Power loss of the chain drive in tandem bicycles

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VU UNIVERSITY AMSTERDAM


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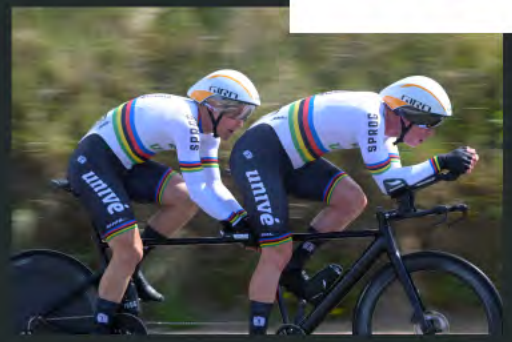
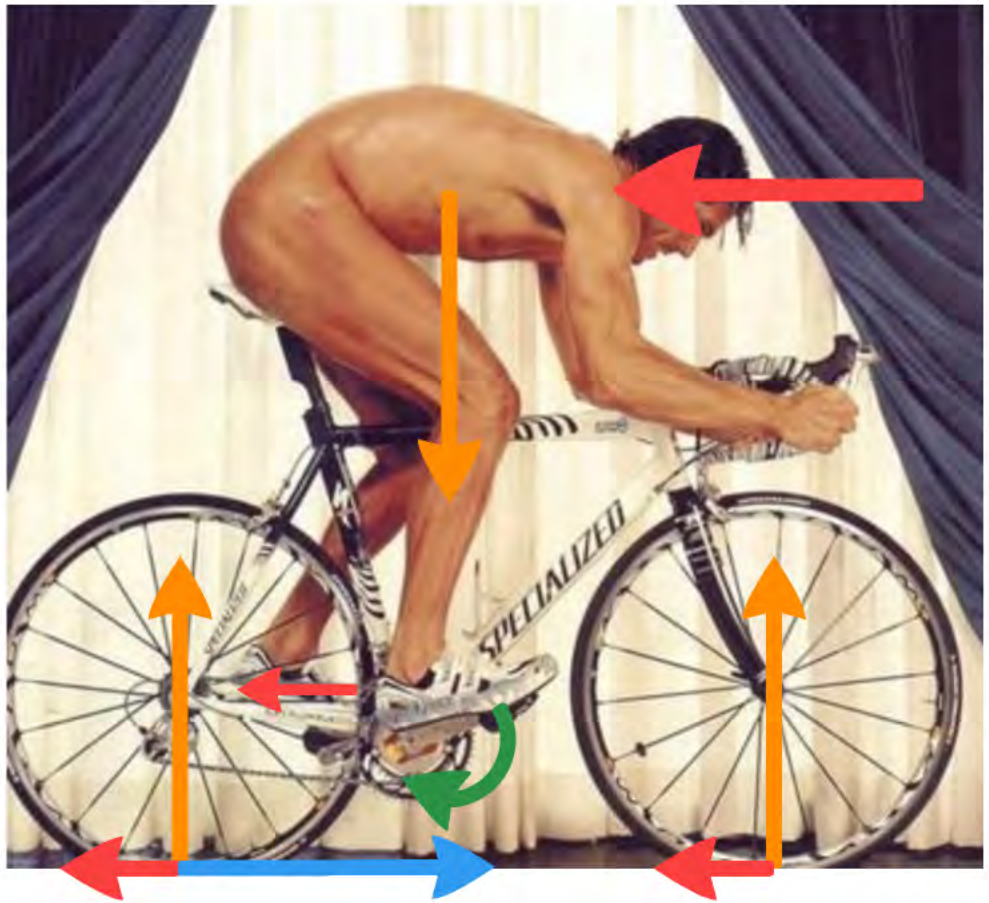
Introduction

Para-cycling

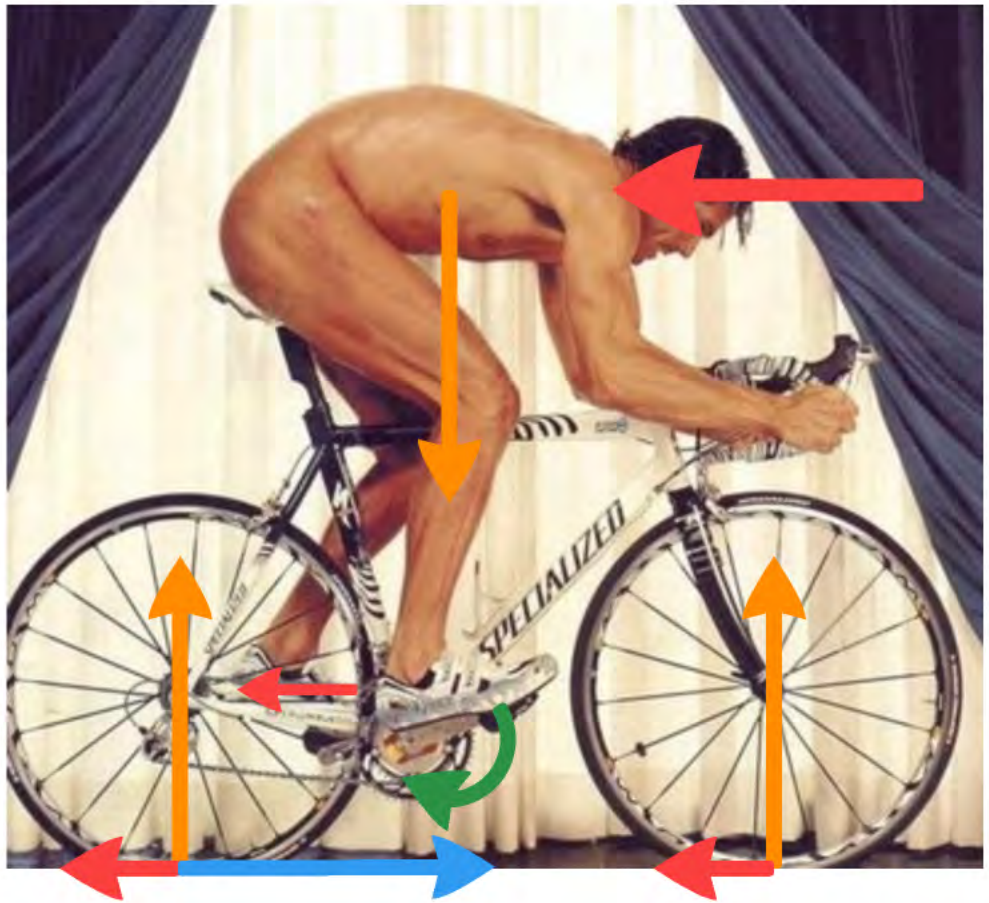


Road: TT and RR
Track: 1km TT and 4km IP

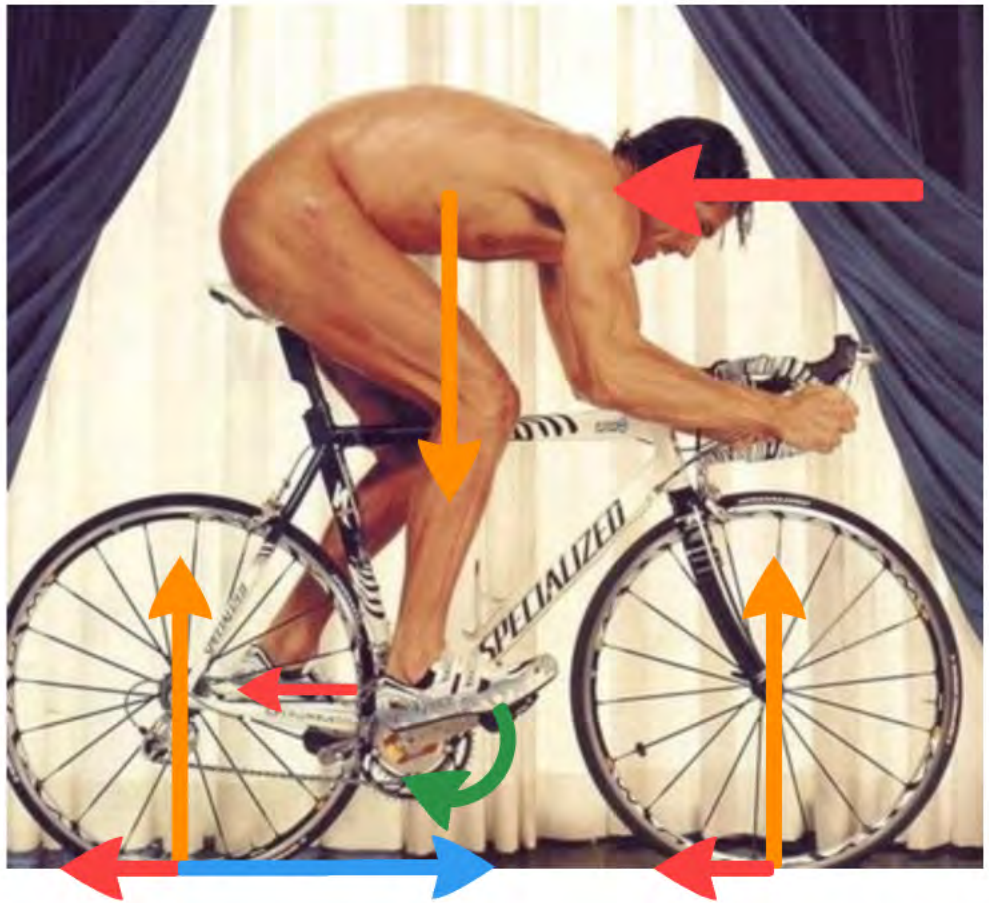
Power balance model

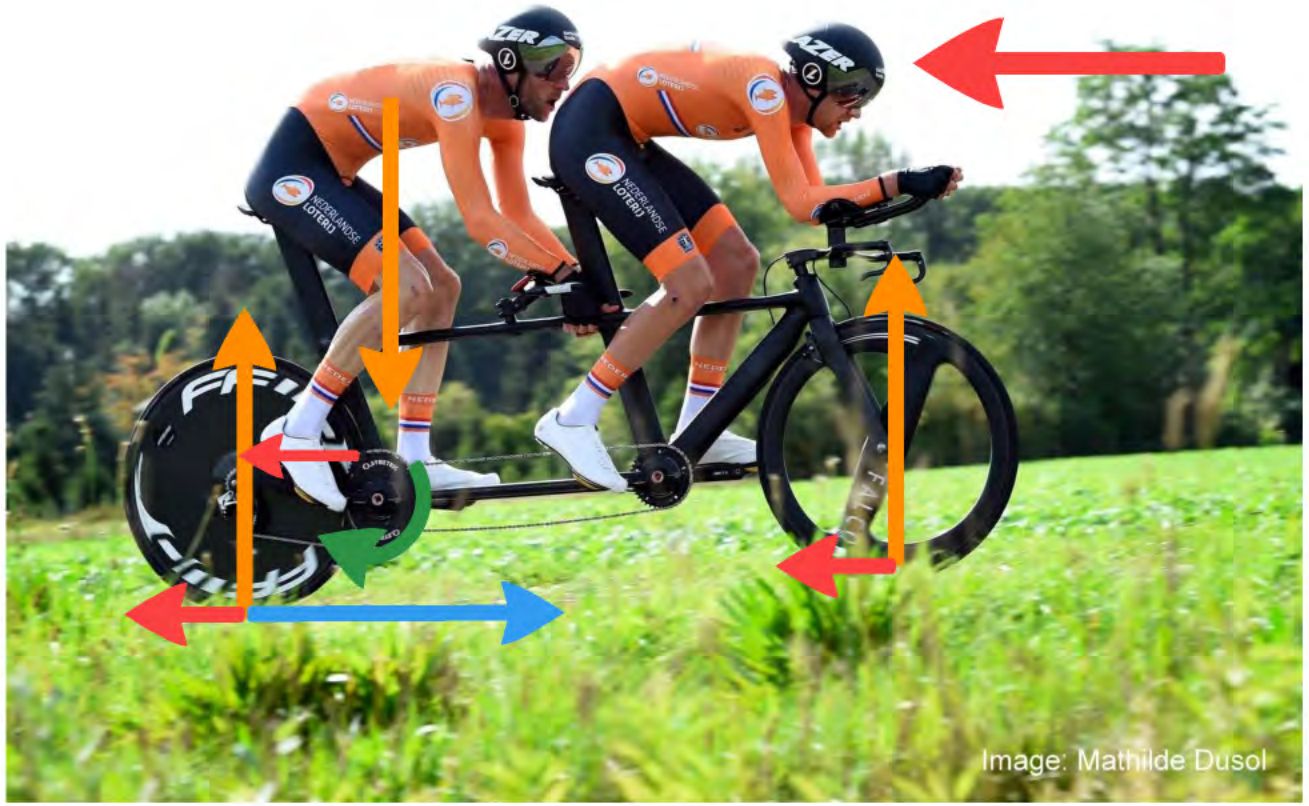


Power balance model

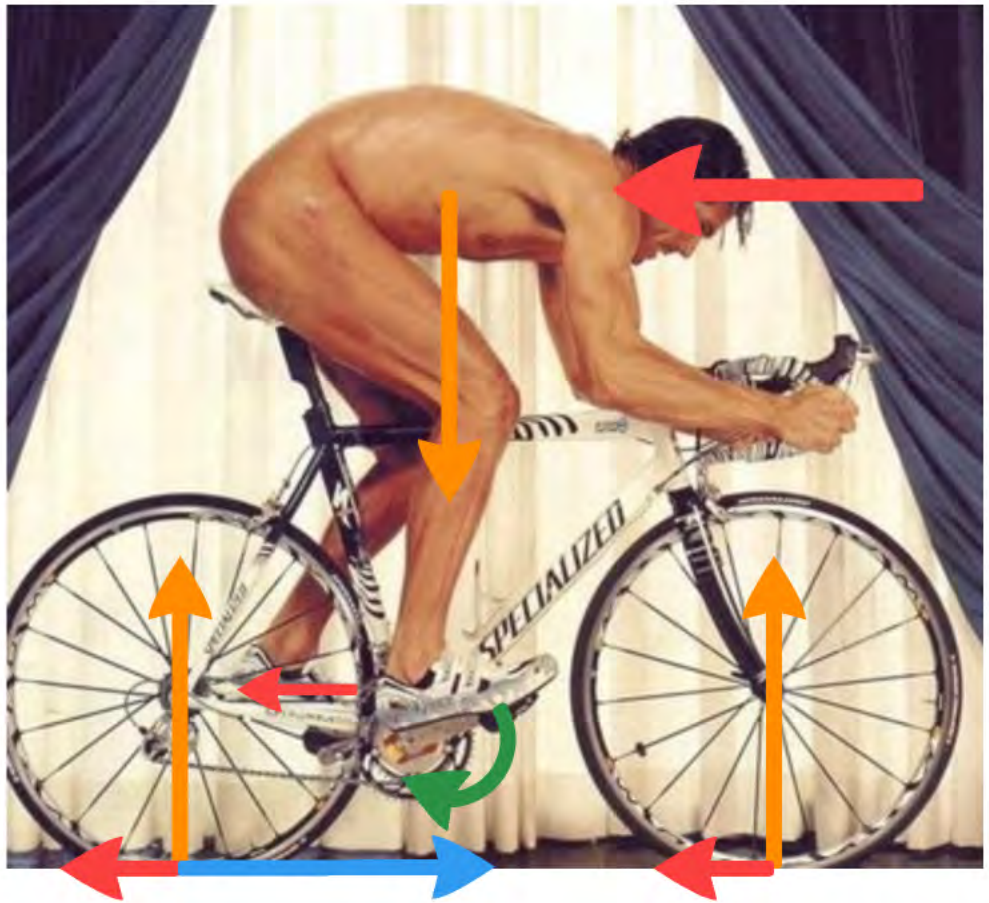


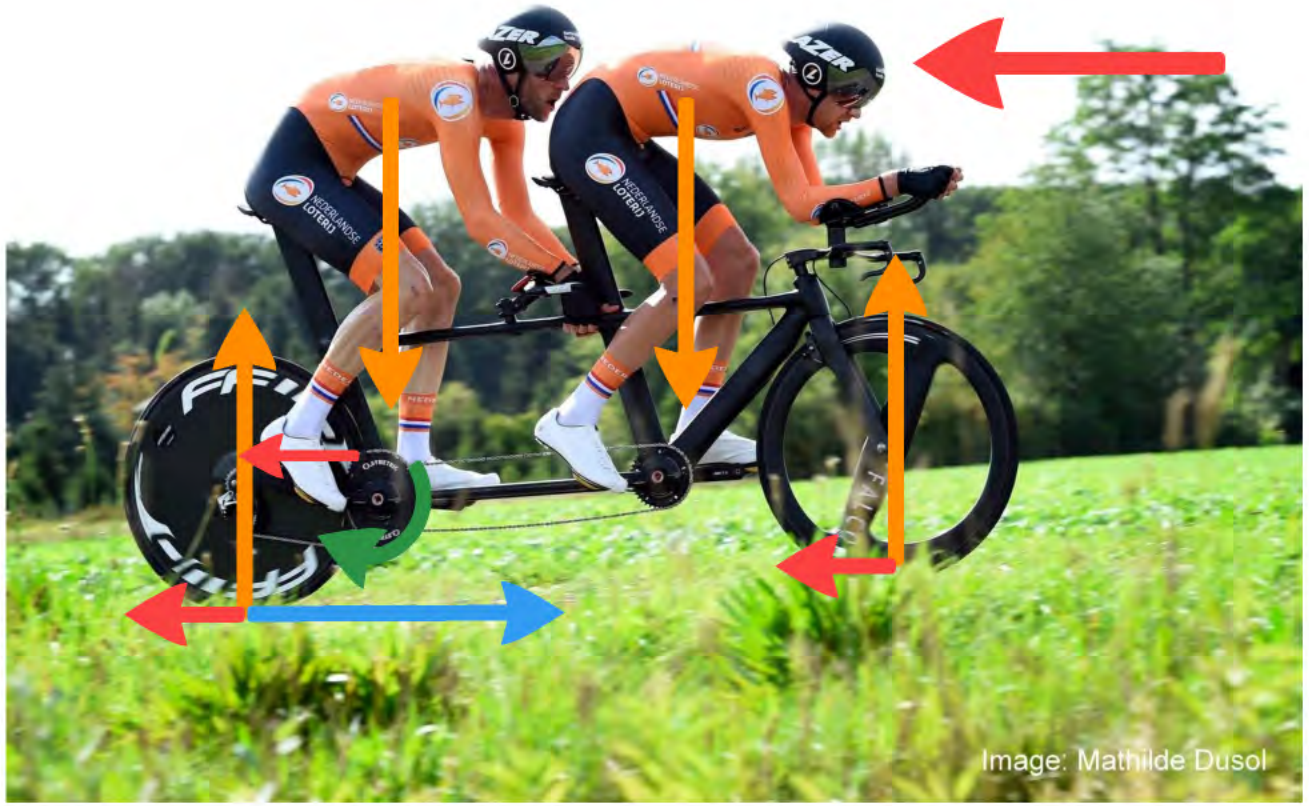
Power balance model





Power balance model





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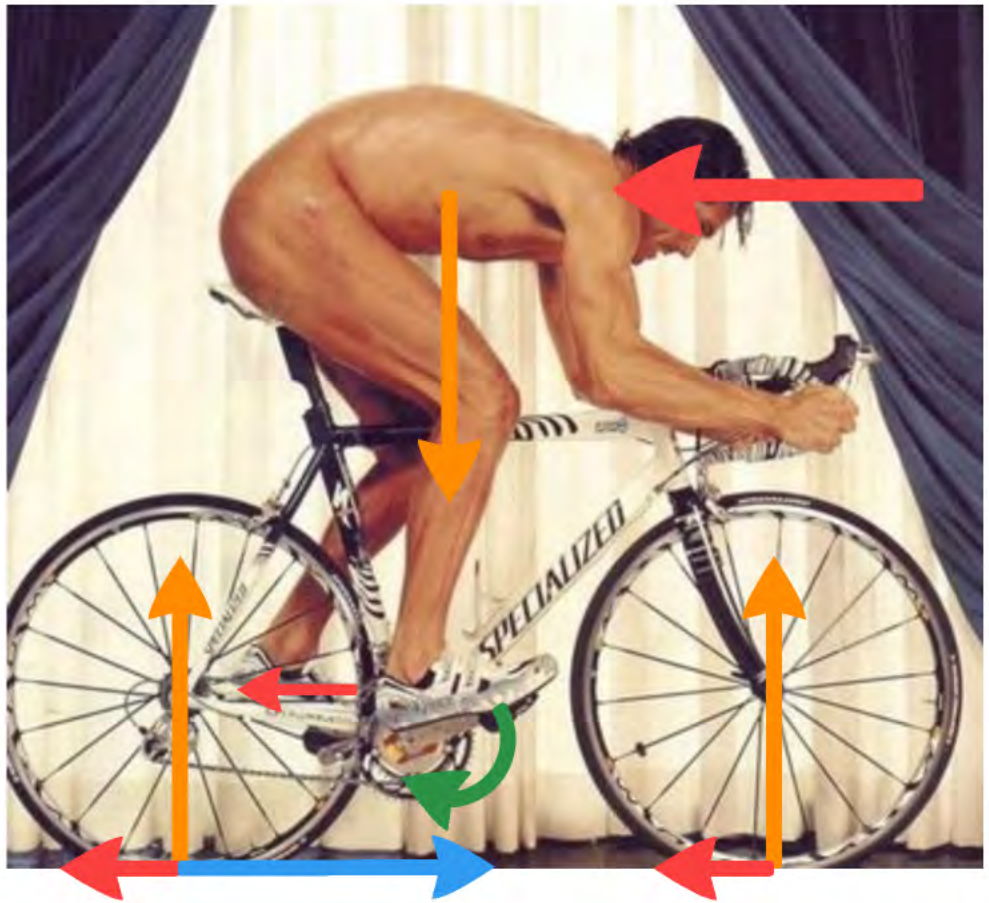

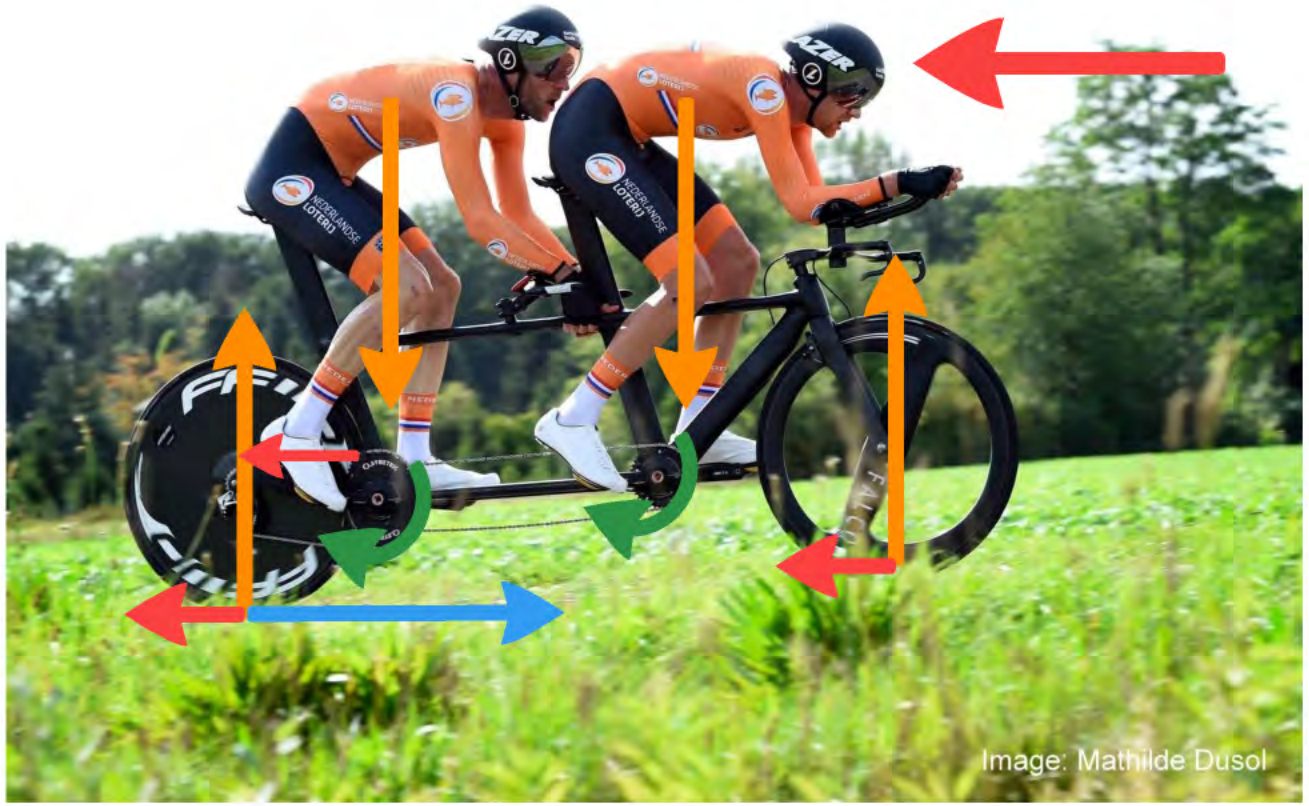

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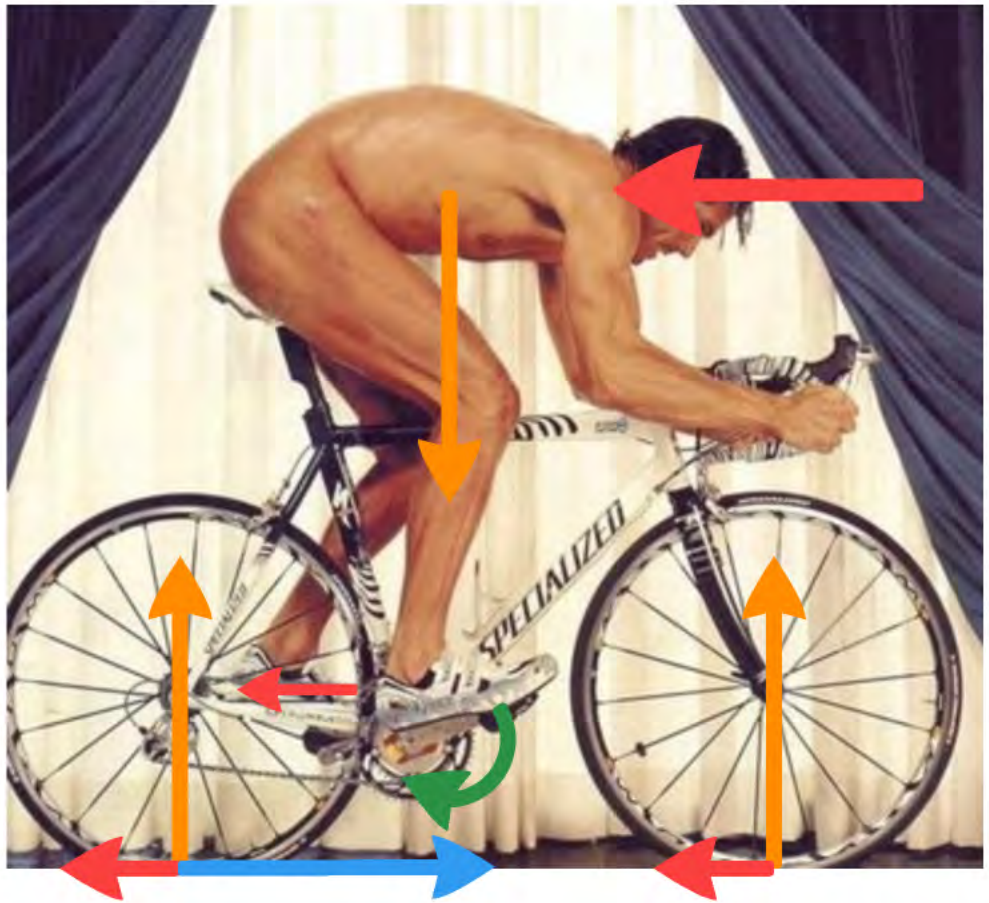

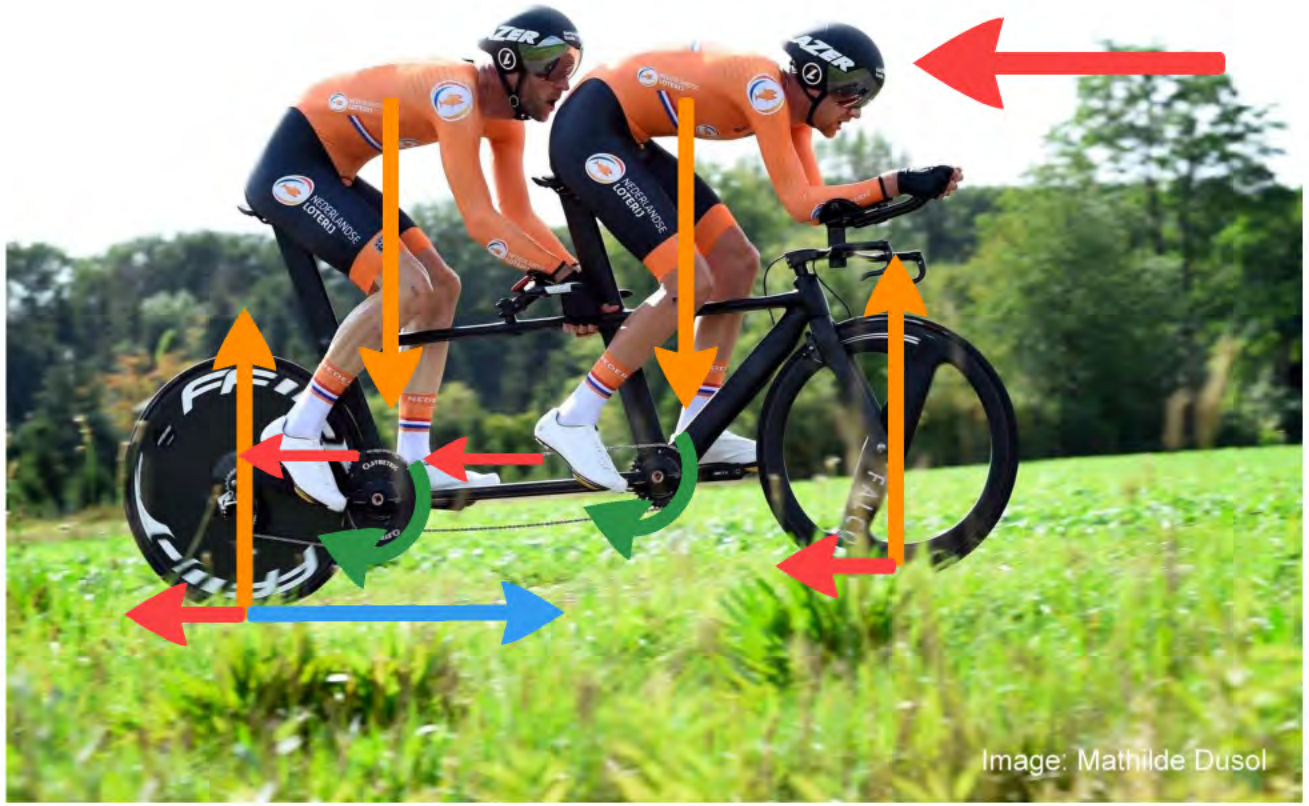

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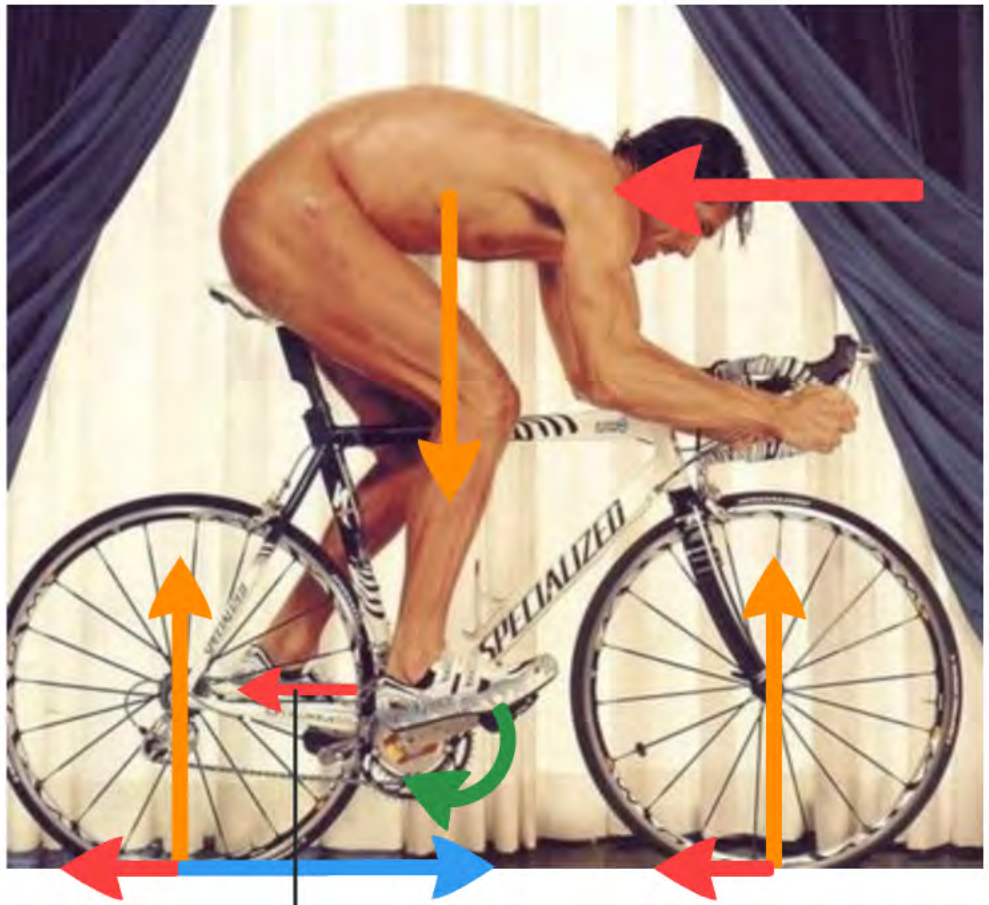
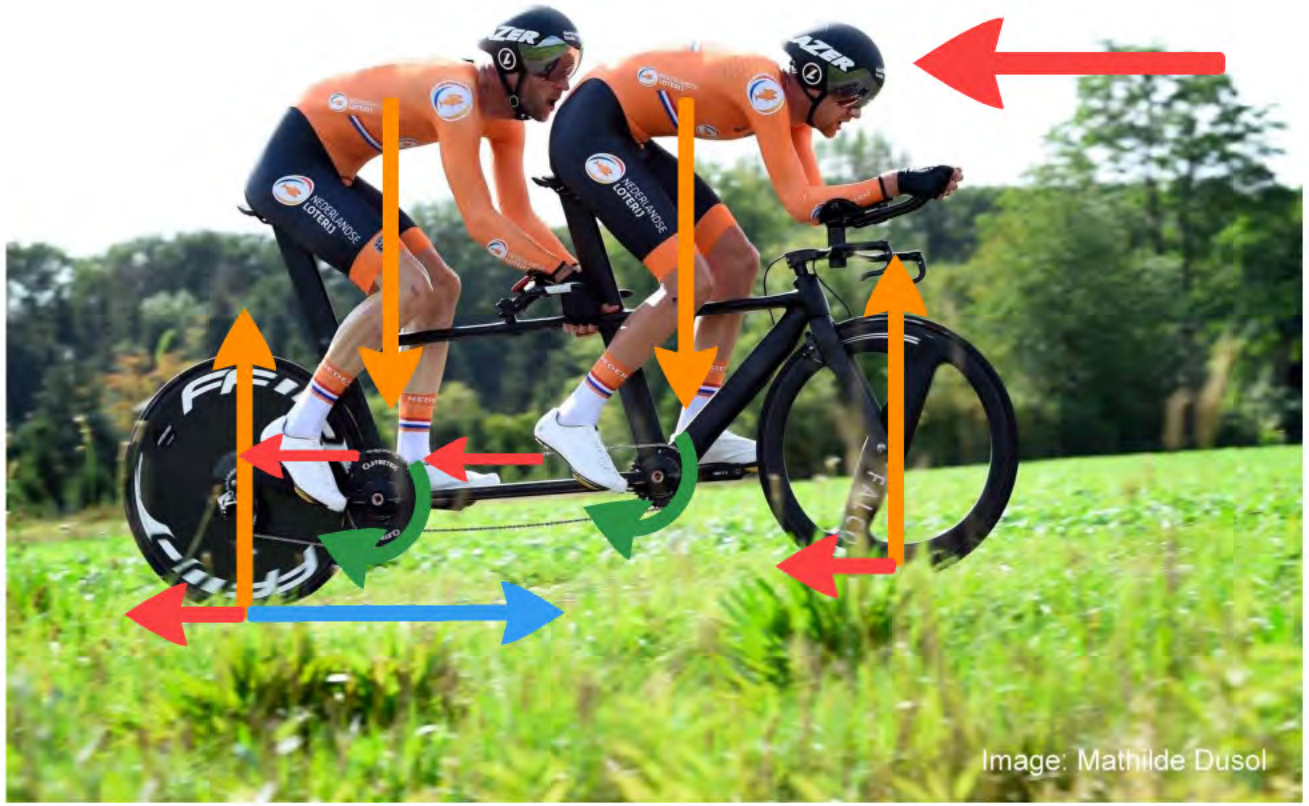
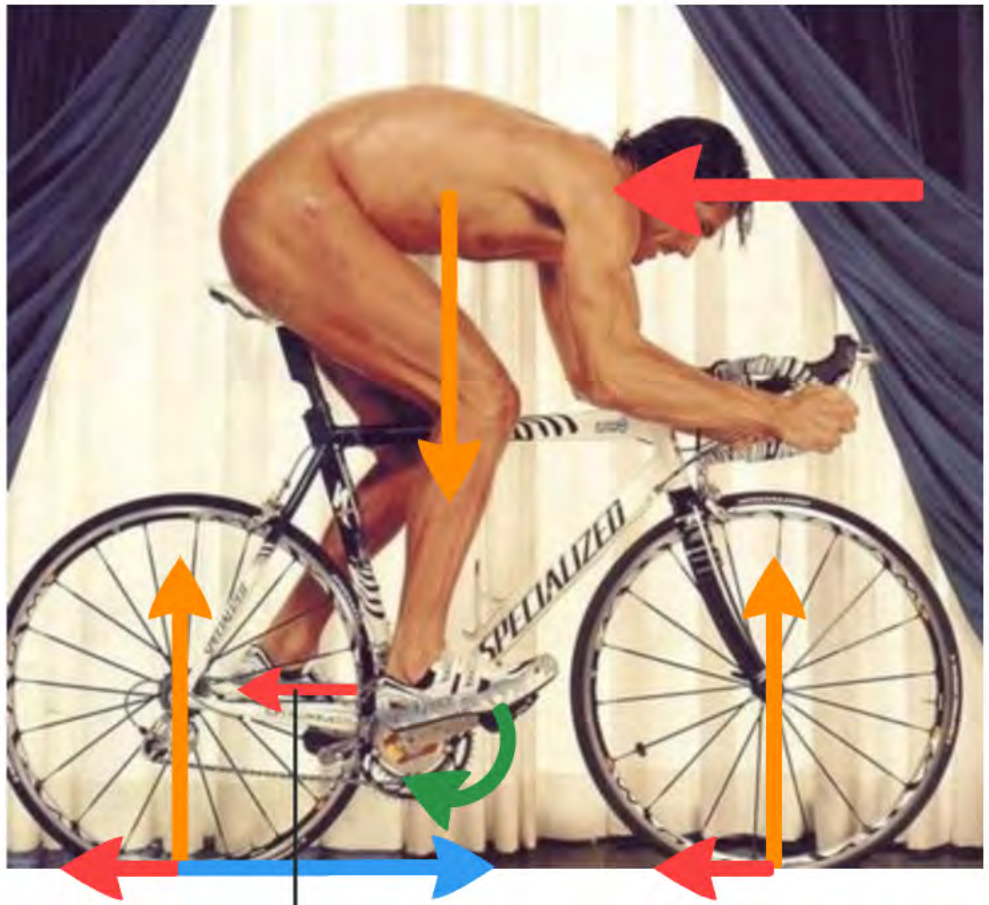


~2%*

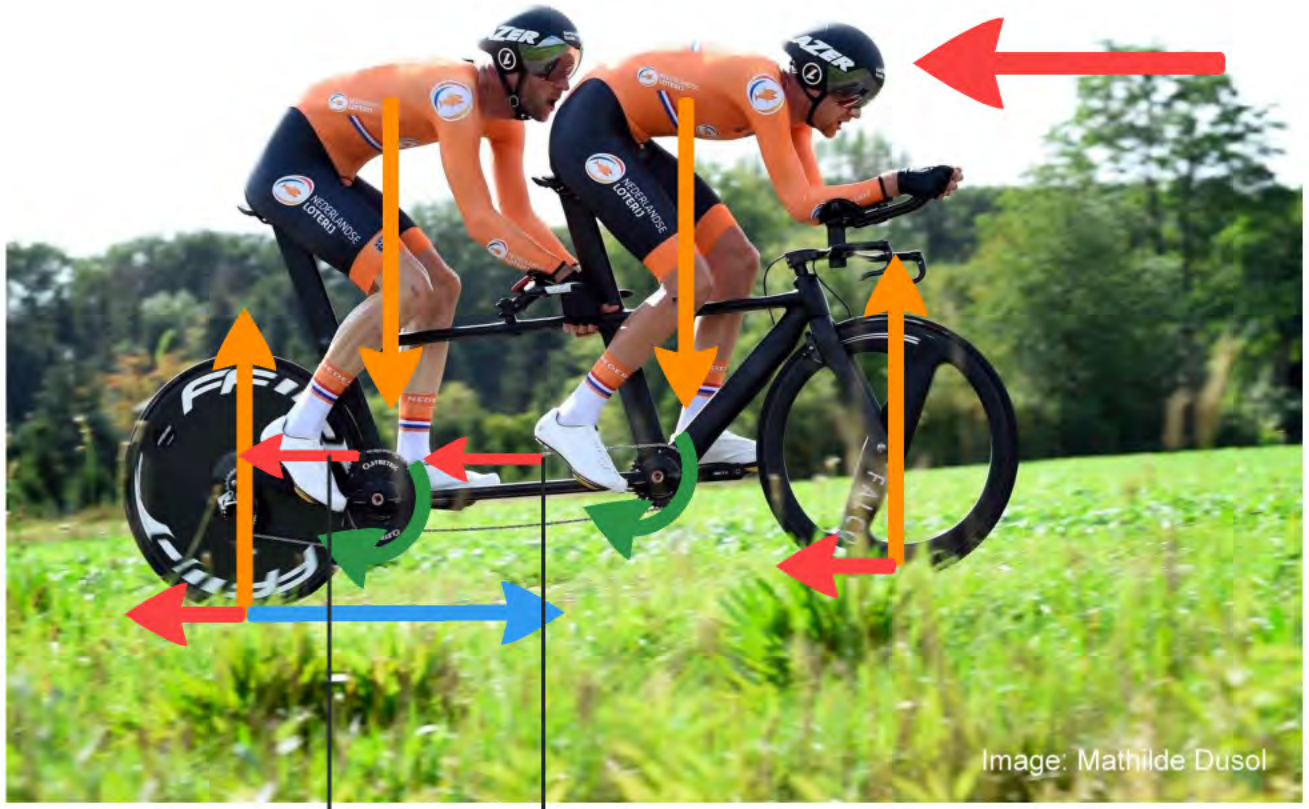


*Spicer et al. 2001

Power balance model



~2%*



~2% ? ~2%

*Spicer et al. 2001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Methods

- 100-400 W (50 W)
- 90 rpm

- Solo
- Stoker
- Pilot

- 53x11
- 53x13

- 100-400 W (50 W)
- 90 rpm

- Solo
- Stoker
- Pilot

- 53x11
- 53x13


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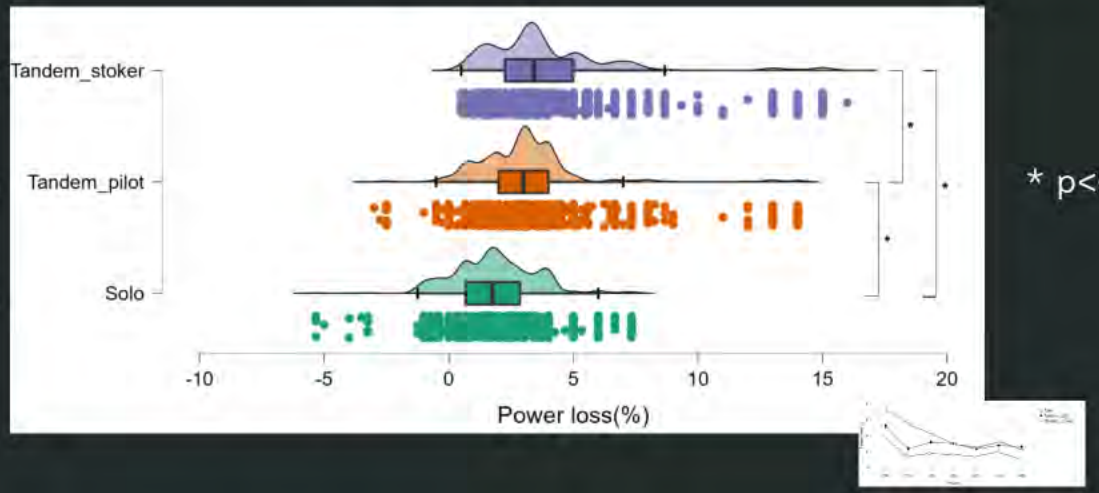
Results

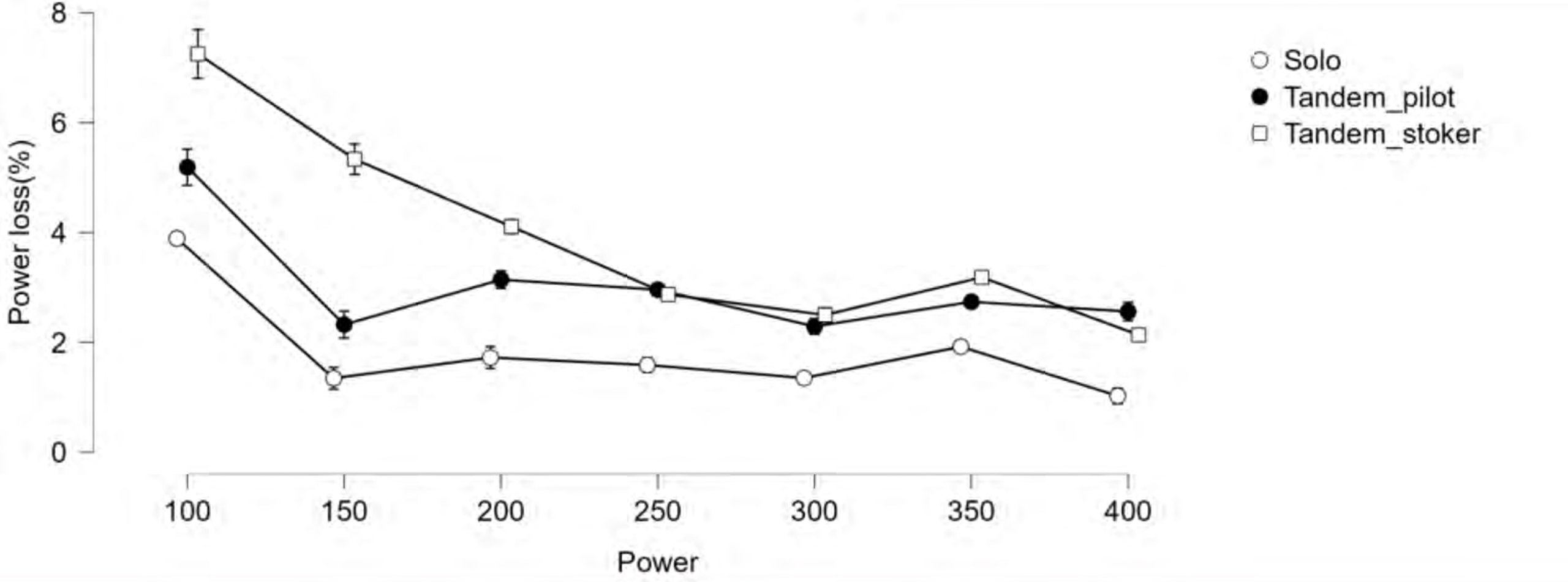
3.7% ± 2.4%

3.0% ± 1.8%

1.9% ± 1.5%



* p<0.001

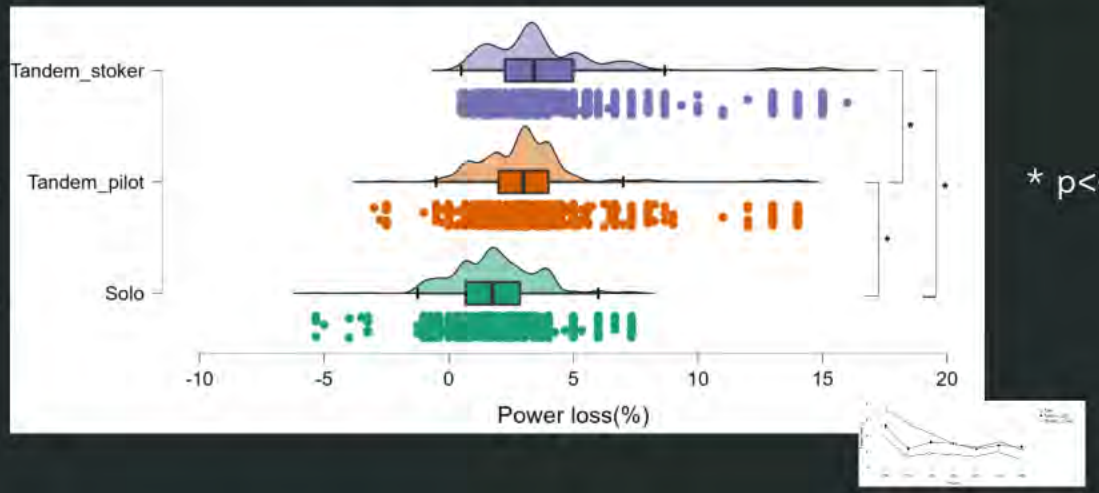

Power loss(%)
0
2
4
6
8
100
150
200
250
300
350
400
Power
Solo
Tandem_pilot
Tandem_stoker

Results

3.7% ± 2.4%

3.0% ± 1.8%

1.9% ± 1.5%



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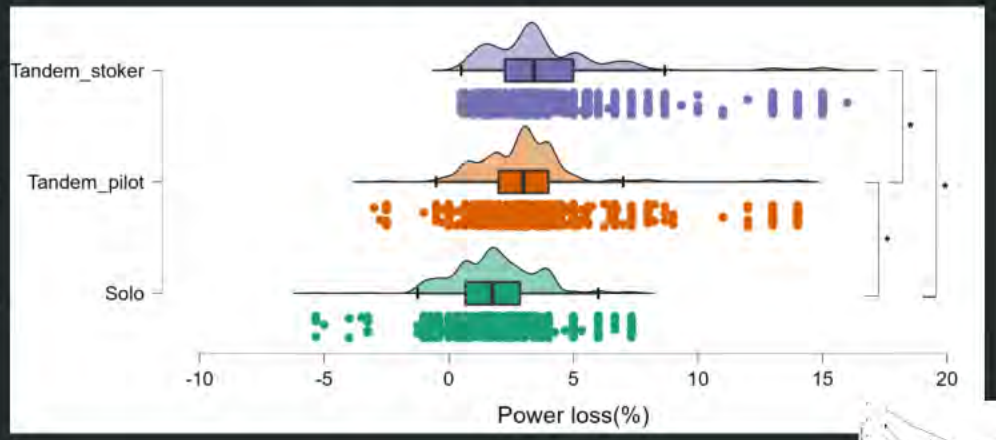
Results

3.7% ± 2.4%

3.0% ± 1.8%

1.9% ± 1.5%



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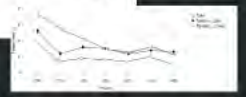
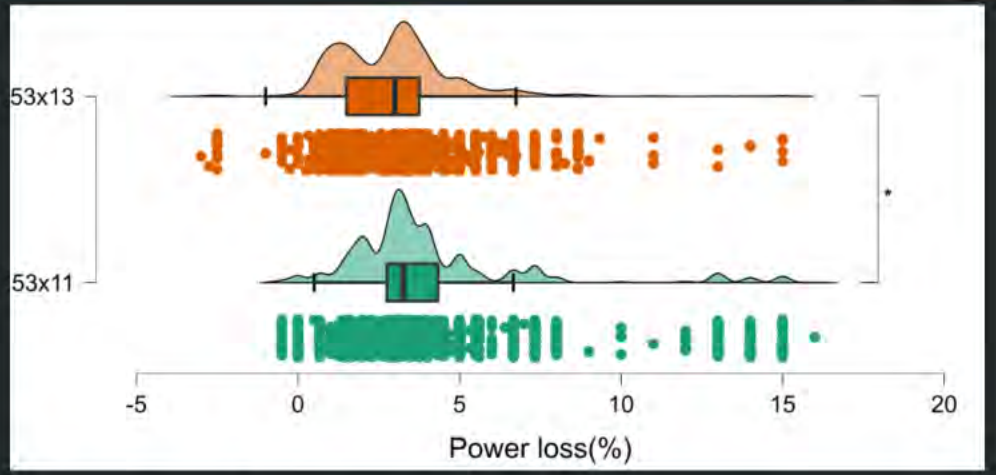


2.9% ± 1.7%

4.0% ± 2.8%



Pilot and stoker combined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Discussion

- Power loss tandem > solo
- Power loss tandem = comparable to one earlier study (3%)*

- Power loss stoker > pilot, but only for lower power output
- At high power output, power loss = friction
- At low power output, power loss = impact + vibration + elasticity + friction

- Power loss 53x11 > 53x13
- Comparable to studies on solo bicycles with derailleur (2% difference between 52x11 and 52x15)**

- It is unknown what the effect of two riders is on the power loss

* Alberts, et al. (2011). Exec. Sport Sci Rev. **Spicer et al. 2001. Journal of Mechanical Design


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Conclusion

- Power loss tandem is higher than solo bicycles
- There is siginifcant difference in power loss between pilot and stoker at lower power output, but marginal differences at higher power output
- Tandem cyclists should use larger chainwheels
- Future studies with real tandem cyclists are needed to examine the effect of inter-personal coordination in pedaling on power loss in the chain drive of tandem cycling.

Power loss of the chain drive in tandem bicycles

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