Effect of Seat Height on Cycling Efficiency

By

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Colloquium Presentation, May 27, 2010

Eastern Oregon University

Introduction

The Competitive Cyclist

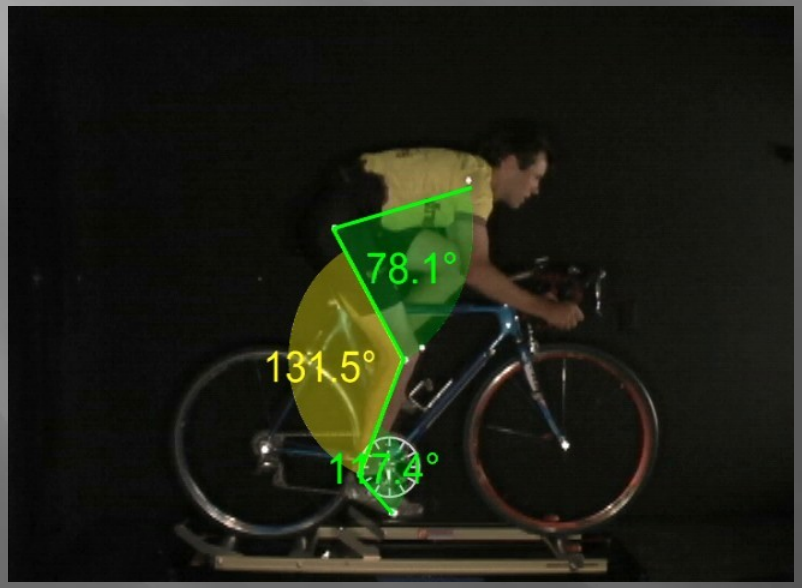
Base miles, extras, k's, putting in the miles

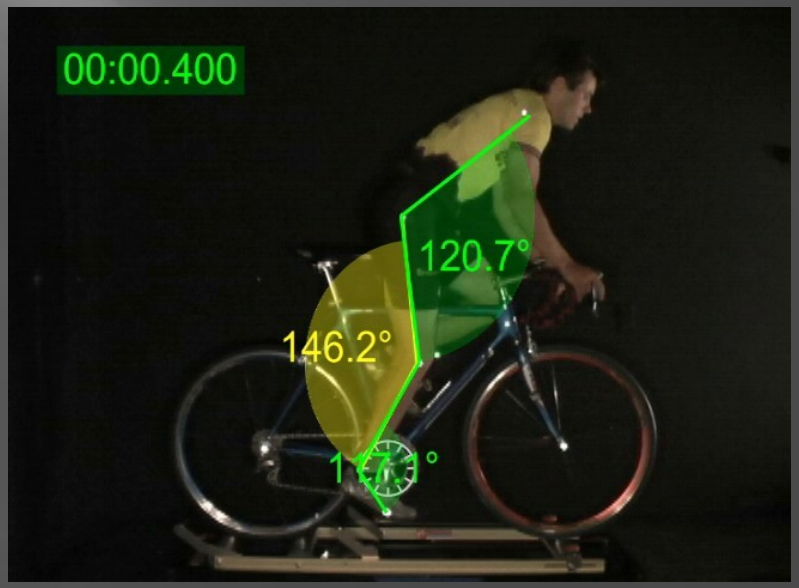
=

6 hour rides, 100 milers, 2 hundie (k's)

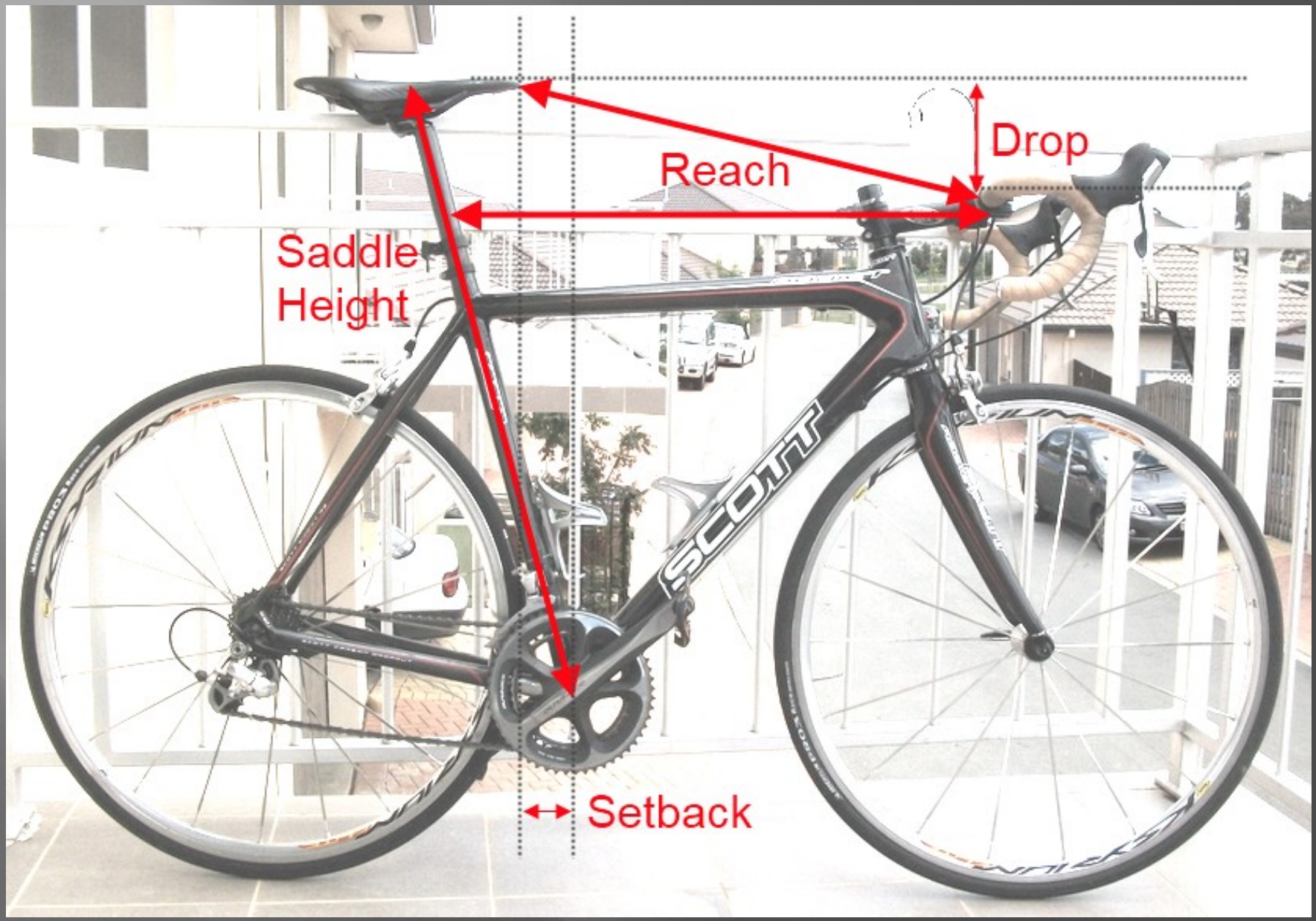
Bike-Body Interface

- Feet to pedals
- Hip (ischial tuberosities) to saddle
- Hands to handlebars





Bike Setup

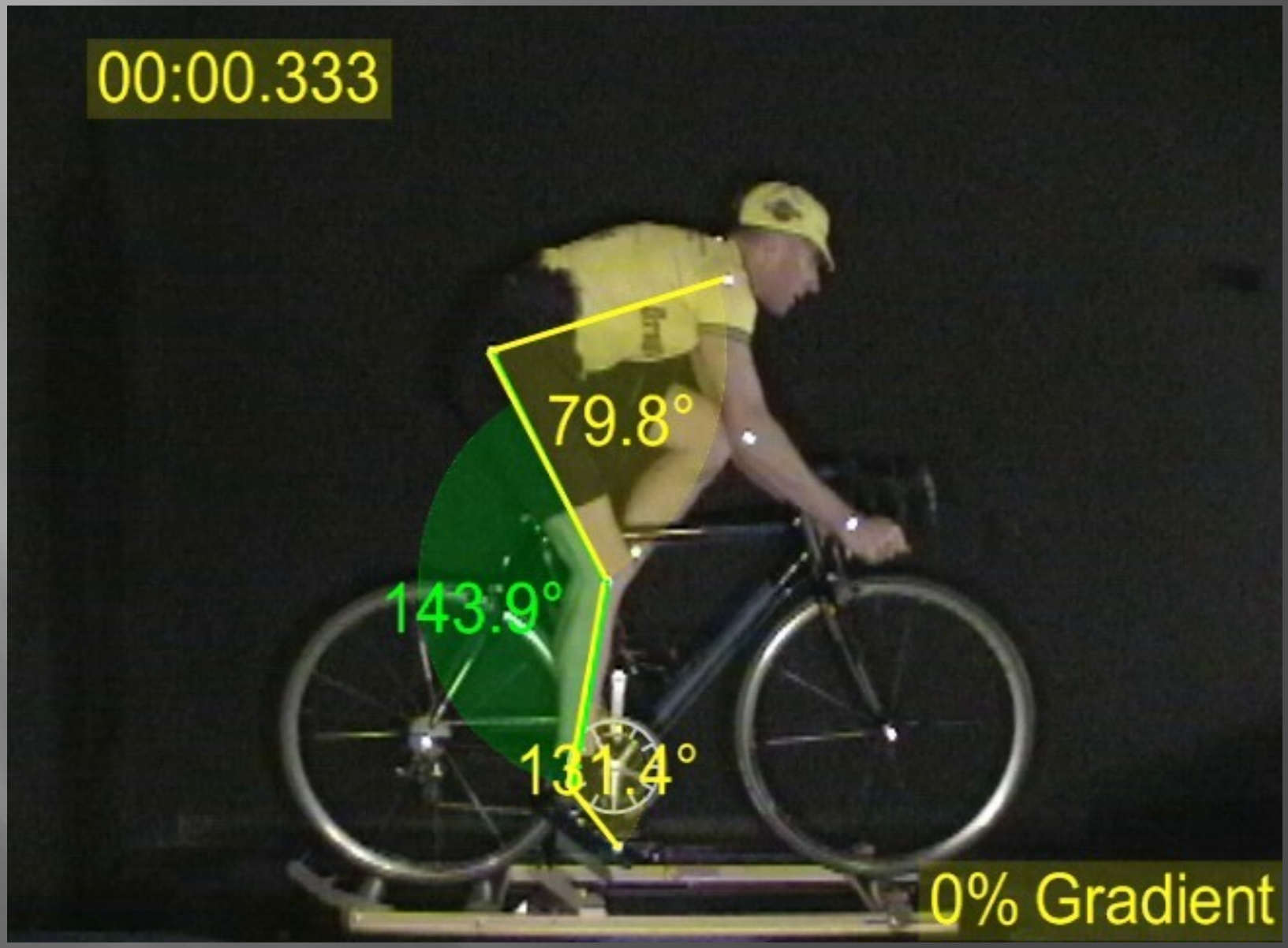


Bike Setup

- Very particular
  - e.g. Merckx, Armstrong
- Ambivalent
  - e.g.

Importance of Saddle Height

- Influence on the knee angle
- Pelvis fixed on seat
- Foot constrained by pedal
- Bi-lateral symmetry
- Knee is center of primary muscle contractions for force to the pedal


00:00.333
79.8°
143.9°
131.4°
0% Gradient

Review of Literature

- Hamley and Thomas (1967).
  - 109% of symphysis pubis height (measured from the top of the pedal to the top of the saddle)
- Nordeen-Snyder (1977)
  - 100% of trochanter height
- Both formulas yield similar results (Jorge and Hull, 1986)

Review of Literature

- Peveler (2008): VO2 was significantly lower at 25 degrees knee angle compared to both the 35 degrees knee angle and the Hamley method of 109% of inseam.
- Mandroukas, Angelopoulou, Christoulas, and Vrabas (2000): bent knee (140 degree) required lower oxygen uptake, straight knee (180 degree) lead to longer time to fatigue and higher VO2max.
- Price and Donne (1997): 104% of trochanteric height (knee angle 157.5 deg.), VO2 and heart rate significantly higher and power efficiency significantly lower than both 96 (146.4 deg.) and 100% (knee angle 136.9 deg.)

Review of Literature

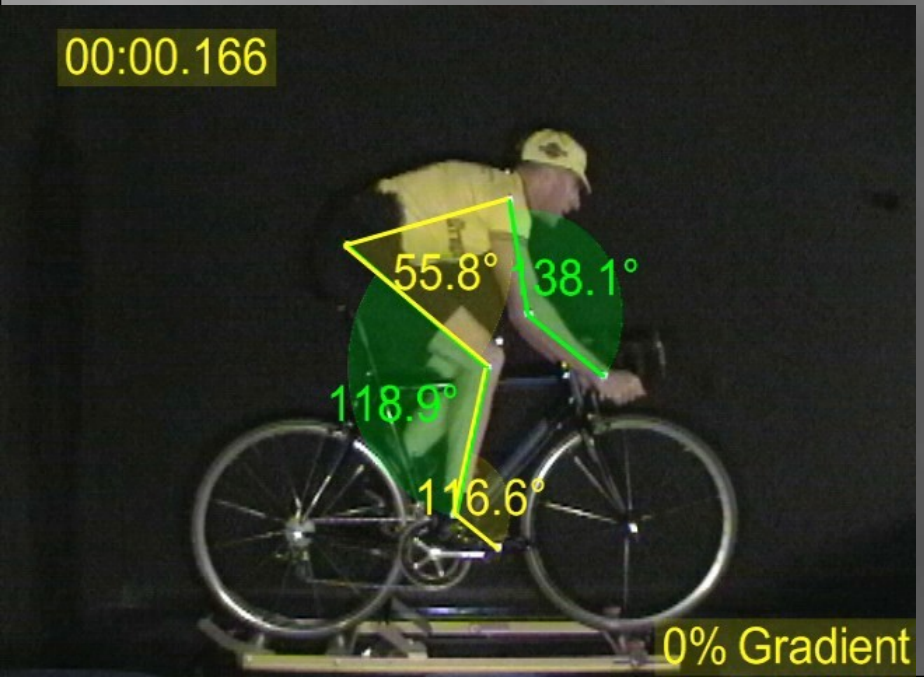
- Titlow, Ishee, and Anders (1986): no significant difference in estimated VO2max and heart rate at different knee angles (175-180, 155-160, and 135-140 degrees)
- Other research has demonstrated metabolic differences in seated compared to standing posture on the bicycle.
- Some studies have shown decrease power at lower saddle heights, although the knee angle was not examined as part of the research (Hamley and Thomas 1967; Shenum, Devries 1976; Nordeen-Snyder, 1977).

How to Measure Saddle Height

- Percentage of Inseam: Problematic
  - anthropometric differences (e.g. variable relative femur, tibia, foot differences)
  - Pedalling style, load, incline differences
  - Mechanical differences (e.g. pedal, seat, crank arm q-factor)
  - Equipment differences: Pedal models, saddle types.
- Static goniometry
- Dynamic: Software like Dartfish


00:00.367
84.7°
123.5°


00:00.333
83.6°
141.3°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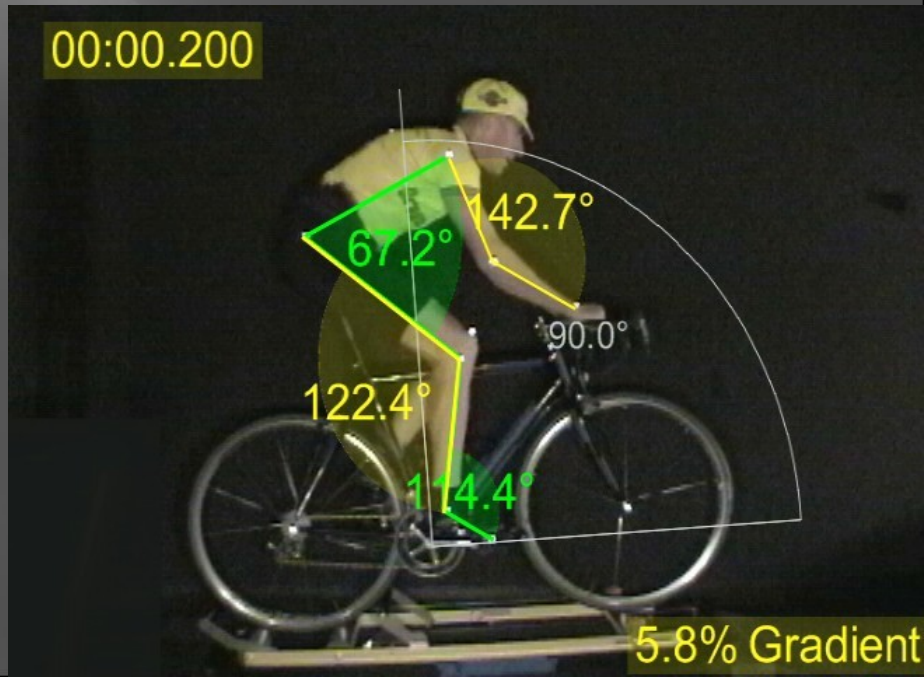
55.8°
118.9°
116.6°
0% Gradient


00:00.200
142.7°
67.2°
90.0°
122.4°
114.4°
5.8% Gradient

Recommendations

- Lemond method:
  - 0.883 x inseam,

    center bottom bracket to top of saddle
- Carmichael (2003)
  - 145-155 degrees with crank arm in line with the seat post (5 o'clock or 150 degrees)
- The Howard method (Burke, 2002)
  - 150 degree angle with the ball of the foot on the pedal at 6 o'clock (180 degrees).
- The Pruitt method (Burke)
  - 145-150 degrees

Websites Resources

Pierce Library Colloquium Resources
http://pierce.eou.edu/home/faculty/colloquia/20100527

CyclingAnalysis.com

Annotated Bibliography of Cycling Research
http://www.cyclinganalysis.com/annotated-bibliography-cyc