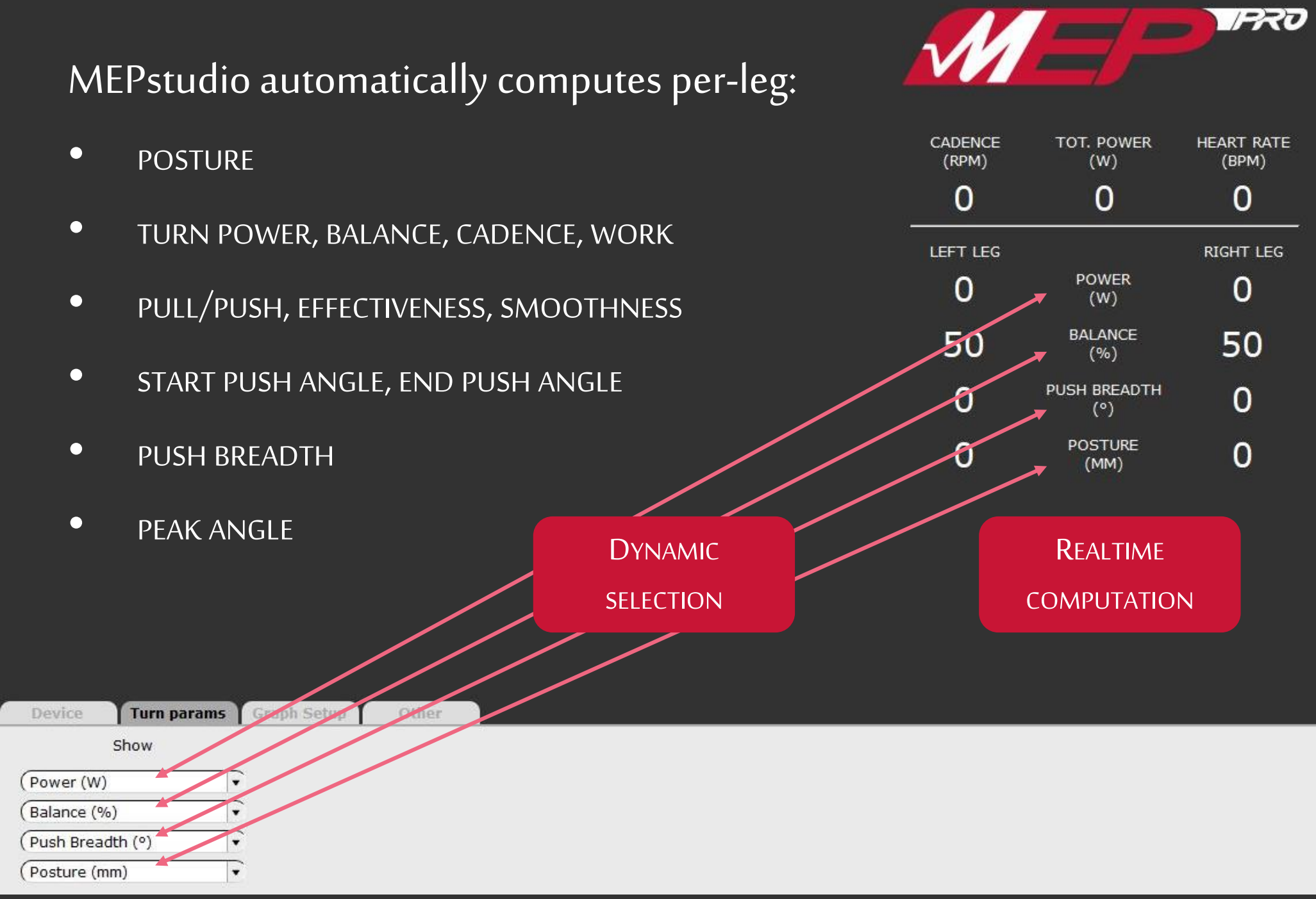
Costumizable turn parameters visualization

MEPstudio automatically computes per-leg:

- POSTURE
- TURN POWER, BALANCE, CADENCE, WORK
- PULL/PUSH, EFFECTIVENESS, SMOOTHNESS
- START PUSH ANGLE, END PUSH ANGLE
- PUSH BREADTH
- PEAK ANGLE



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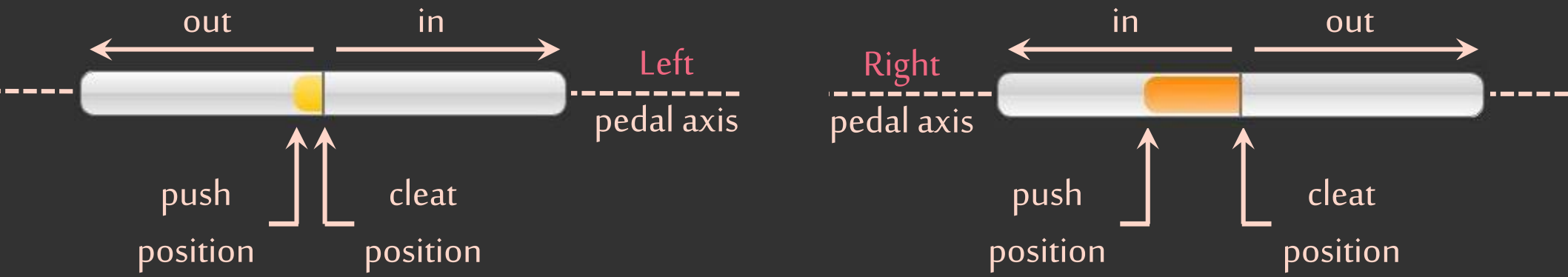
Posture visualization

Posture: distance from the cleat, measured along the pedal axis, where maximum leg force is applied

Denotes: supination, pronation, wrong cleat adjustment, ...



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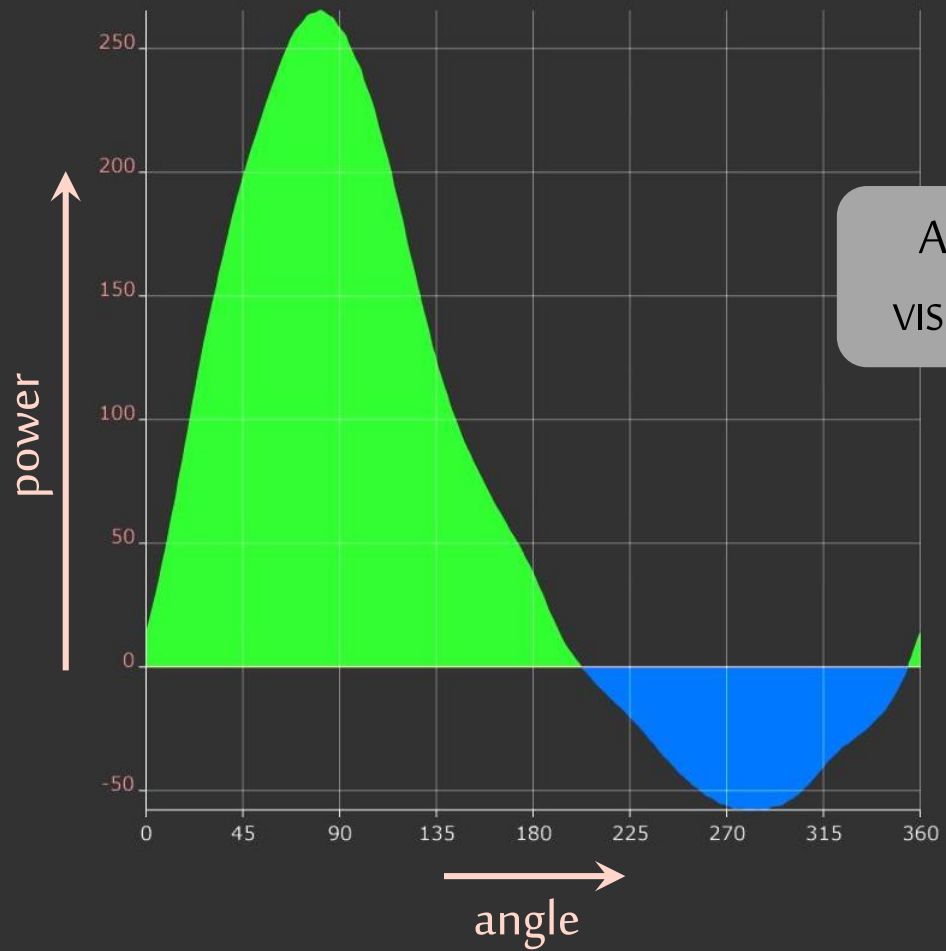
MEPstudio 2018 – understanding Leg Plots

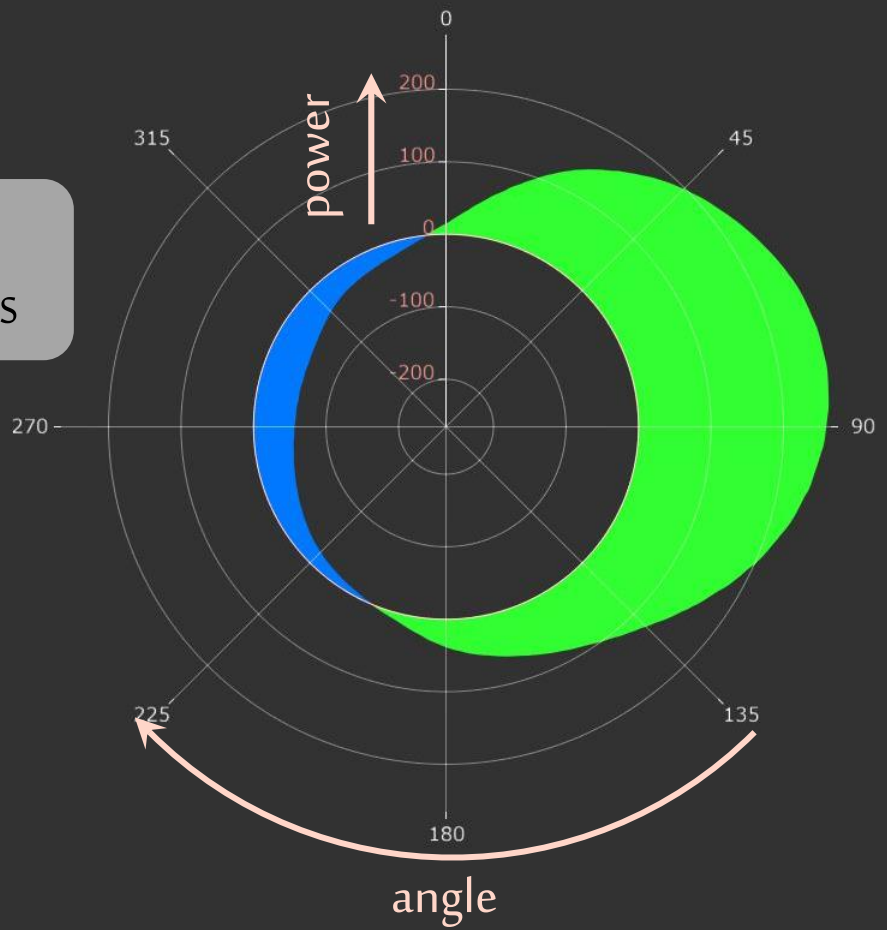
- Two Plots: one for LEFT LEG (at left) and one for RIGHT LEG (at right)
- Each Plot represents one leg in its own reference frame
  - 0 degrees → crank arm oriented vertically upwards
  - Left and Right angles differ by 180 degrees
- Several visualization options
  - Apply to both LEFT LEG PLOT and RIGHT LEG PLOT

→ For easiness of explanation, in the following we present the visualization options for only one leg (no matter which side it is)
All considerations also apply to the other leg

Cartesian & Polar plots



ALTERNATIVE VISUALIZATIONS



Power variations: vertical direction

Angle variations: horizontal direction

Power variations: radial direction

Angle variations: anular direction

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PLOTTING THE SAME LEG TURN

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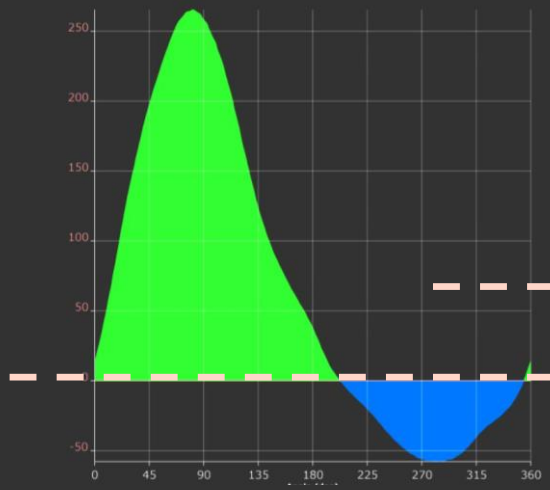
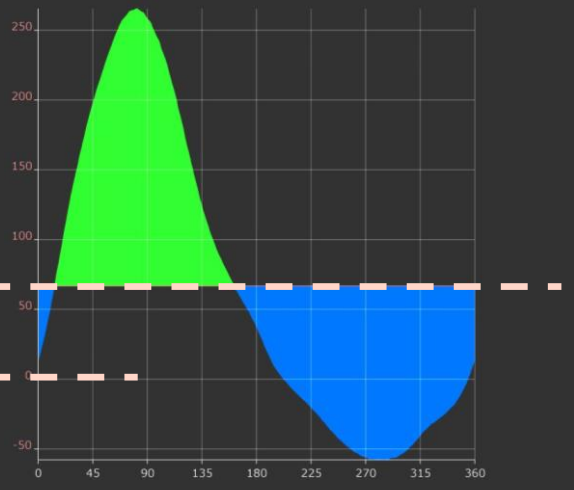
Plot options: summary

Positive & Negative Power



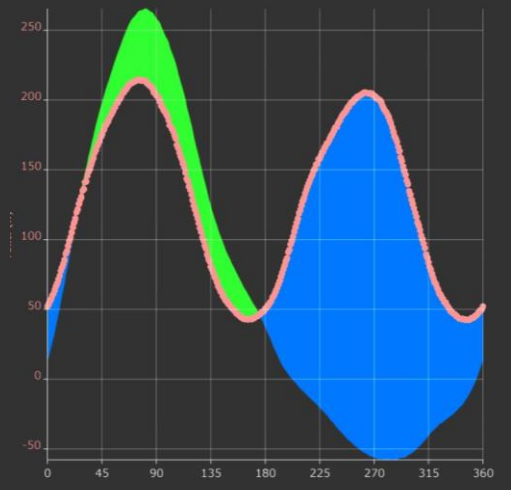
Smoothness Profile

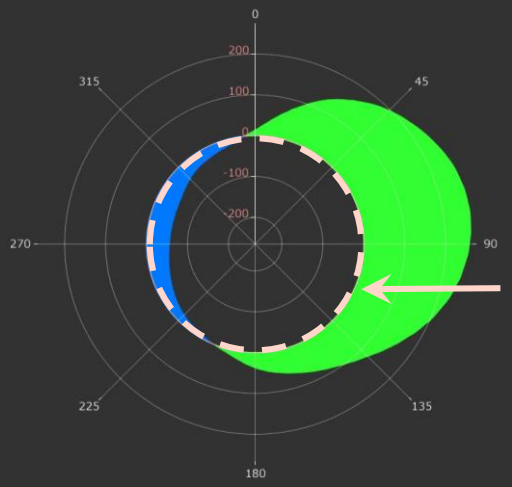


turn power

power = 0

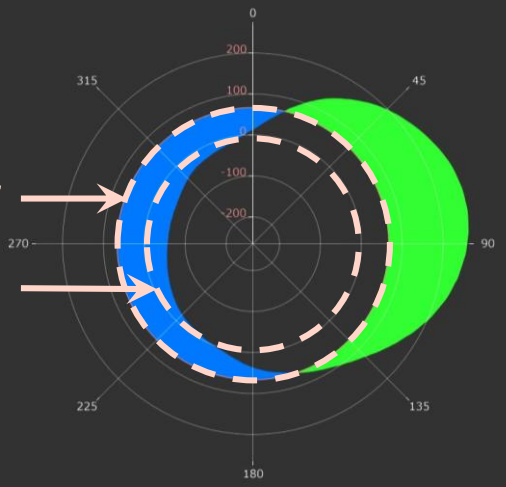
Leg contribution to Left+Right Power

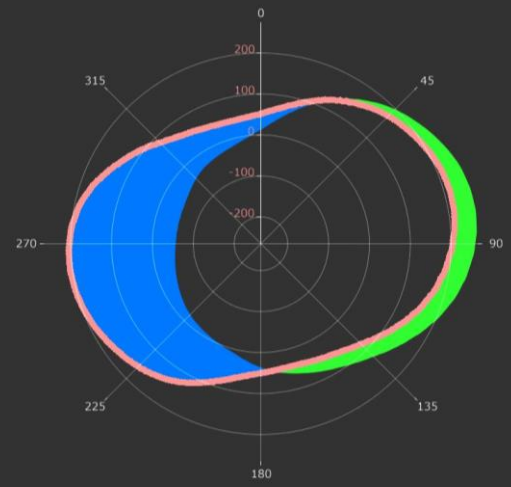




turn power

power = 0





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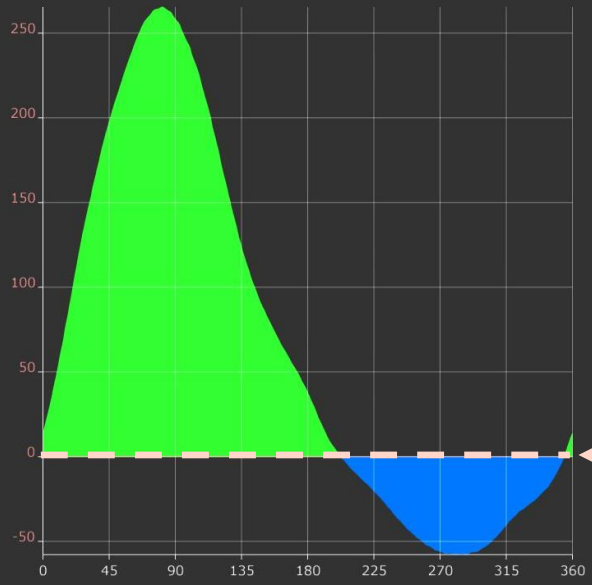
Plotting the same leg Turn

Plot options: Positive & Negative Power

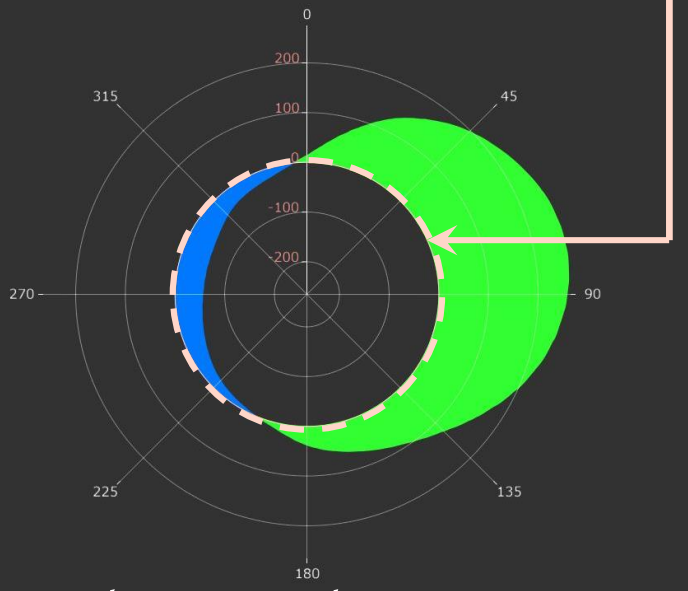


At some angles the leg OPPOSES, at others it PUSHES the cranks

NEGATIVE POWER + POSITIVE POWER =

TURN POWER — ALWAYS POSITIVE

power = 0



How much does leg opposition phase reduce leg push power?

NEGATIVE POWER : POSITIVE POWER =

TURN PULL/PUSH — ALWAYS NEGATIVE OR 0

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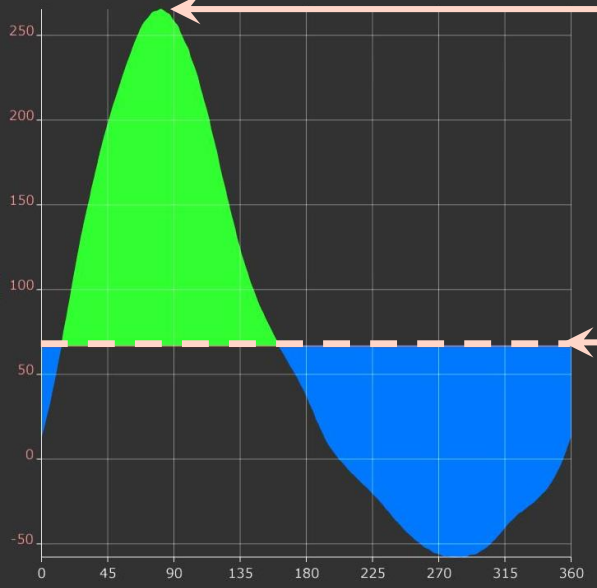
PLOTTING THE SAME LEG TURN

Plot options: Smoothness profile



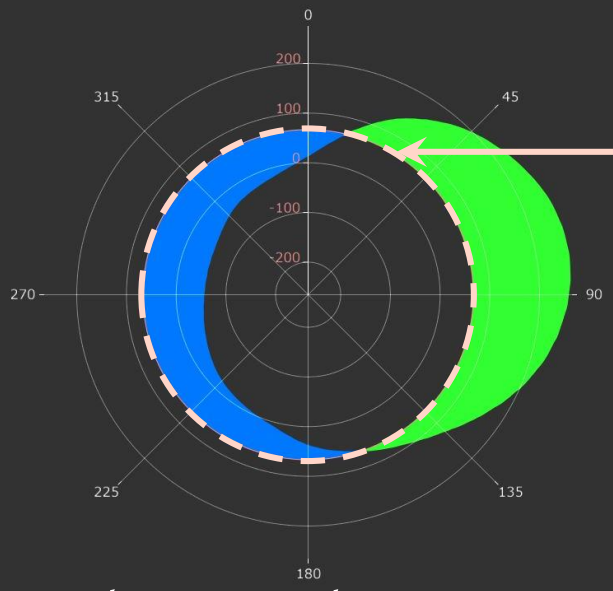
Max Power of this leg

Turn Power : **Max Power** =

Smoothness — Always positive

Smoothness profile:

* Is power curve constant during the Turn?
* If not, how does it change?



Turn Power: if power curve were always equal to this line, it would be 100% Smooth (by definition)

Green areas detect where power is LARGER than TURN POWER

Blue areas detect where power is SMALLER than TURN POWER

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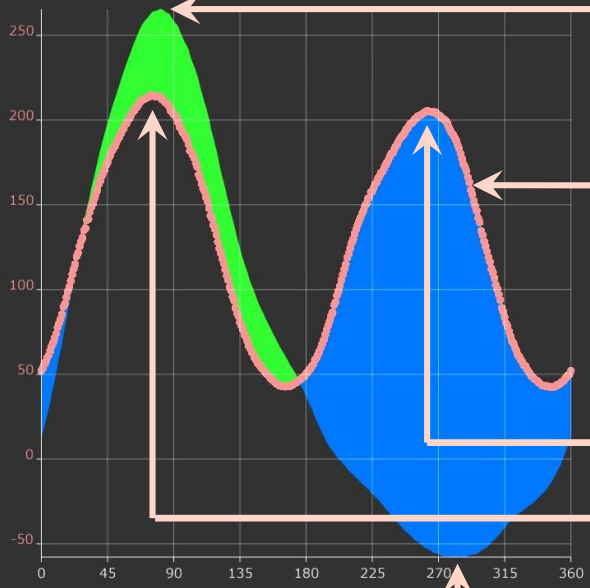
Plotting the same leg Turn

Plot opt: leg contribution to Left+Right Power



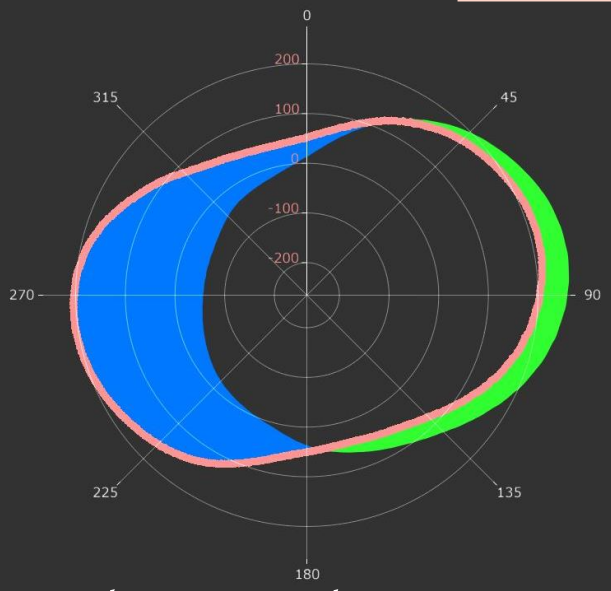
Max Power of this leg

LEFT + RIGHT POWER

Left+Right power curve shows two peaks:

* the last roughly corresponds to the other leg max power
* the first roughly corresponds to this leg max power

Min Power of this leg



Interpretation of the colored regions:

Green areas detect where the other leg is OPPOSES to this leg

Blue areas detect where the other leg CONTRIBUTES to this leg

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PLOTTING THE SAME LEG TURN

MEPstudio 2018

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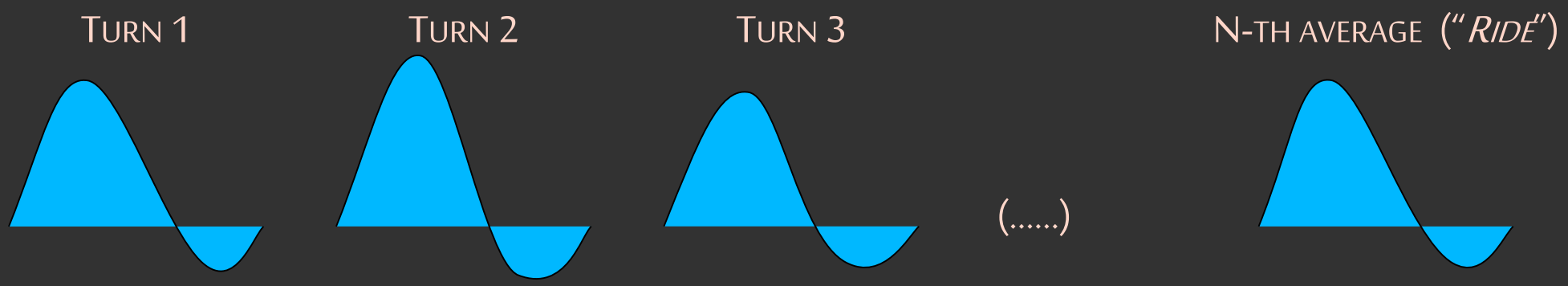
Angle-wise average

Problem: under the same conditions (setup, resistance, effort, ...)
consecutive Turns slightly differ: analysis is hard



Solution: average last N Turns (in realtime!)
→ data becomes more stable and... comparable
→ in MEPstudio, an N-averaged Turn is named a "Ride"

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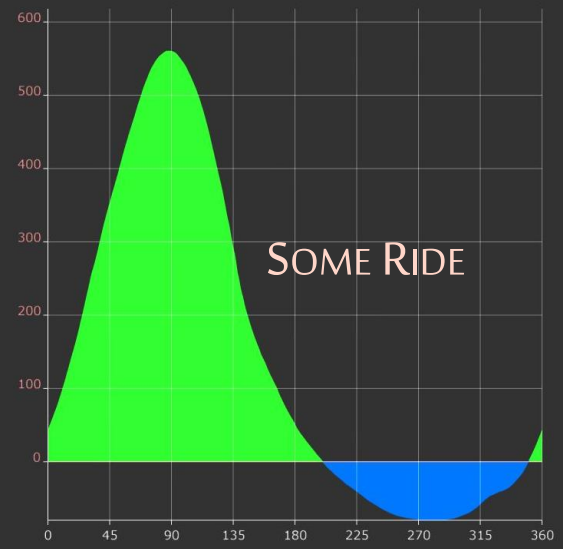
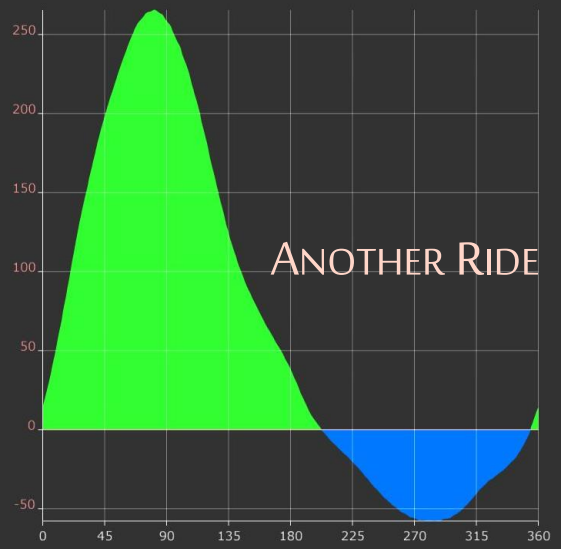
How to compare Rides?



Vs



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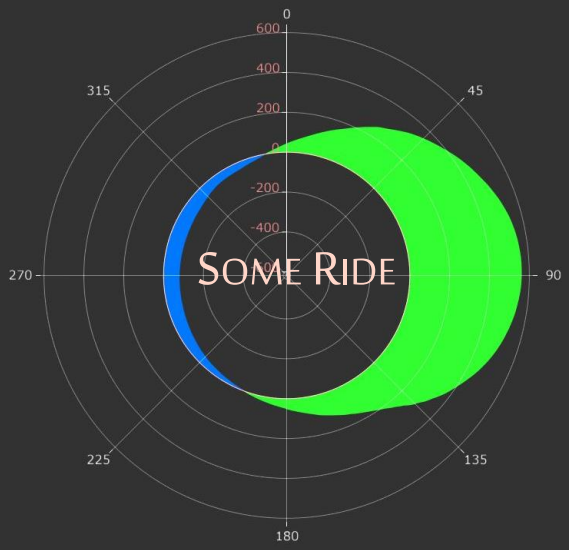
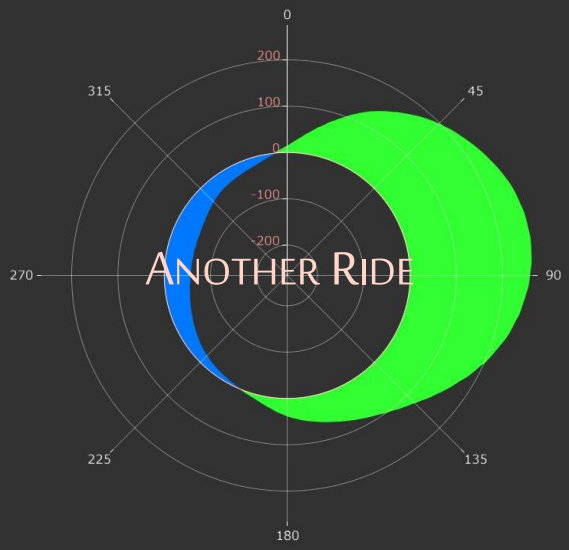
?



Vs



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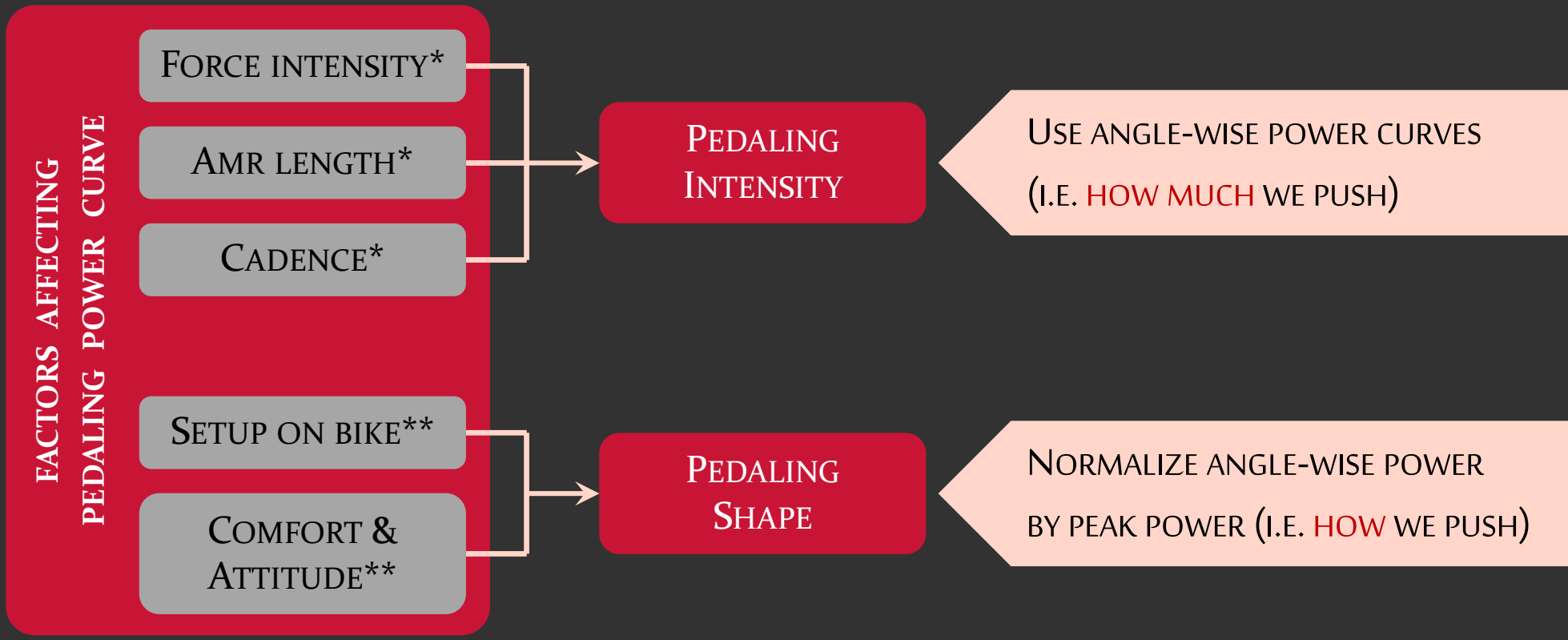
MEP solution: separate Intensity and Shape



* these factors indirectly influence Pedaling Shape, since they affect (**) factors
e.g. pedaling at a different Cadence results in a different Comfort (thus P.S.)

** these factors indirectly influence Pedaling Intensity, since they affect (*) factors
e.g. a better Setup generally brings out a larger Force (thus P.I.)

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Comparing Rides in *MEPstudio* (1/2)

- In MEPstudio, there are three rides:
  - *Live Ride* – stores data as it gets sampled by MEP PRO crank arms
  - *Ride A* and *Ride B* – store user-chosen copies of any *Live Ride*

Ride	updates while pedaling	can set number of averaged Turns	file load/save	compare Intensity	compare Shape
Live Ride	Yes	Yes	–	Yes	Yes
Ride A	–	–	Yes	Yes	Yes
Ride B	–	–	Yes	Yes	Yes

→ In MEPstudio You can analyse how Intensity and Shape change while the Athlete is pedaling!

e.g. store *Live Ride* in *Ride A*, then enable *Live Ride comparison Vs Ride A* and analyse differences when altering bike setup

Comparing Rides in *MEPstudio* (2/2)

MEPSTUDIO SUMMARY BAR

Number of Turns being averaged

Copy *Live ride* into *Ride A* or *B*

Delete *Ride A* or *B*

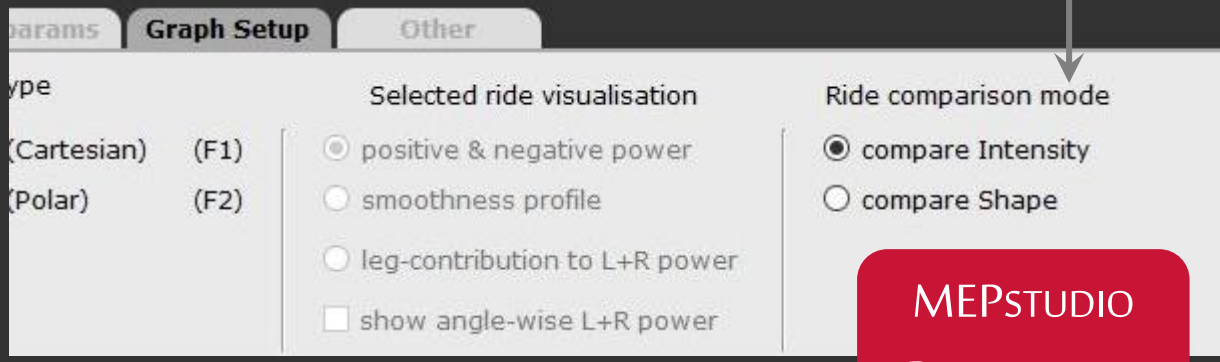
View & Plot selected *Ride*

Save to file *Ride A* or *B*

Set *Ride A* or *B* as reference Ride

Load file in *Ride A* or *B*

Switch between Intensity and Shape comparison modes



MEPSTUDIO BOTTOM BAR

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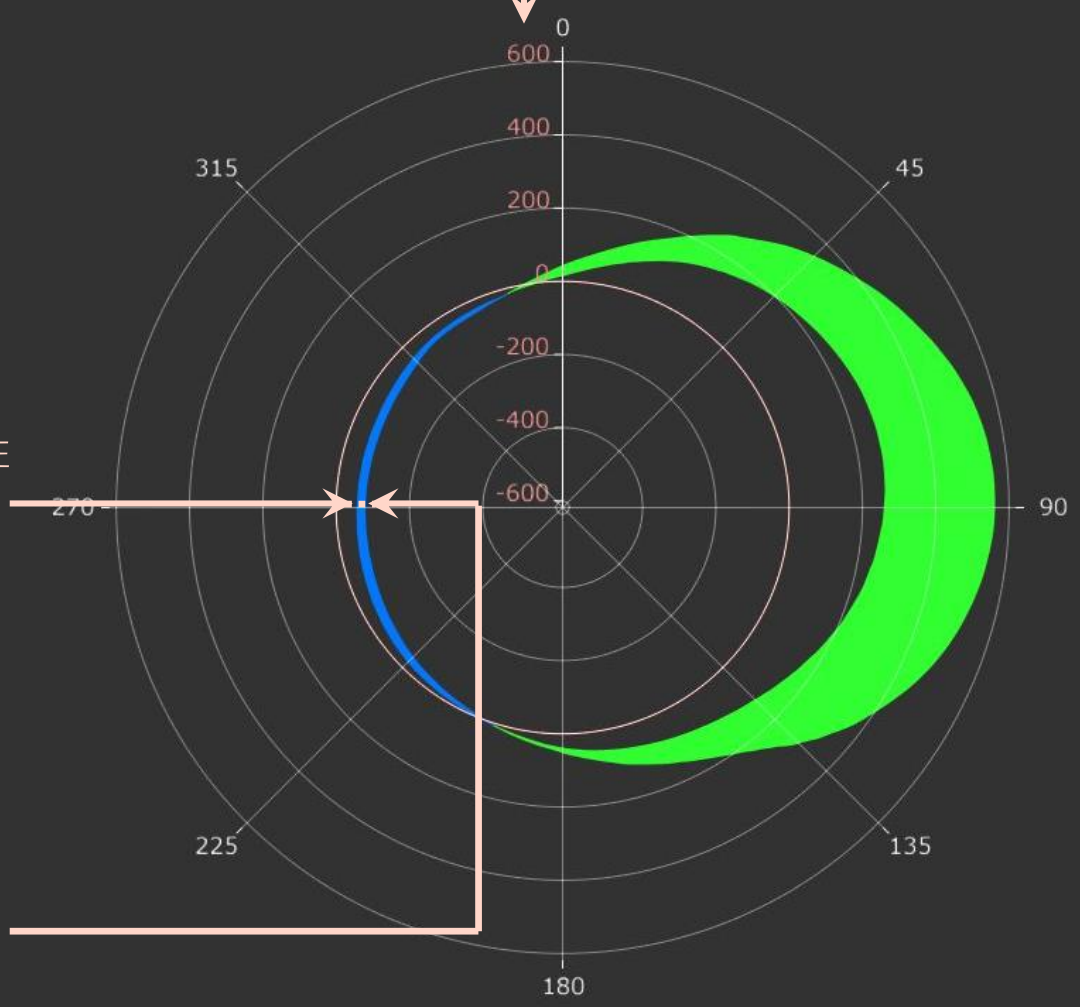
Angle-wise Intensity comparison: blue (1/2)

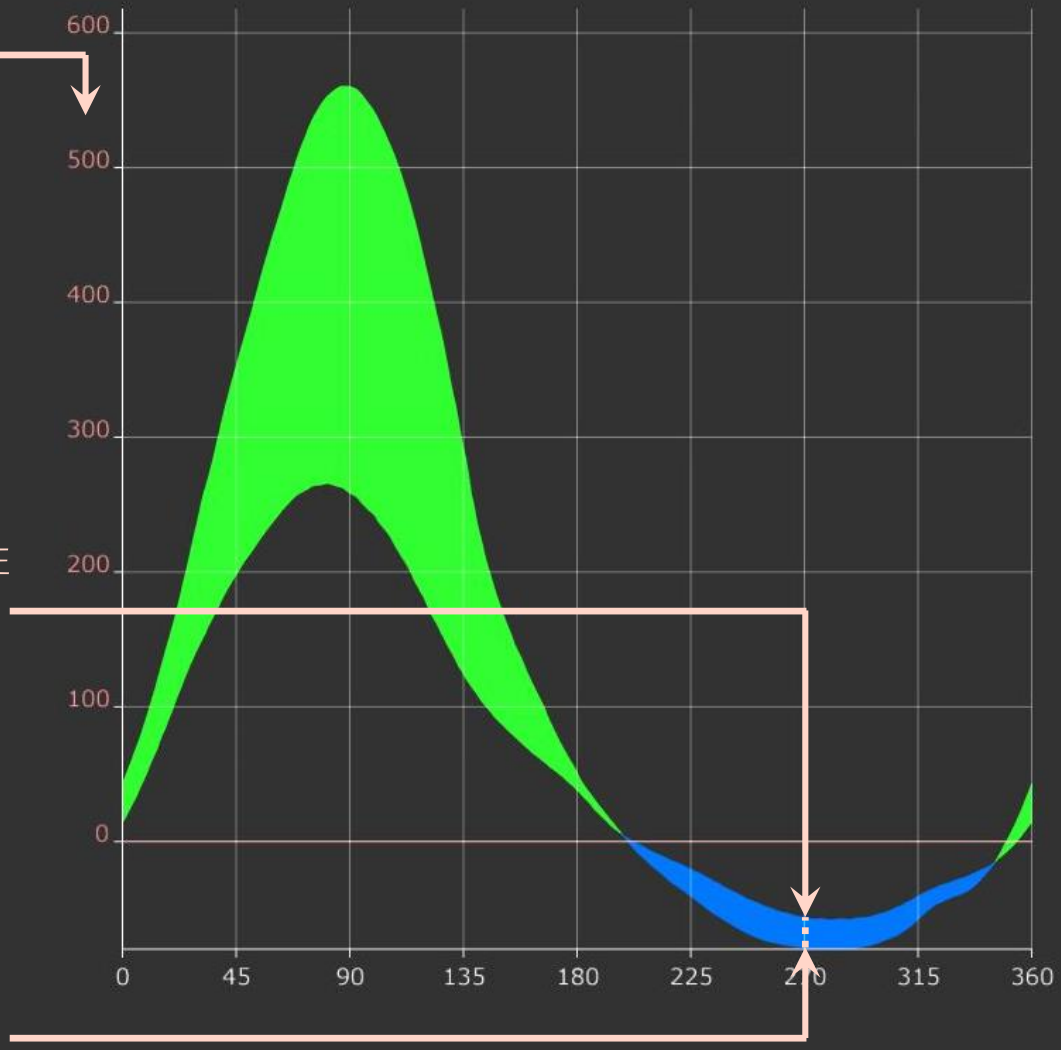


RIDE B IS PUSHING LESS (OPPOSING MORE) THAN RIDE A

Paolo Brivio - PhD

COMPARING RIDE B VS RIDE A

Angle-wise Intensity comparison: blue (2/2)



POWER SCALE

REFERENCE RIDE POWER CURVE

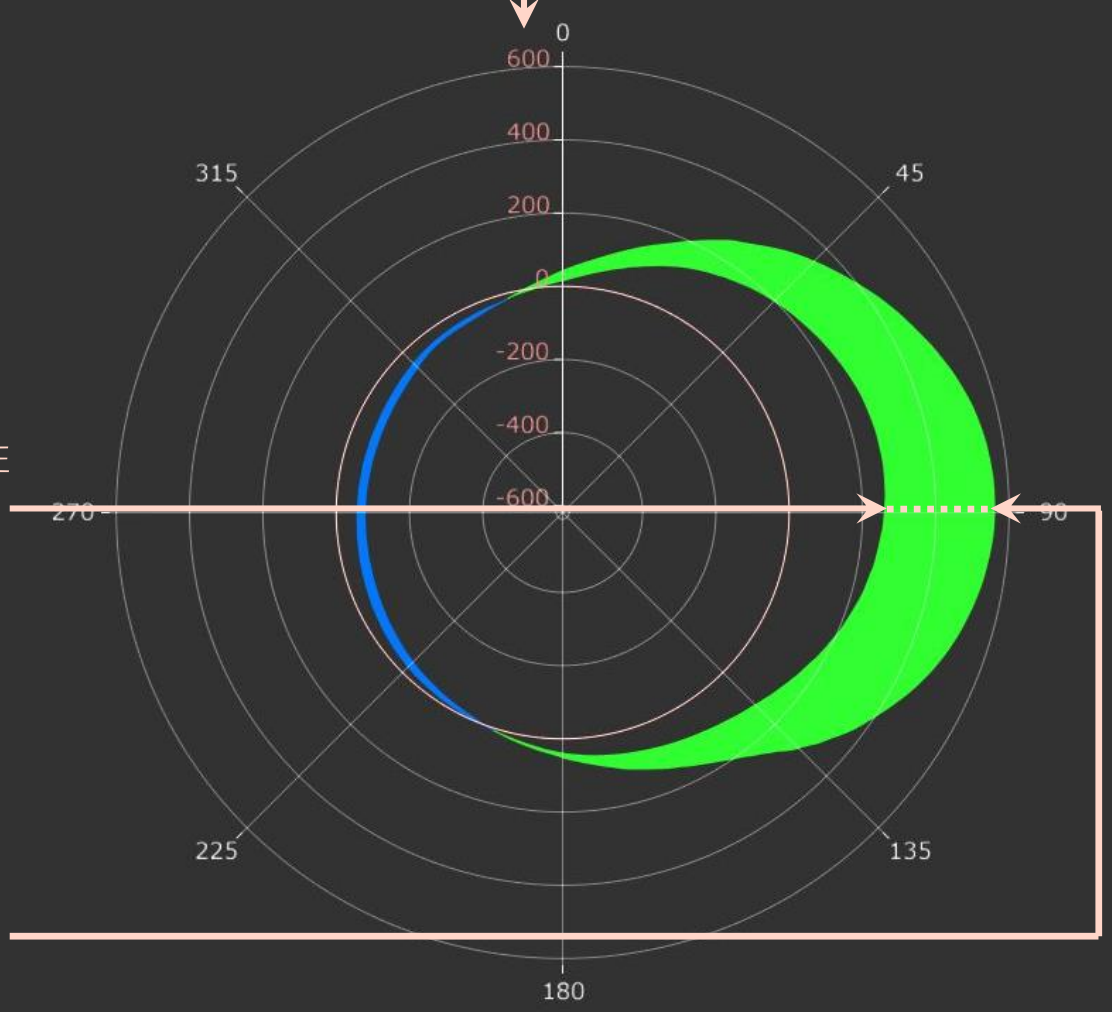
SELECTED RIDE POWER CURVE

RIDE B IS PUSHING LESS (OPPOSING MORE) THAN RIDE A

Paolo Brivio - PhD

COMPARING RIDE B VS RIDE A

Angle-wise Intensity comparison: green (1/2)

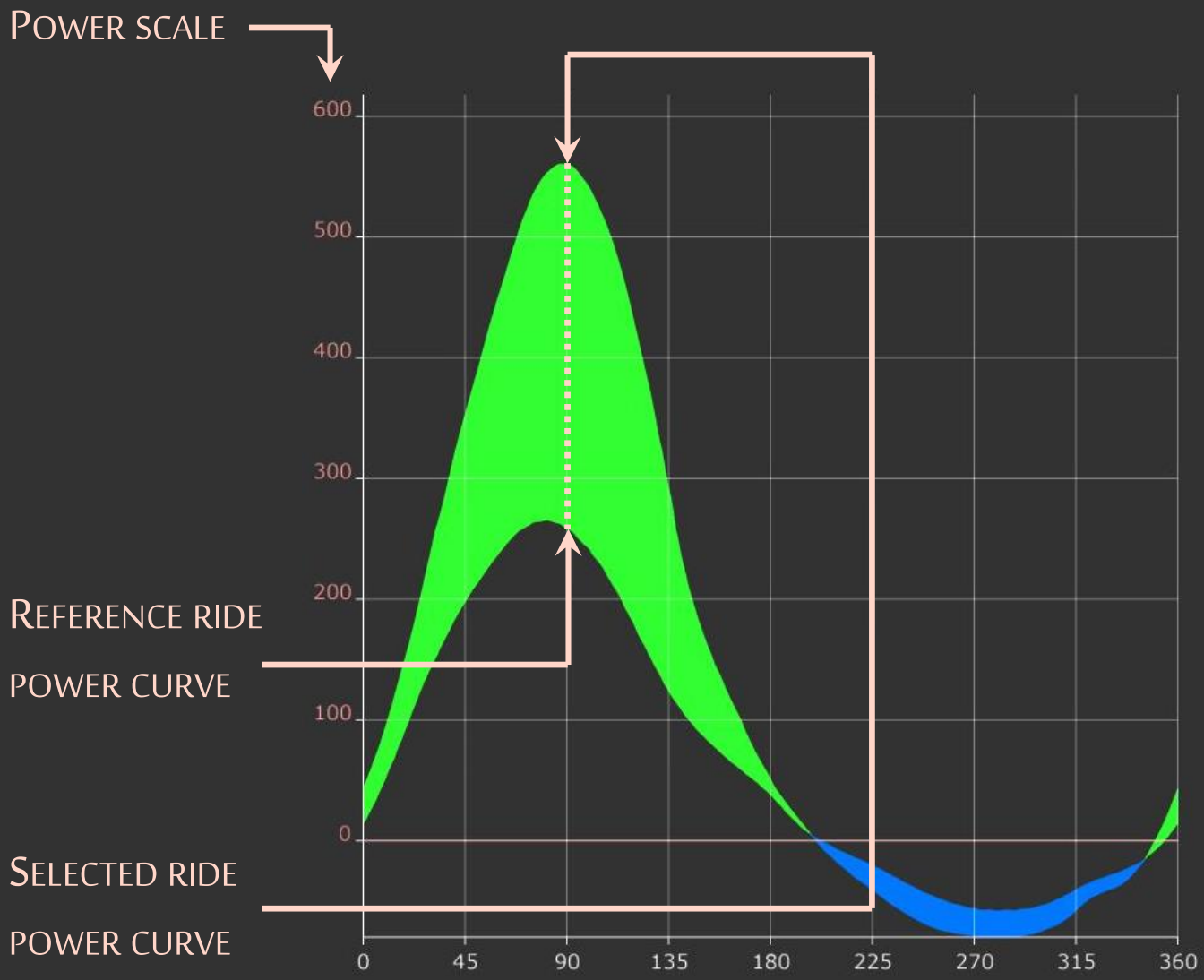


RIDE B IS PUSHING MORE (OPPOSING LESS) THAN RIDE A

Paolo Brivio - PhD

COMPARING RIDE B VS RIDE A

Angle-wise Intensity comparison: green (2/2)



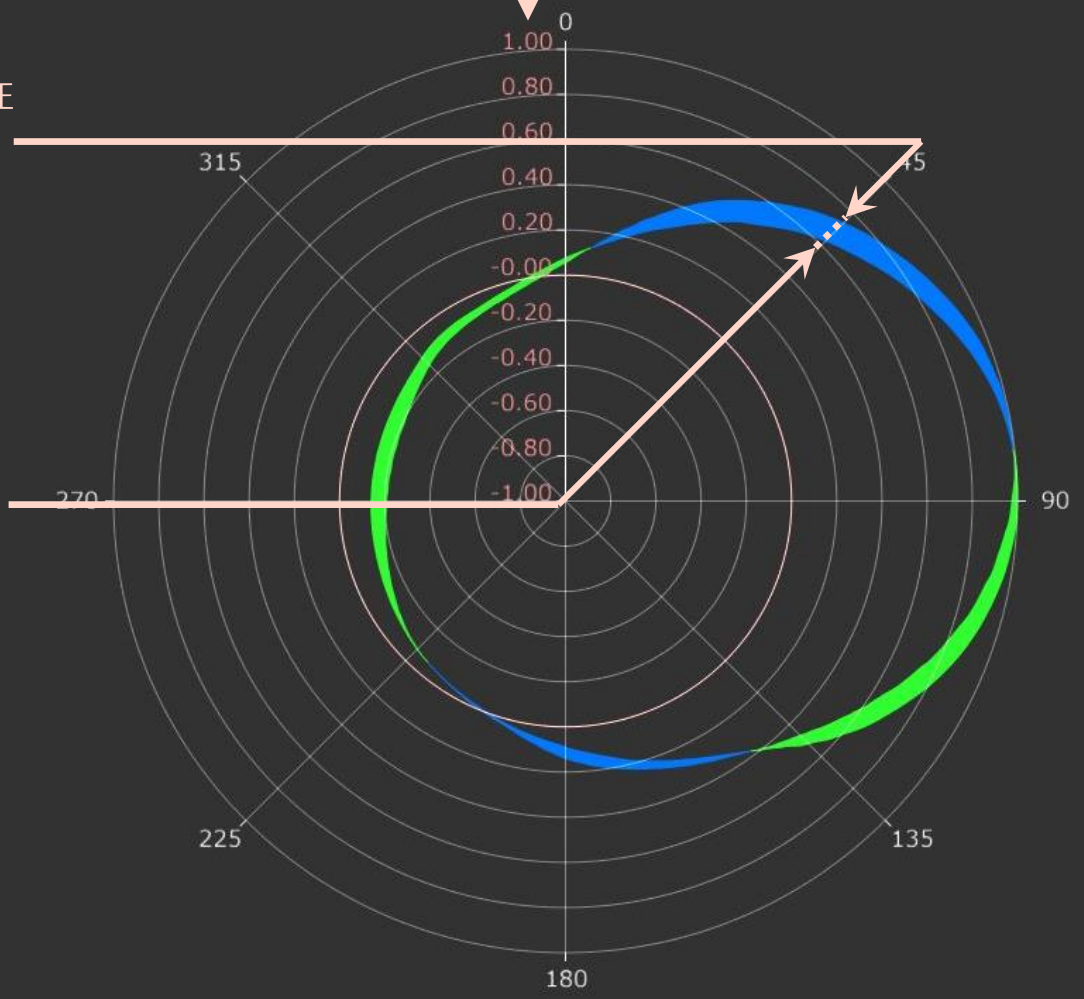
Ride B is pushing more (opposing less) than Ride A

Angle-wise Shape comparison: blue (1/2)

NEUTRAL SCALE

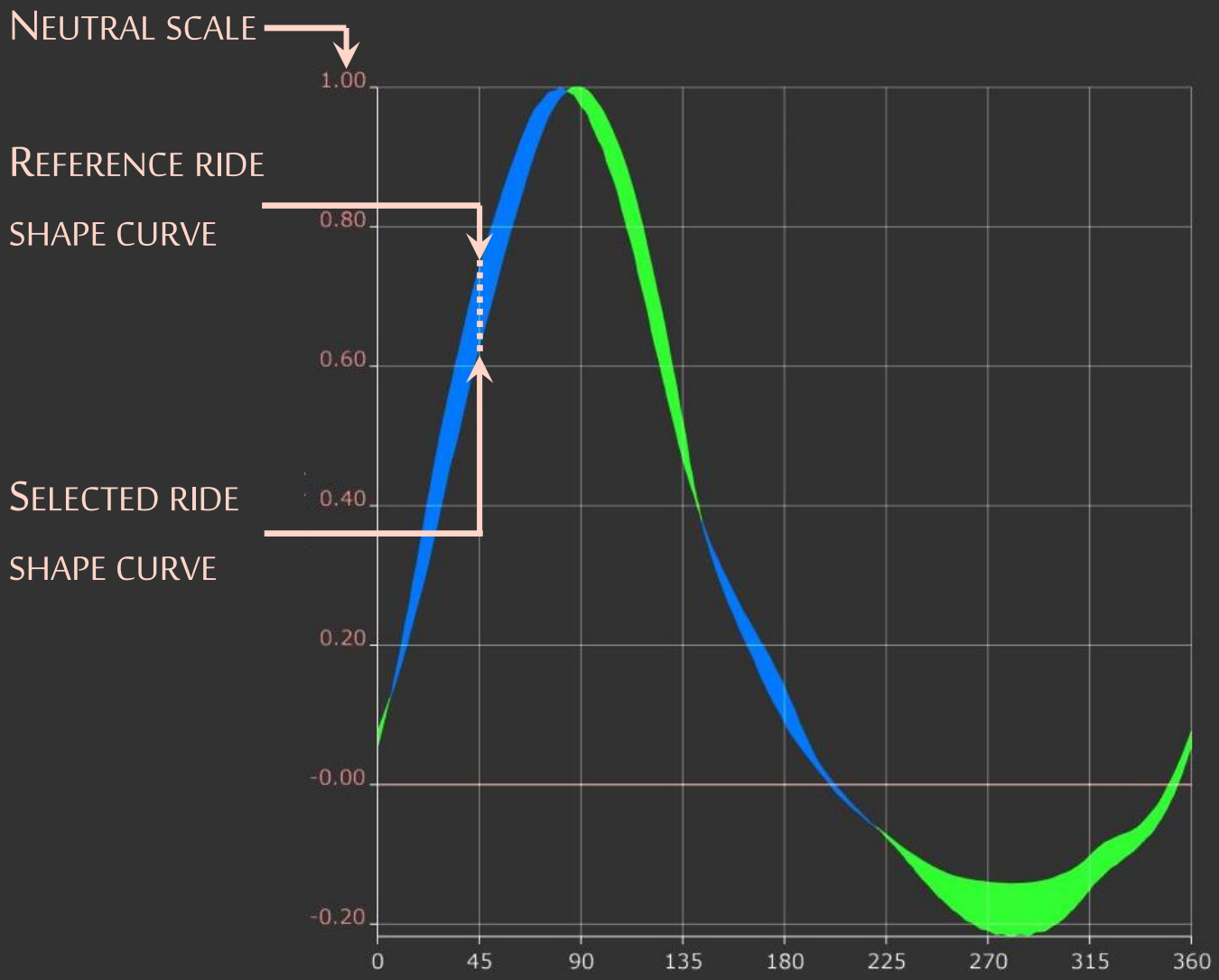
REFERENCE RIDE SHAPE CURVE

SELECTED RIDE SHAPE CURVE



RIDE B IS TURNING HARSHER THAN RIDE A

Angle-wise Shape comparison: blue (2/2)



RIDE B IS TURNING HARSHER THAN RIDE A

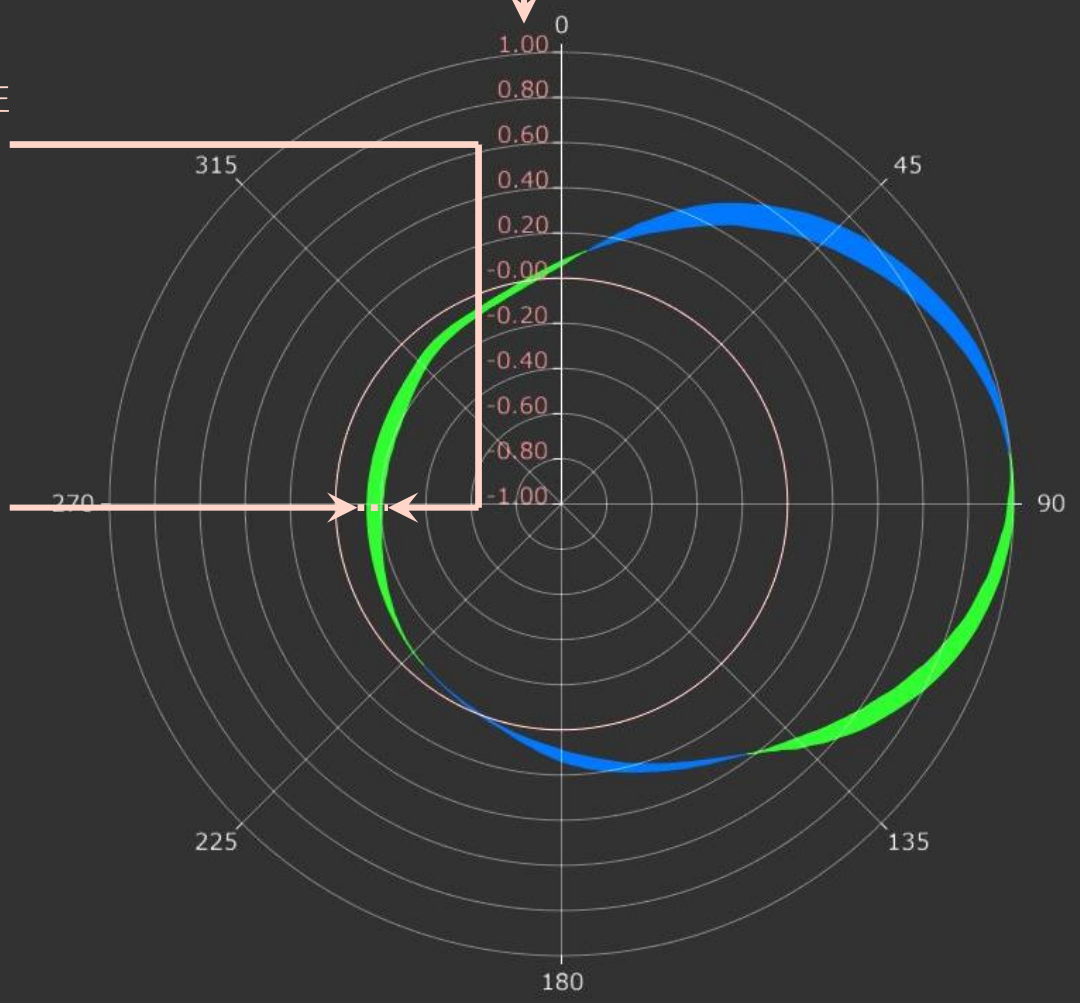
COMPARING RIDE B VS RIDE A

Angle-wise Shape comparison: green (1/2)

NEUTRAL SCALE

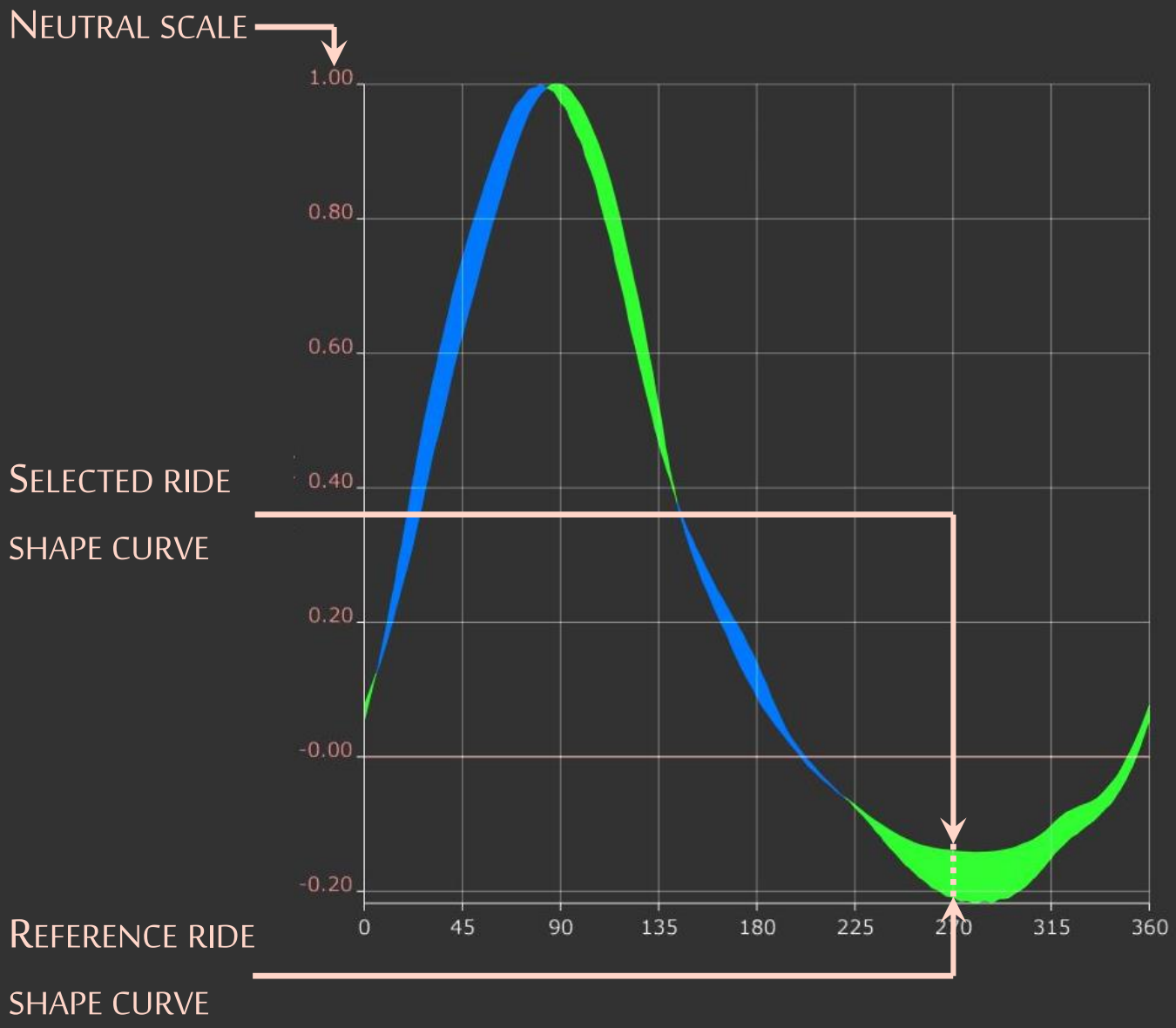
REFERENCE RIDE SHAPE CURVE

SELECTED RIDE SHAPE CURVE



RIDE B IS TURNING EASIER THAN RIDE A

Angle-wise Shape comparison: green (2/2)



RIDE B IS TURNING EASIER THAN RIDE A

COMPARING RIDE B VS RIDE A

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H) PDF report generation — V 2018.2

GDPR-ready data storage

- Each Ride can be saved as MEP turn file (*.mpt*)
  encrypted with Advanced Encryption Standard (AES-256)
  → Cipher algorithm Government-approved for TOP SECRET INFORMATION
- You can use a unique password, or customize it for each Athlete
  → You must remeber password to load previously saved data
- Can export recorded data in plain CSV format

MEPSTUDIO BOTTOM BAR

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PDF report generation

- Automatic PDF report based on "*Ride A*" and "*Ride B*"
- If only "*Ride A*" is loaded
  → print "*Ride A*" turn parameters and leg graphs
- If also "*Ride B*" is loaded
  → print "*Ride A*" turn parameters and leg graphs
  → print "*Ride B*" turn parameters and leg graphs
  → print "*Ride B Vs Ride A*" Intensity comparison
  → print "*Ride B Vs Ride A*" Shape comparison

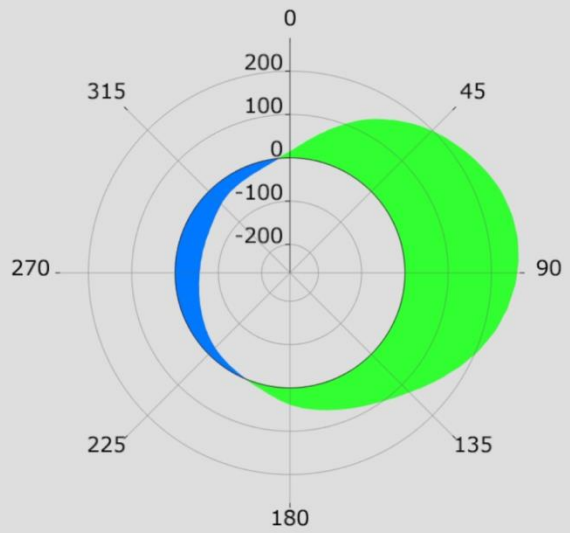
MEP REPORT

22 NOVEMBER 2018
JOHN DOE

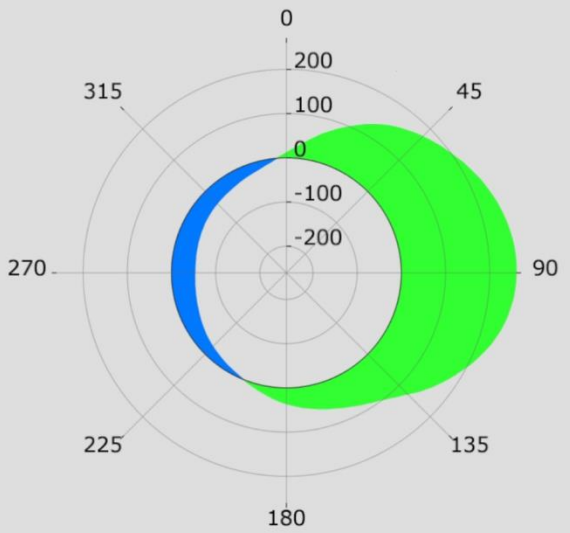
WEIGHT: 70
AGE: 35

Arm length: 172.5 mm Cleat position: 50 mm Comment: low rate pedaling 20 NOVEMBER 2018

LEFT INTENSITY (WATT)



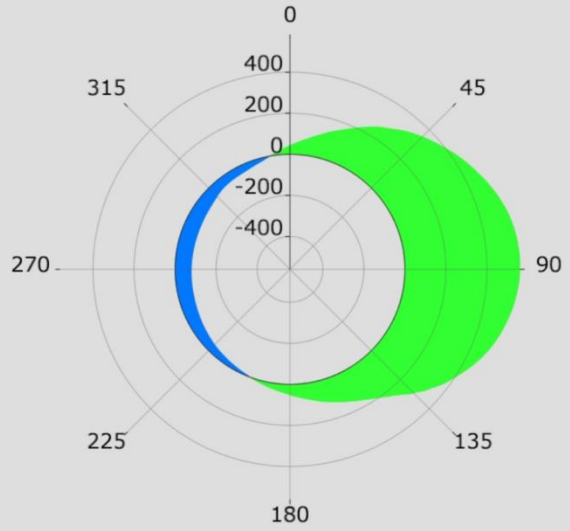
67	TURN POWER W	61
52	BALANCE %	48
206	PUSH BREADTH deg	205
-2	MAX PUSH OFFSET mm	4



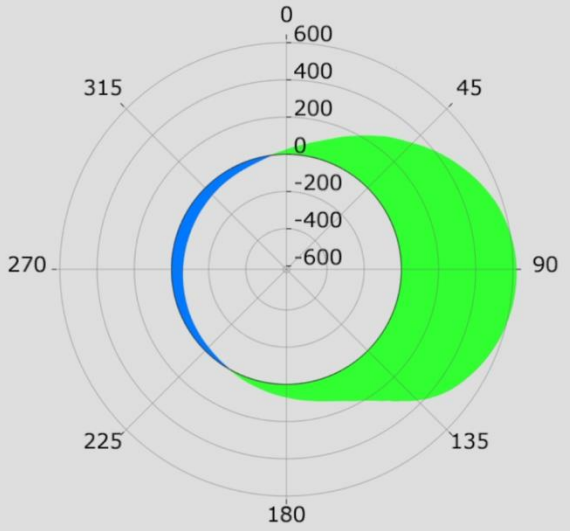
RIGHT INTENSITY (WATT)

Arm length: 172.5 mm Cleat position: 50 mm Comment: high rate pedaling 20 NOVEMBER 2018

LEFT INTENSITY (WATT)



140	TURN POWER W	148
49	BALANCE %	51
207	PUSH BREADTH deg	214
3	MAX PUSH OFFSET mm	4



RIGHT INTENSITY (WATT)

* positive values are green, negative values are blue

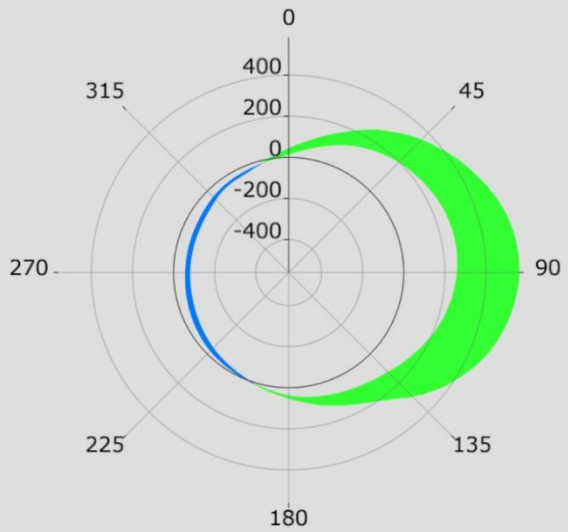
MEP REPORT

22 NOVEMBER 2018
JOHN DOE

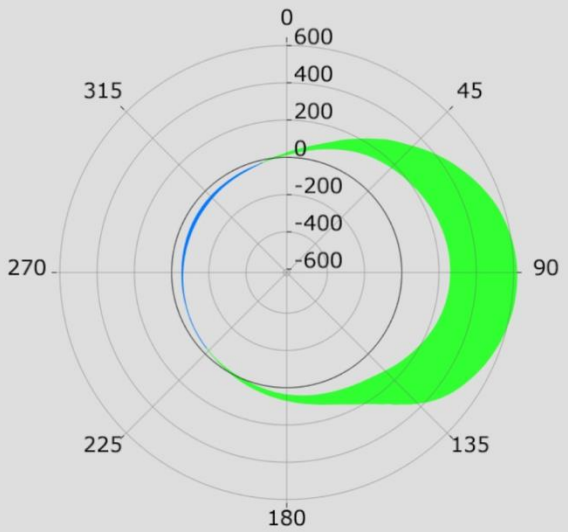
WEIGHT: 70
AGE: 35

L. INTENSITY COMPARISON

Comparing "high rate pedaling" Vs "low rate pedaling" Intensity (*)



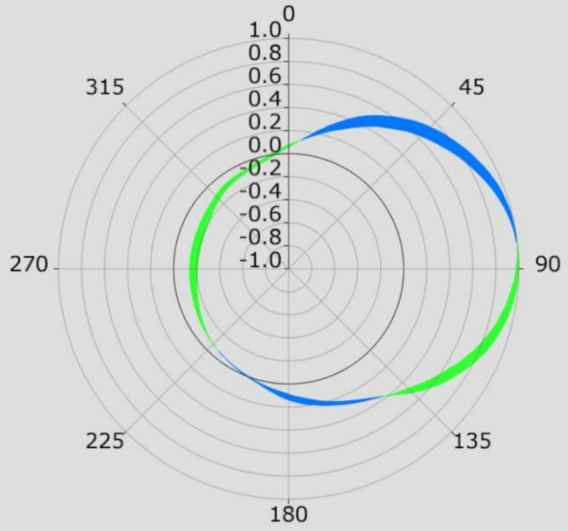
73	TURN POWER W	87
-3	BALANCE %	3
1	PUSH BREADTH deg	9
5	MAX PUSH OFFSET mm	0



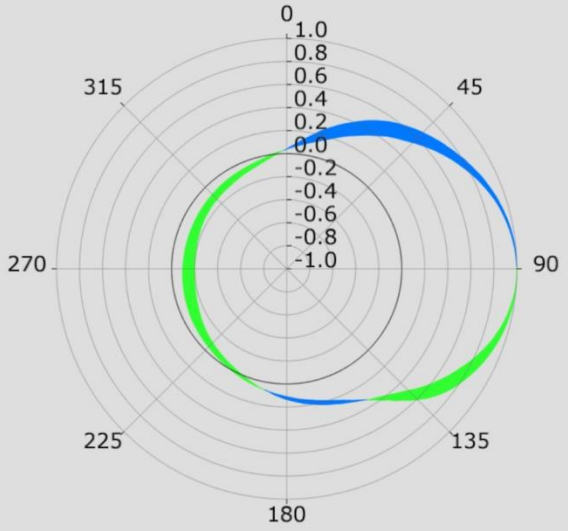
R. INTENSITY COMPARISON

L. SHAPE COMPARISON

Comparing "high rate pedaling" Vs "low rate pedaling" Shape (*)



73	TURN POWER W	87
-3	BALANCE %	3
1	PUSH BREADTH deg	9
5	MAX PUSH OFFSET mm	0



R. SHAPE COMPARISON

* higher values are green, smaller values are blue

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