Effect of varied terrain and bicycle fit on Aerobic Power Production

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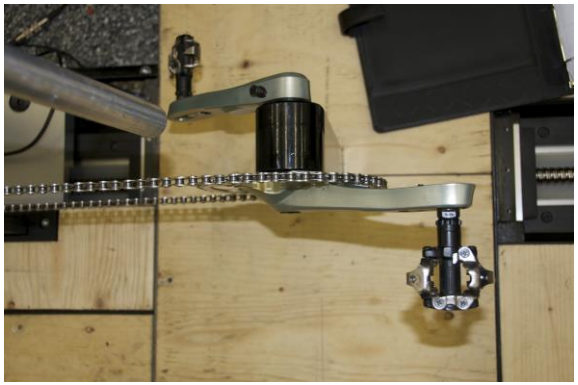
Background



Aim

Why

Focusing on the aerobic zone offers a good payoff.

< 50%VO_{2max}	50 - 90%VO_{2max}	70 - 90%VO_{2max}	> 90%VO_{2max}
25%	32%	29%	14%

Effort distribution in a grand tour

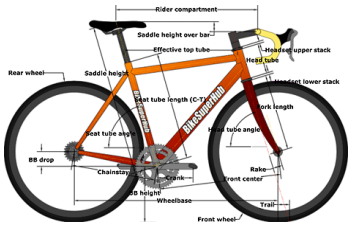
How

Aerobic and anaerobic system training

Enhance flexibility

Technique

Functional strength



Is there an optimal setup for increased aerobic power production

Changing the bicycle setup is fast and relatively easy compared to other options.

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Some previous work

Bini et al., 2011

Formulas based on anthropometric measurements (e.g. Lemond, inseam)

Retül, 2014

Video analysis and test jigs

Peveler, 2007

Comparison of 109% inseam and 25-35º knee flexion methods on anaerobic power

Increase in seat tube angle has a tendency to less activity at the gastrocnemius and biceps femoris.

Bisi et al., 2012

Saddle height increase leads to reduction in flexion across hip, knee and ankle joints

Ferrer-Roca et al., 2011

- Important individual aspect to the optimal setup.
- The number of testing positions is limited.

Methodology

- 20 minute self selected warmup.
- 20 minute FTP test.
  - Load and heart rate zone for subsequent tests.
- Own bike.

3 tests (1 week between each)

- 20 minute self selected warmup.
- 45 minutes at % of FTP load at aerobic zone.
  - 5 minutes per each of 9 possible positions.
- Test carried in custom made ergometer.
- Data recorded for the last minute of each position.

Saddle height	Saddle reach	Load set point
+1cm (109% inseam)	+5%	FTP torque
Current	Current	150% FTP torque
-1cm (25º knee flexion)	-5%	50% FTP torque

- The set point is set based on torque values due to the control used to simulate the load. However, by keeping the cadence within a set average value via the aerobic zone condition effectively power is being controlled.

Example: For a mean power of 265 Watts. To keep within the zone the participant keeps an average of 70 rpm. The load set is 40 Nm.

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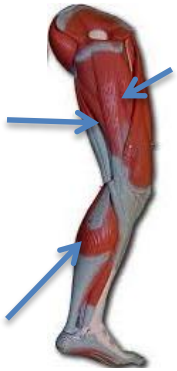
Test setup and workflow

Gastrocnemius (Medial head)

Bicep femoris (Long head)



Vastus lateralis

- Raw EMG signal.

- Torque left/right leg.
- Saddle height/ reach.

- Pedal position.
- It can be used for joint movement analysis.

EMG

- Split data by minute
- EMG data resampling
- Band pass filter: 70 – 500 Hz
- RMS
- Signal feature extraction: Time and frequency domain.

Power

- Split data by minute
- Calculate the power (net, left, right)
- Moving average filter with 30 second window

CODA

- Split data by minute
- Get the pedal position based on marker location

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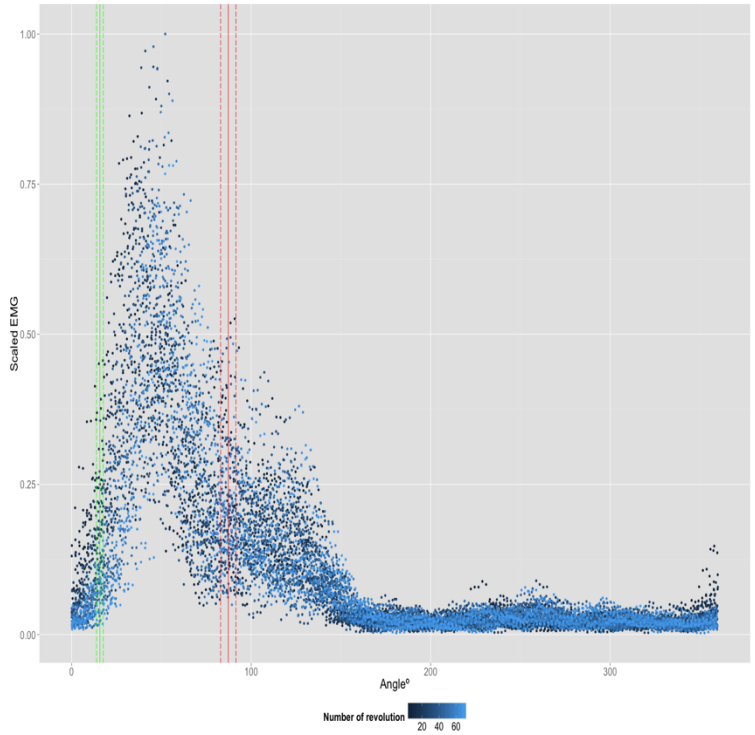
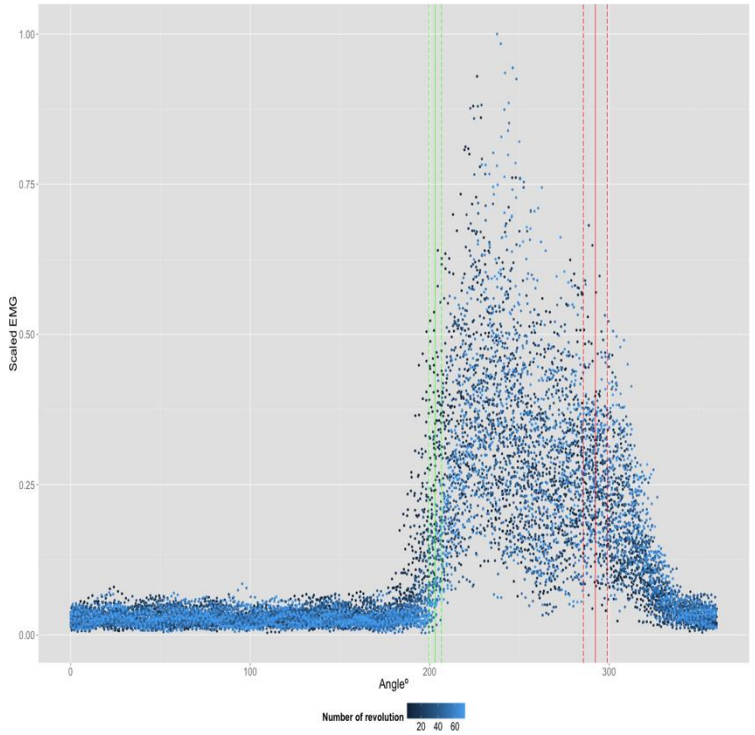
Some issues found along the way: EMG onset/offset



Right Vastus Lat.
(300º - 130º, Max: 30º)



Left Vastus Lat.
(120º - 310º, Max: 210º)

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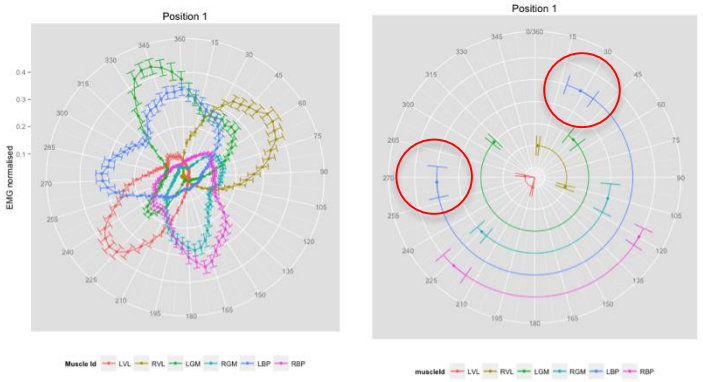
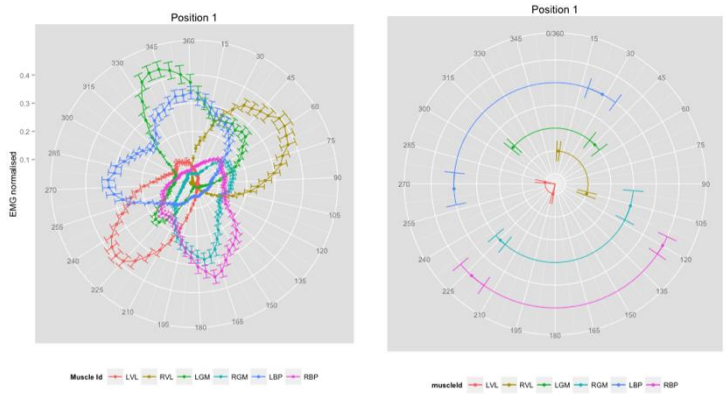
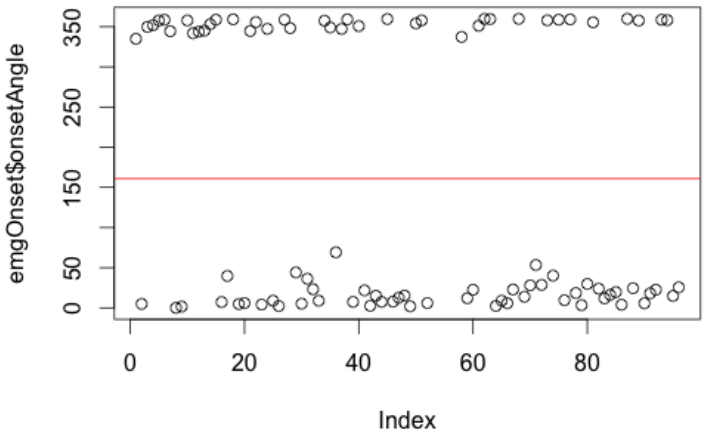
Issues found along the way: Circular nature



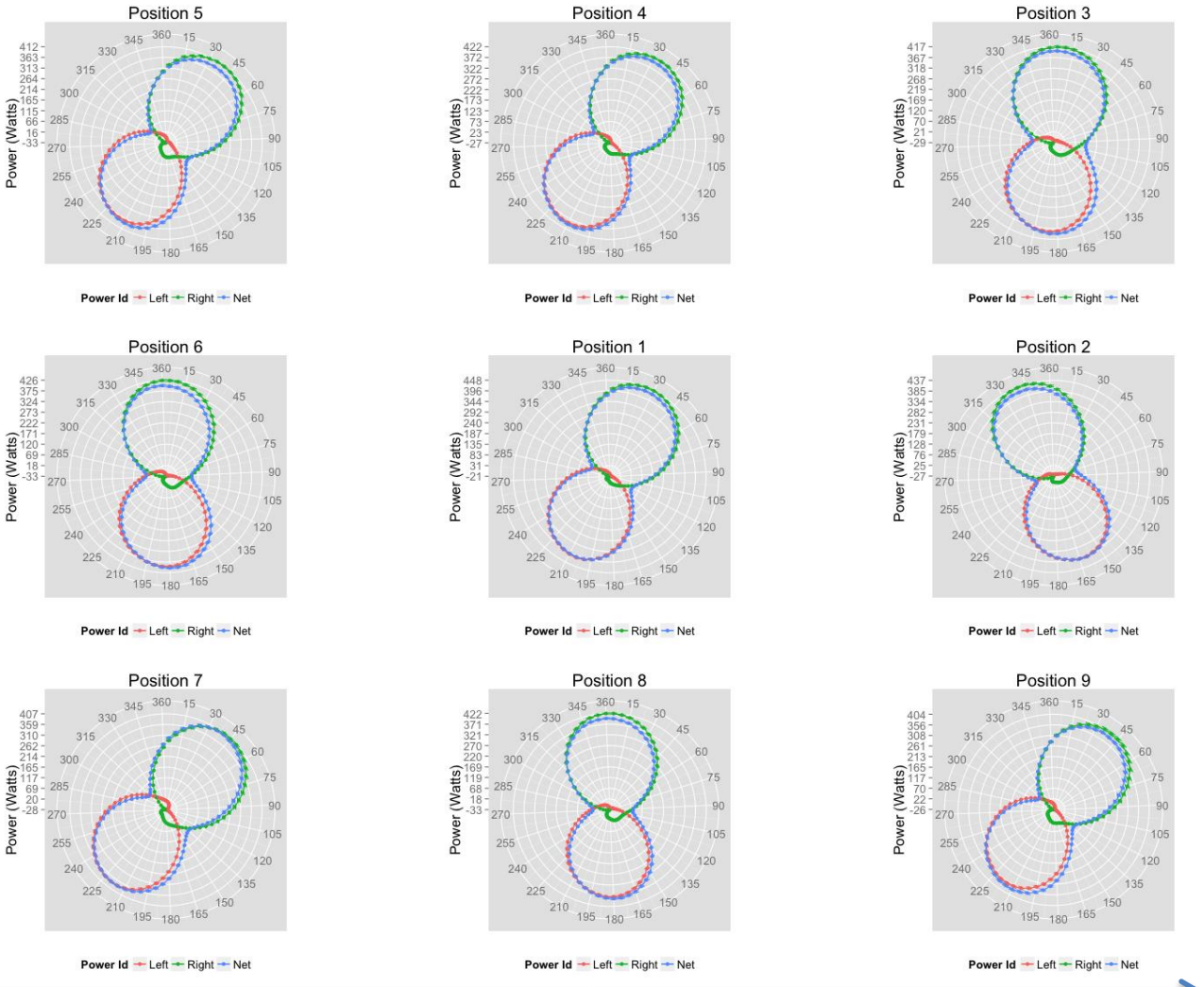
Right detection display issue





Circular mean

Power output: some results for high load (40 Nm)



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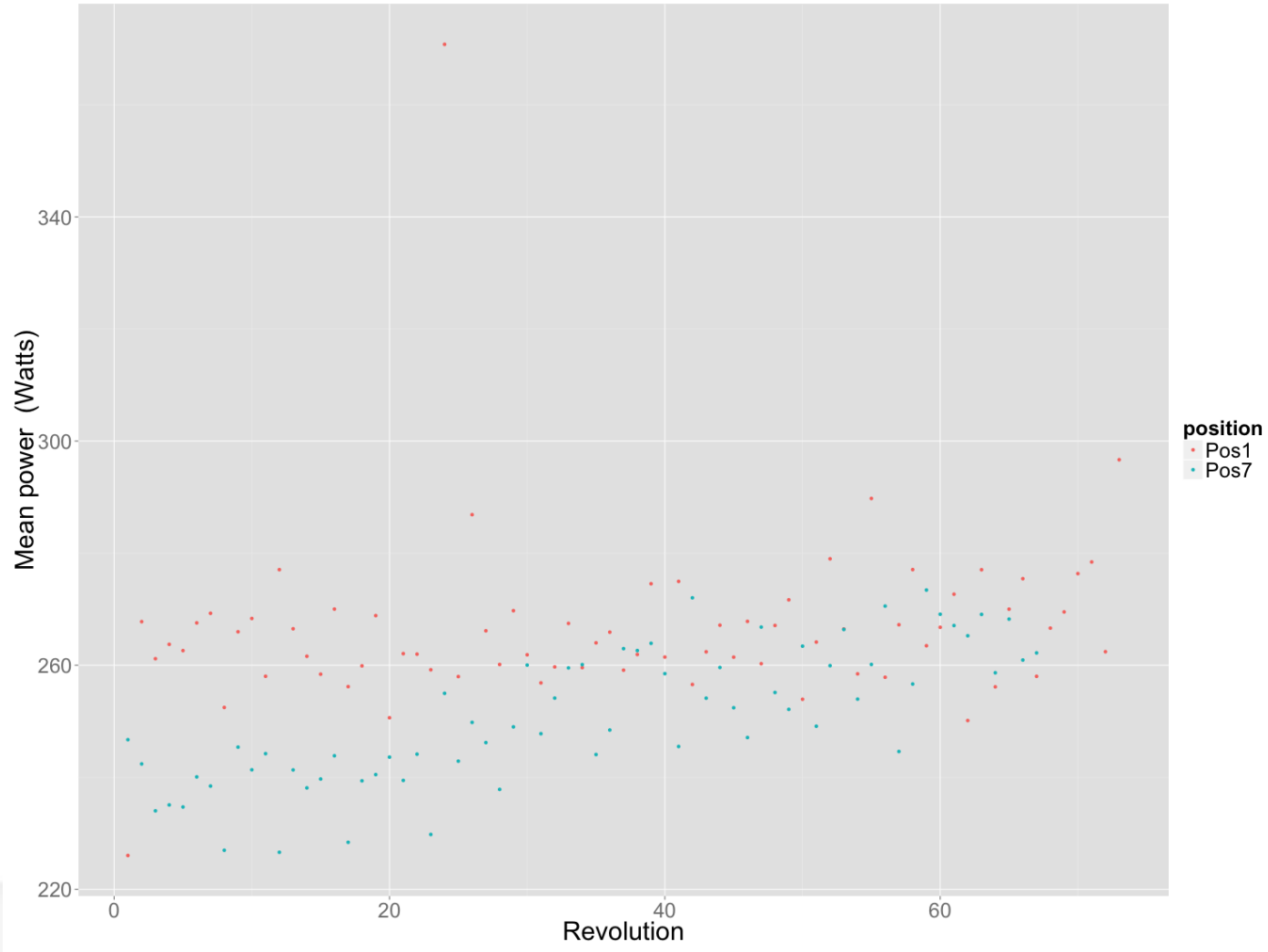
Power output: some results for high load (40 Nm)



There is a difference between the mean power, especially at the early stages.

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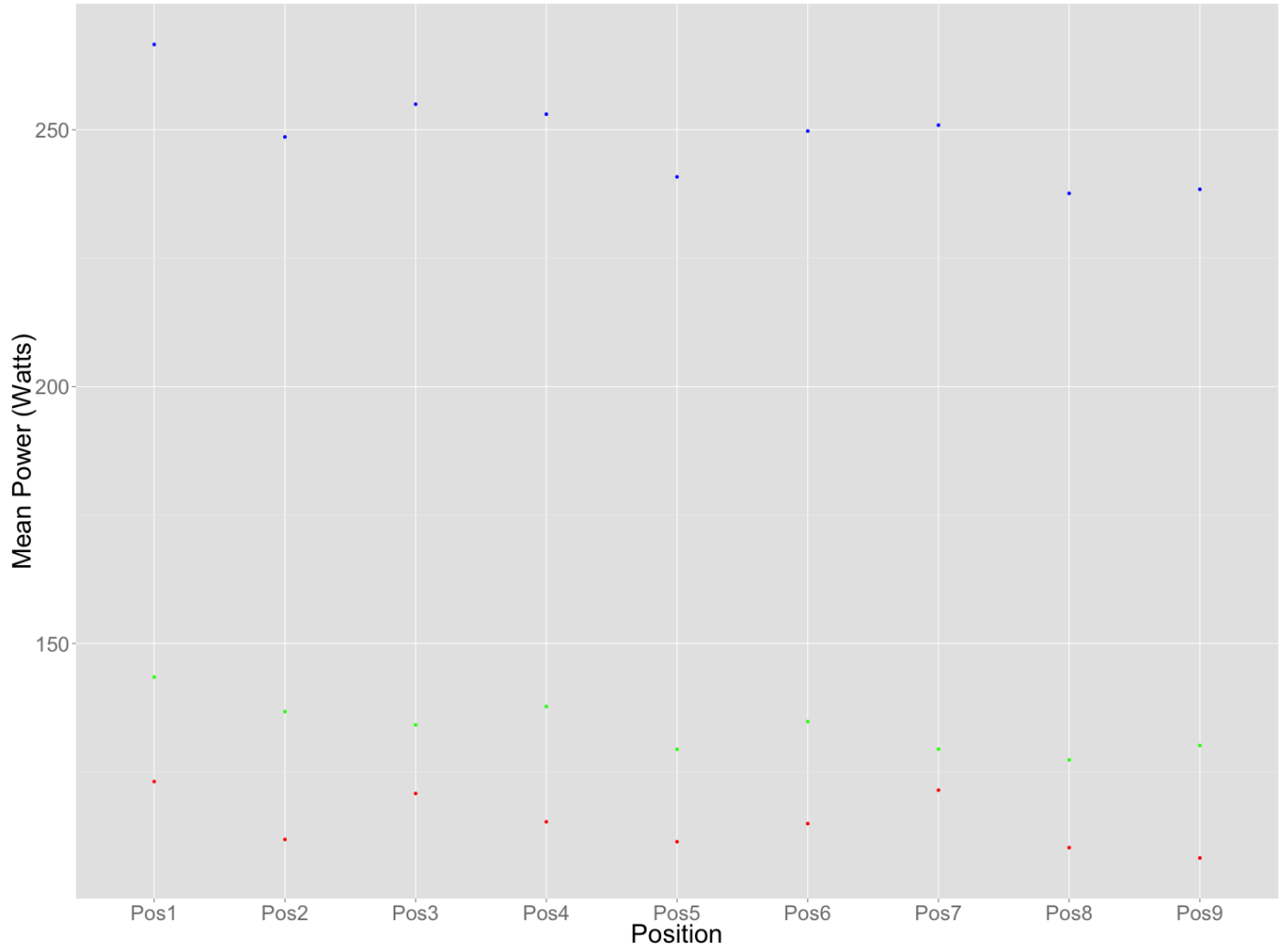
Power output: some results for high load (40 Nm)



There is a change on the mean net power magnitude. We have to check if this is significant or not.

Pos 5	Pos 4	Pos 3
Pos 6	Pos 1	Pos 2
Pos 7	Pos 8	Pos 9

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EMG: some results (40 Nm)

There is no change in the muscle activation timings or duration.

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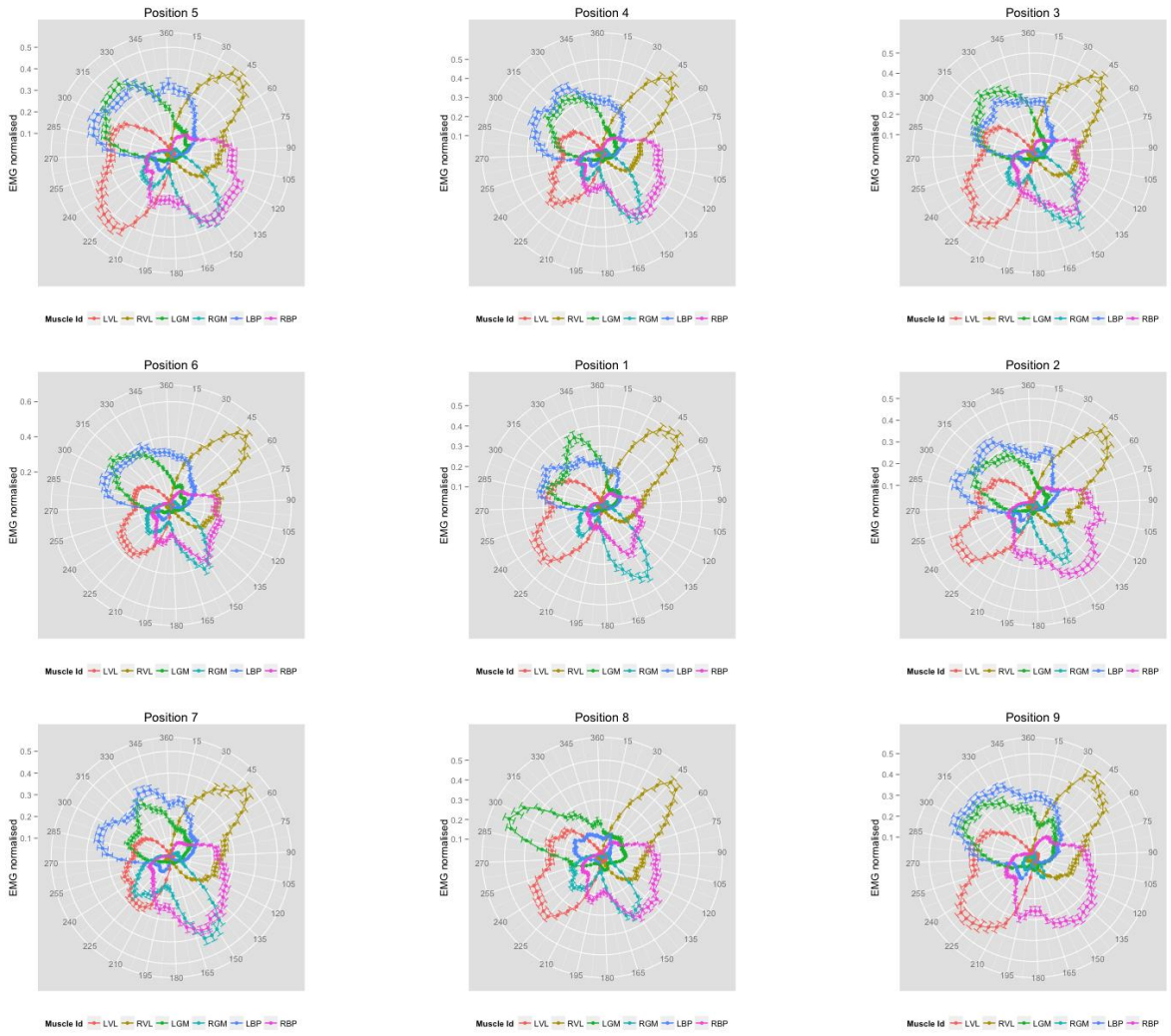
EMG: some results (40 Nm)



There is predominance of RVL over LVL.
The same does not clearly occur for other muscles.

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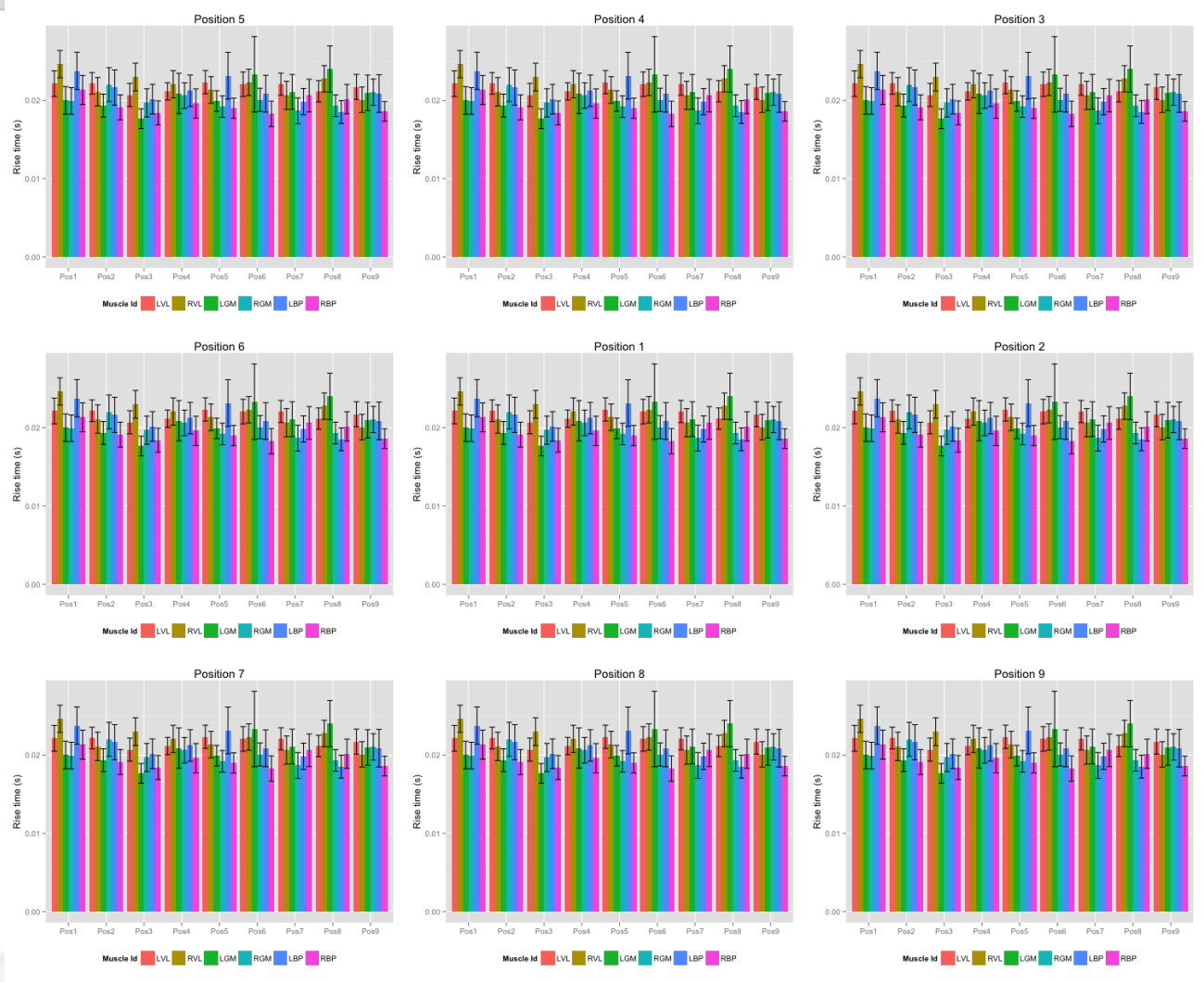
EMG: some results (40 Nm)



No difference on either rise or fall times of EMG.

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Summary

- For the positions tested there seems to be a difference on both the location of the maximum net power and the magnitude of the mean net power. Significance of the differences will be evaluated.
- The EMG analysis showed a predominance of the right leg specially for the Vastus Lateralis.
- At this point the results found are limited but an analysis tool for EMG, torque, and CODA analysis and synchronisation has been developed. A trial with several participants is being conducted currently.
- We do not expect to find general rules rather individual guidelines for setup to improve aerobic performance. On this guidelines we will include both anthropometric measures and comfort.

Questions