Understanding propulsive shoulder forces and scapular kinematics during manual wheelchair use

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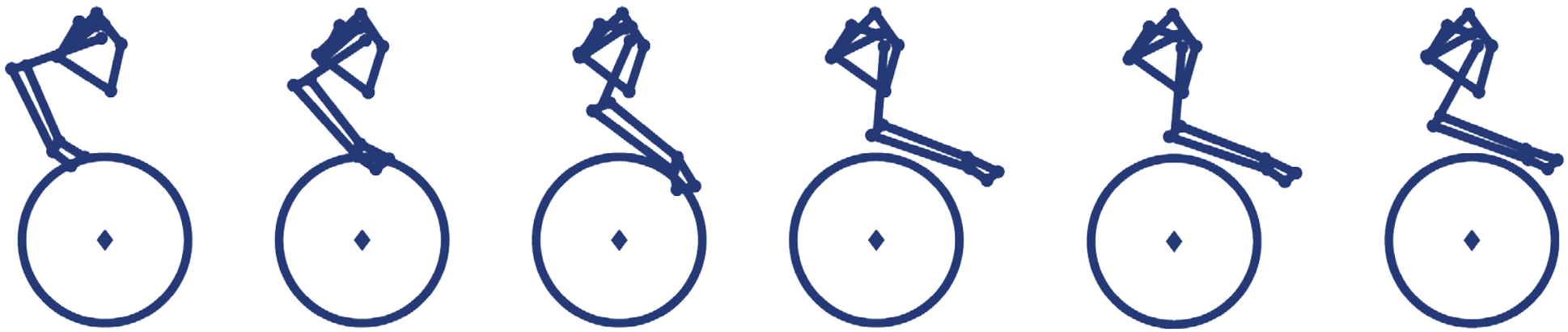
VISTA CONFERENCE
Presented by Pfizer



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Background wheelchair propulsion

- Wheelchair propulsion is a bimanual task
  - Soltau *et al.* (2015) , Vegter et al 2013 , Hurd *et al.* (2008) , Boninger *et al.* (2002)
- Wheelchair rugby players show left-right asymmetries
  - Goosey-Tolfrey et al (under review)
- Shoulder complaints are common in wheelchair athletes
  - Systematic review Heyward et. al. (under review)
- Propulsion technique relates to shoulderload in able-bodied population
  - Vegter et al 2015

Research question

- How do wheelchair athletes propel themselves in their daily wheelchair?

- Can we measure ‘everything’?

- Influence of speed?

Data collection

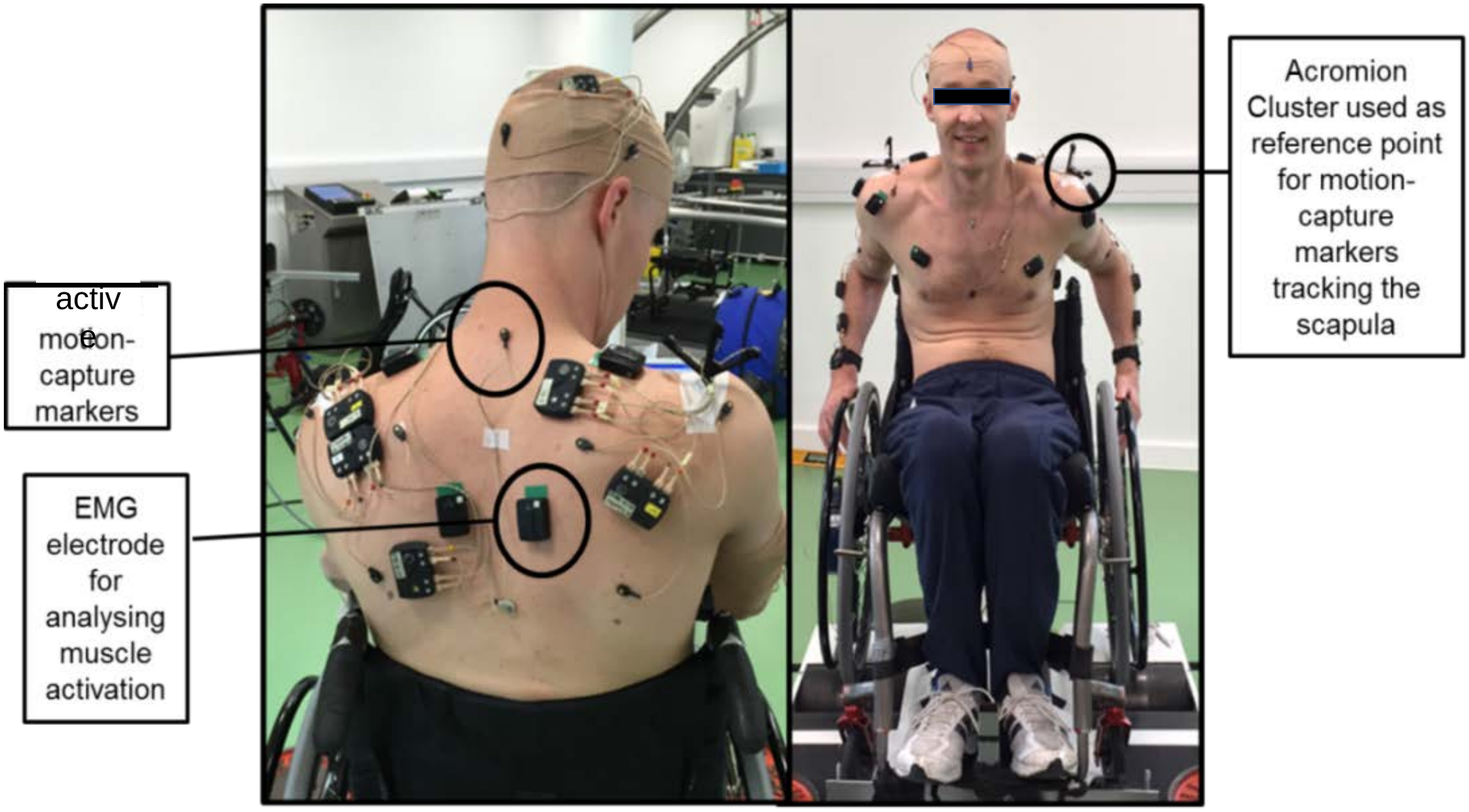


Figure 1. Participant preparation and placement of EMG and passive motion-capture markers

Data collection

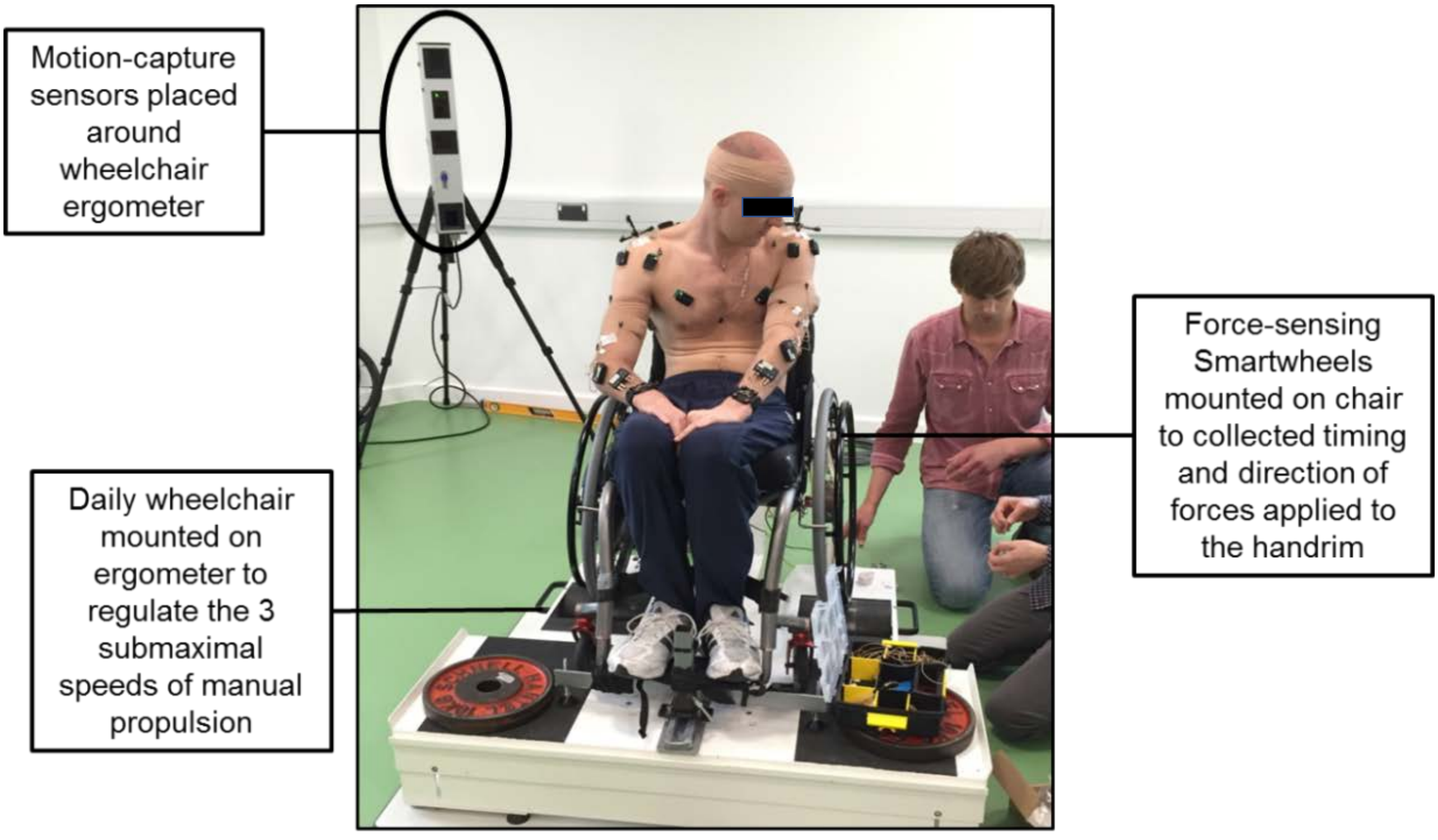
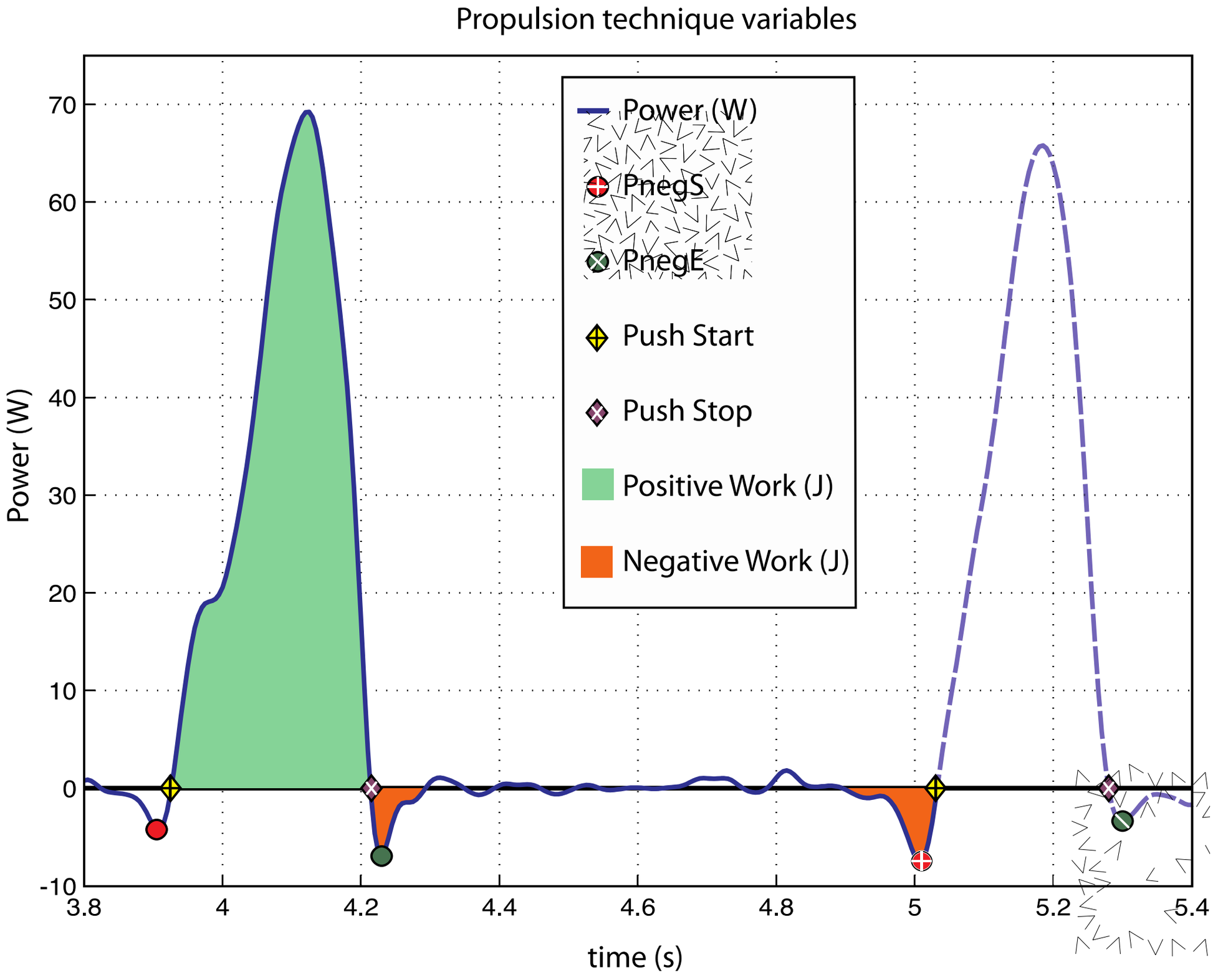


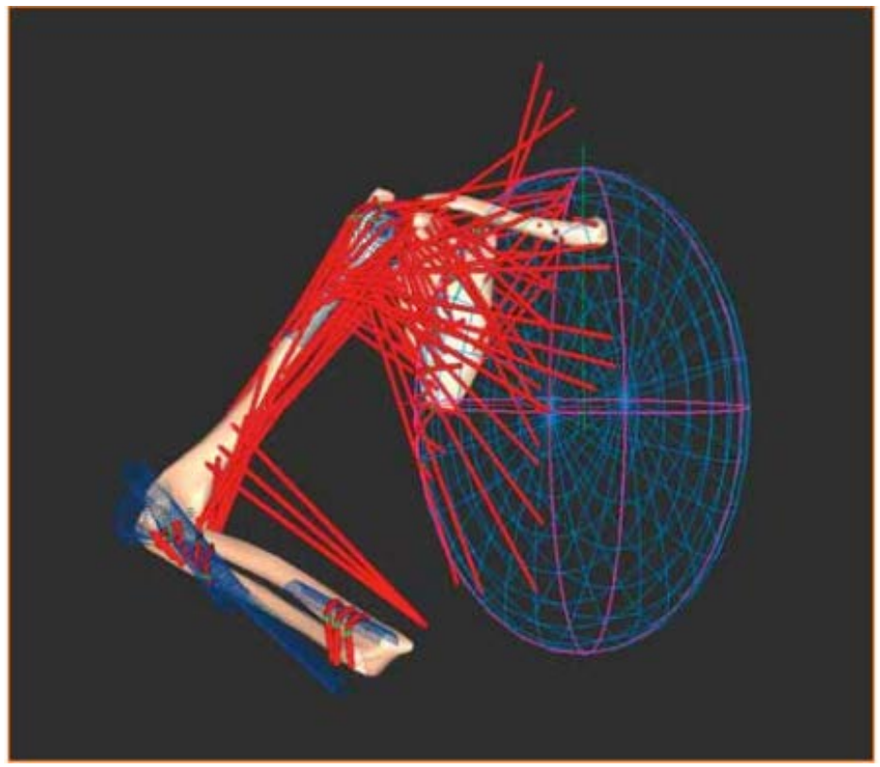
Figure 2. Experimental setup with wheelchair ergometer and motion-capture sensors

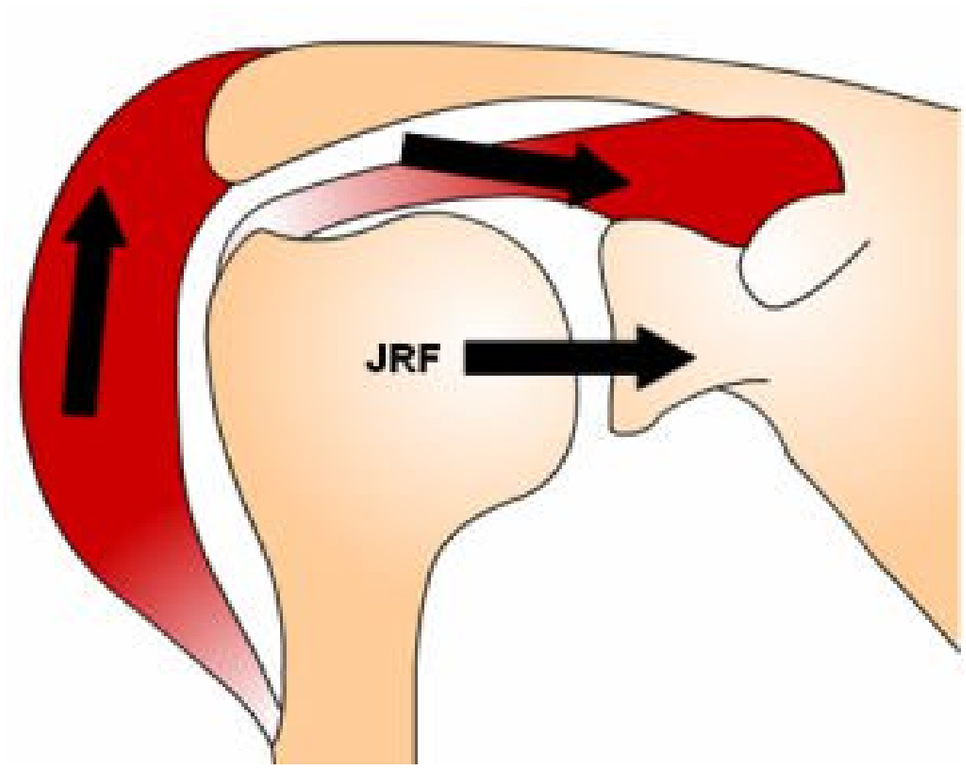
Methods

- 10 Wheelchair rugby athletes
- Three 4-min trials
  - 3 km/h (0.83 m/s)
  - 4 km/h (1.11 m/s)
  - 6 km/h (1.67 m/s)


Propulsion technique variables
Power (W)
PnegS
PnegE
Push Start
Push Stop
Positive Work (J)
Negative Work (J)
Power (W)
time (s)
70
60
50
40
30
20
10
0
-10
3.8
4
4.2
4.4
4.6
4.8
5
5.2
5.4

Delft shoulder and elbow model





- Glenohumeral Joint Reaction Force (N)
- Mean and Max over whole push cycle

RESULTS:PROPULSION PARAMETERS

	3 Km·h^{-1}	4^{-} Km·h^{-1}	6 Km·h^{-1}
Power Output (W)	9 (1)*	12(1)*	18 (2)*
Push freq. (p/min)	52 (10)*	56 (9)*	66 (10)*
Contact Angle (º)	84 (15)*	90 (14)*	93 (15)*
Peak force (N)	44 (10)*	51 (10)*	68 (16)*
Mean Joint reaction force (N)	178 (34)*	209 (46)*	261 (54)*
Peak Joint reaction force	527 (130)*	611 (121)*	862 (85)*
Able bodied population at 4 km/h		419 (117)	

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Conclusion

- Speed changes propulsion technique
- Transition to a longer stroke performed at a higher frequency and a higher peak force
- Skilled wheelchair users appear to have lower shoulderloading

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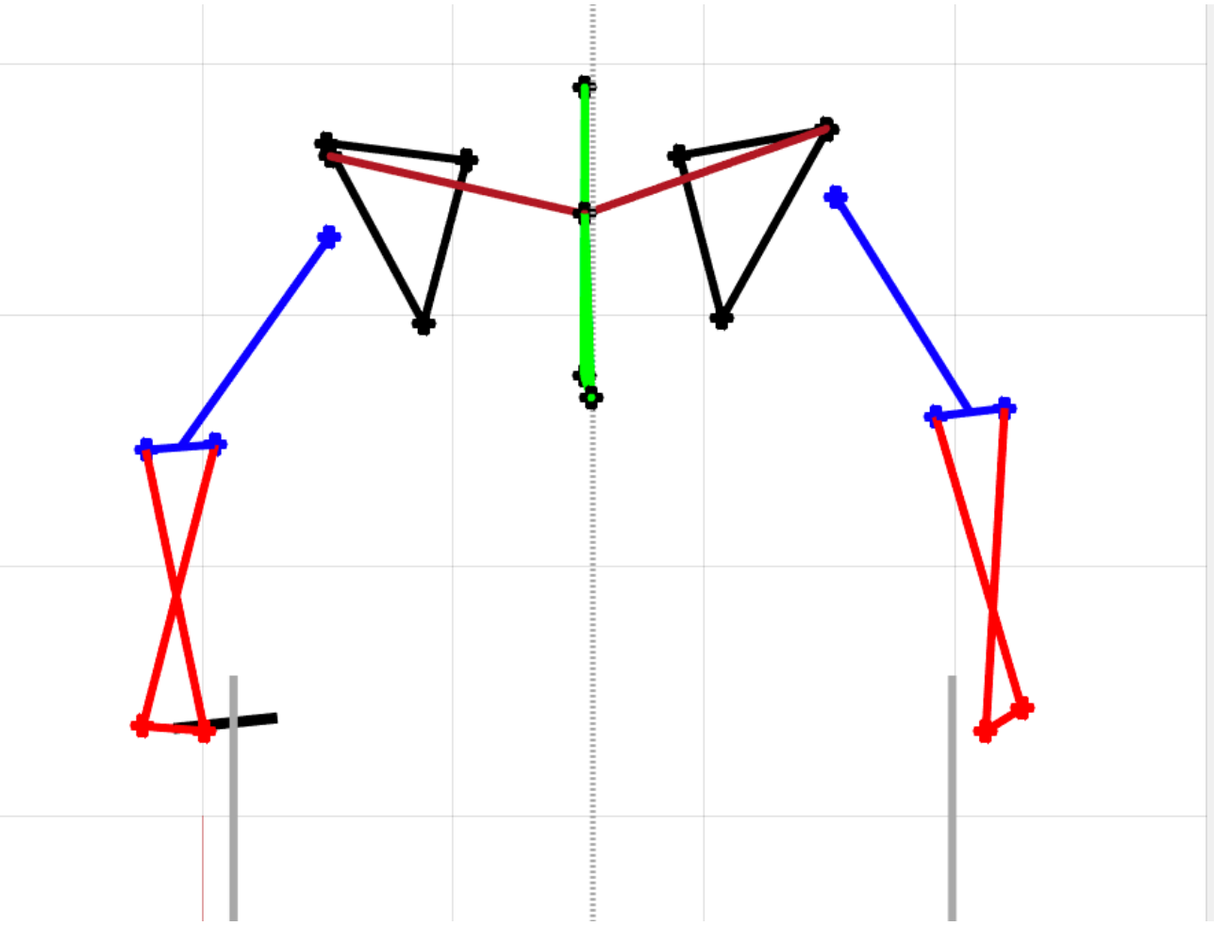
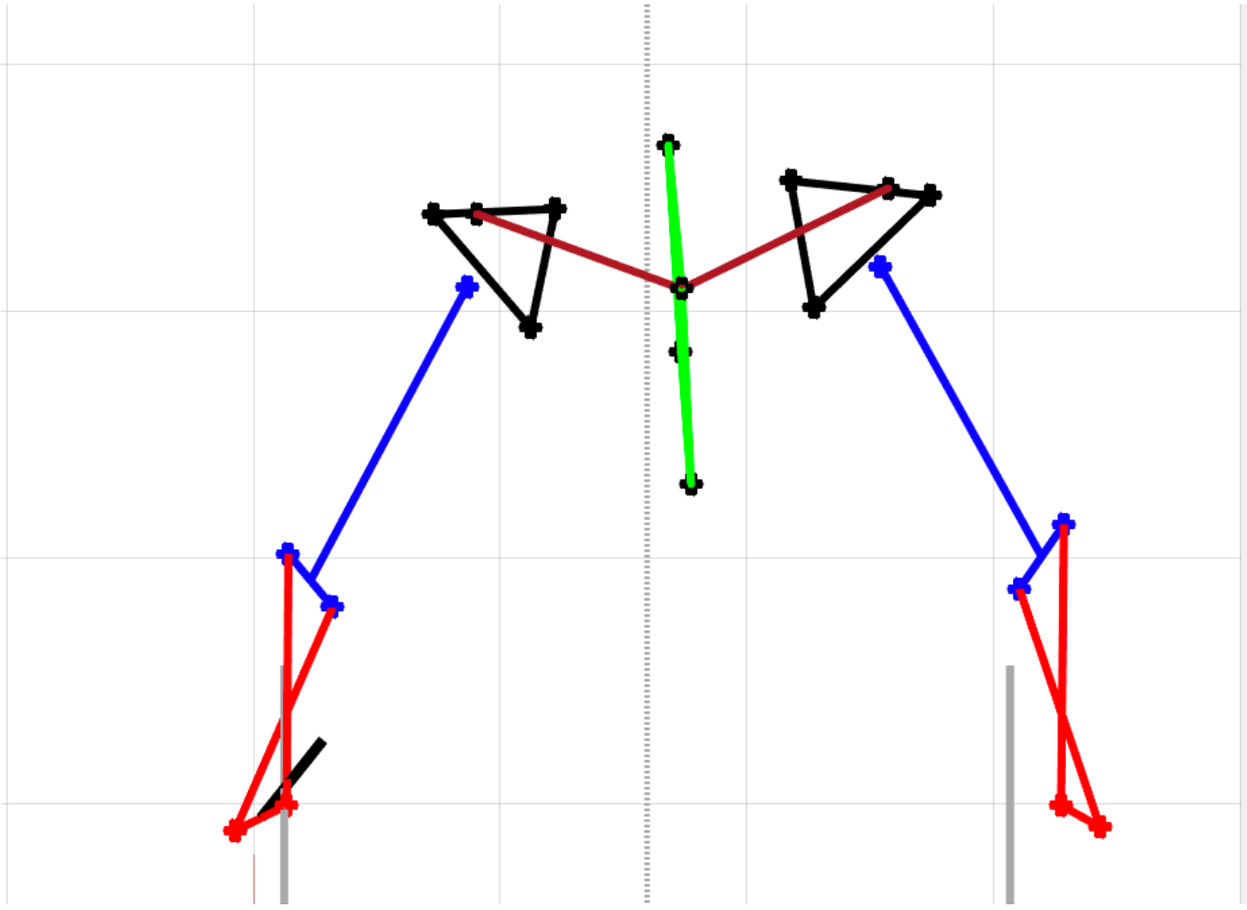
Discussion / outlook

- Understanding the shoulderload differences
- Individual differences, large deviations in technique
- Scapular kinematics and EMG
- Translation to sports situation

Symmetry of propulsion



Symmetrical athlete



Asymmetrical athlete

Keynote speakers (confirmed)
John Buckley
Mindy Levin
Kathleen Martin Ginis
Brett Smith
Walter Thompson

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Questions?

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