Implementing iMG research in community rugby: important considerations and future Directions.

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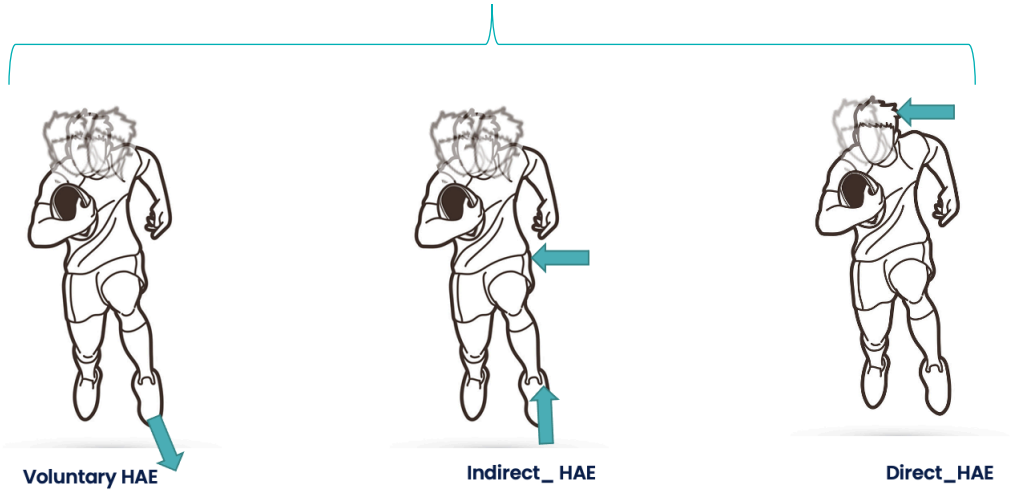
Dr Éanna Falvey and Prof Ross Tucker

Primary Study Objectives

Describe HAE Exposure in Community Rugby



Mechanisms

Age vs Experience

Male vs Female

Training vs Match
Weekly cumulative load

The ORCHID Study

Quick Overview

N ~ 700

5 Grades

U13 - NPC

106 Games

+

178 Training Sessions

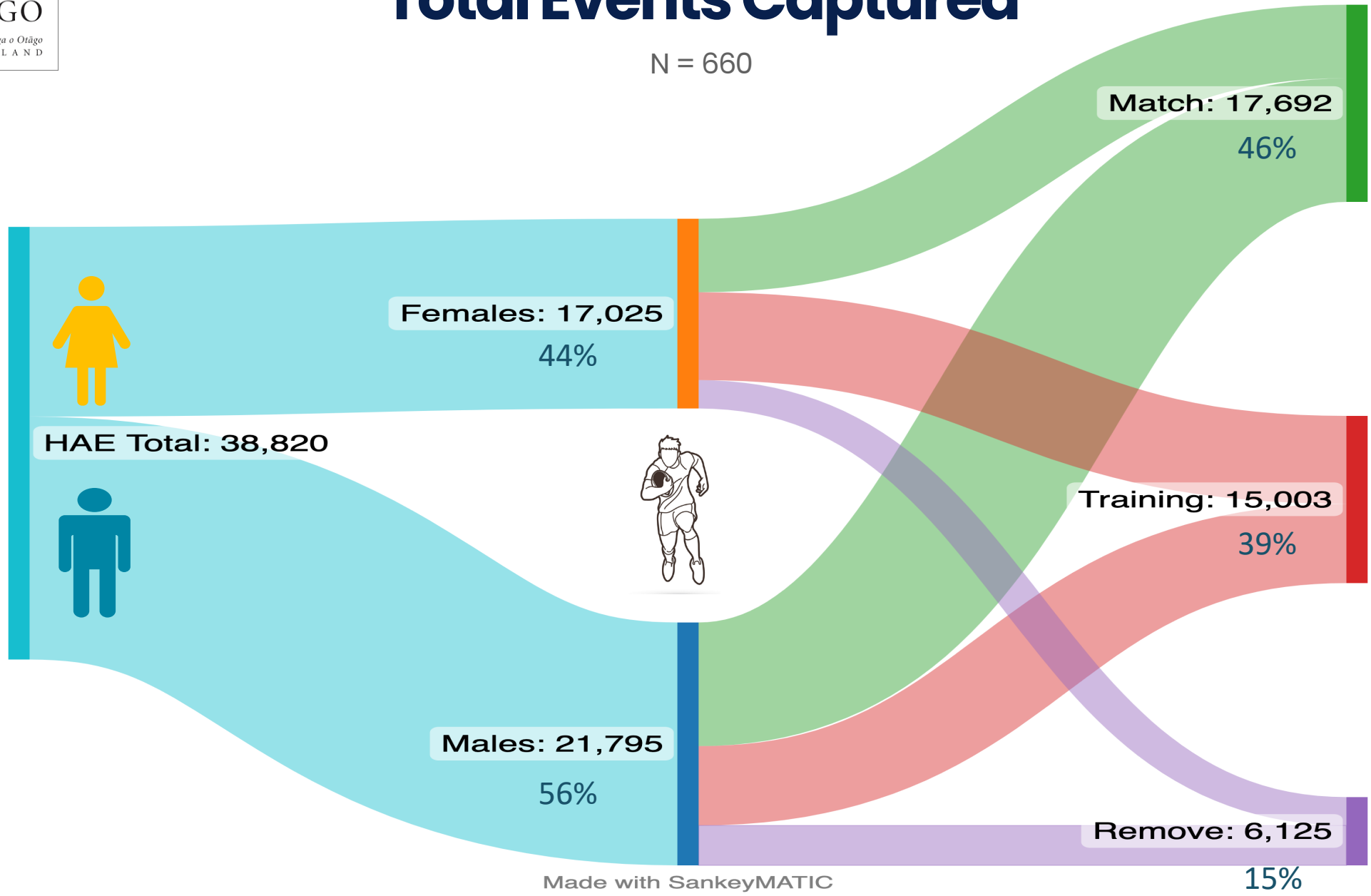
> 450 hrs Video

~38,019

prevent

Total Events Captured

N = 660



Challenges

1. **Large scale data collection – quality control.**
   - **Instrumentation**
   - **Fitting**
   - **Verification vs Context**
2. **Data processing and analysis**
   - **Signal noise and data filtering**
   - **Normalizing the data, impact-to-impact, person-to-person**
   - **Dealing with the large variability in the population size**

Quality Control: Instrumentation

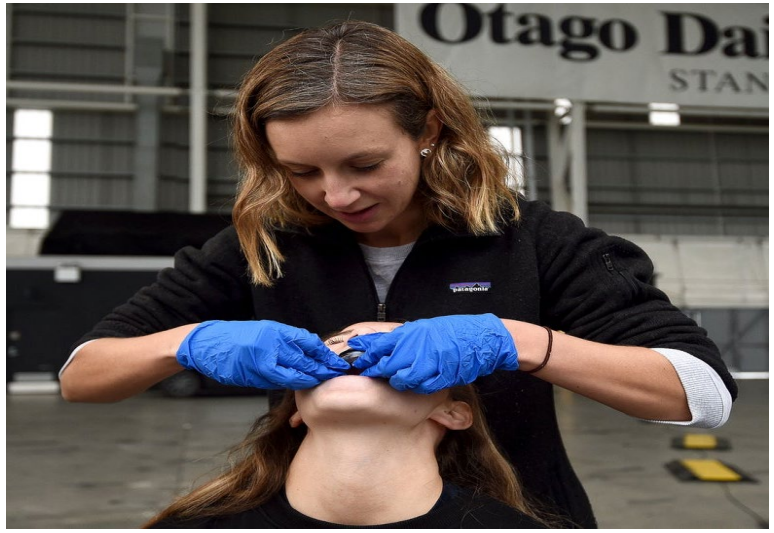
Trigger = single axis 5 g (Wu et al., 2022)

- Quality instrumentation
- Bandwidth
- Proximity sensor
- False positive detection
- Trigger threshold

Kieffer EE, Begonia MT, Tyson AM, Rowson S. Ann Biomed Eng. 2020;48(11):2613-2625.
Liu Y, Domel AG, Yousefsani SA, et al. *Ann Biomed Eng*. 2020;48(11):2580-2598

Jones, B., Tooby, J., Weaving, D., Till, K., Owen, C., Begonia, M., Stokes, K., Rowson, S., Phillips, G., Hendricks, S., Falvey, É., Al-Dawoud, M., & Tierney, G. (2022). Ready for Impact? A validity and feasibility study of instrumented mouthguards (iMGs). *MedRxiv*, 2022.01.28.22270039. https://doi.org/10.1101/2022.01.28.22270039

Quality Control: Fit

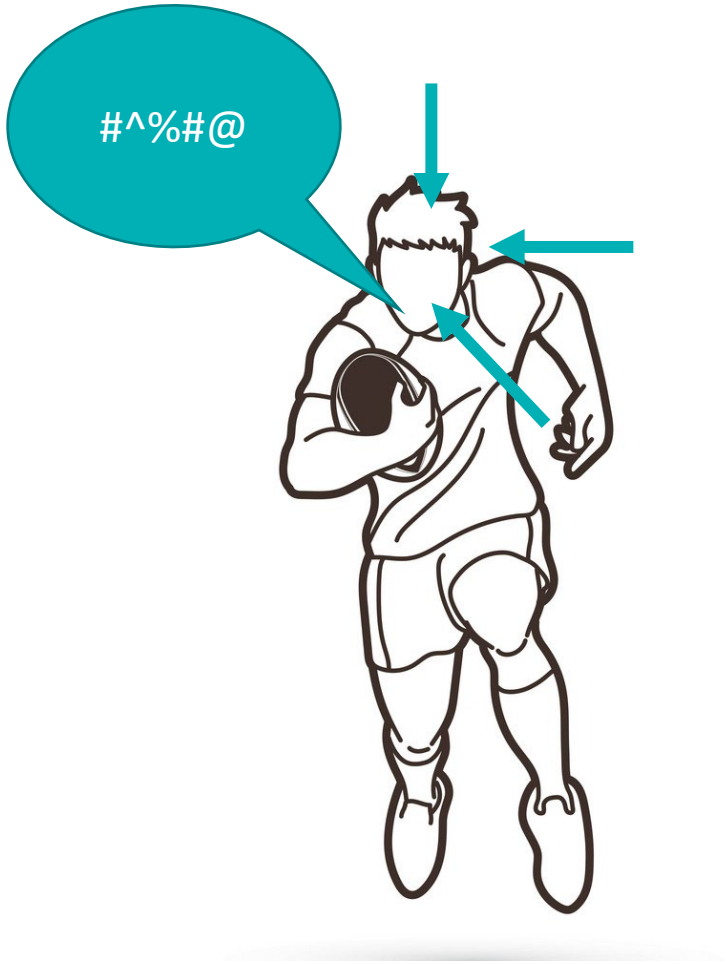


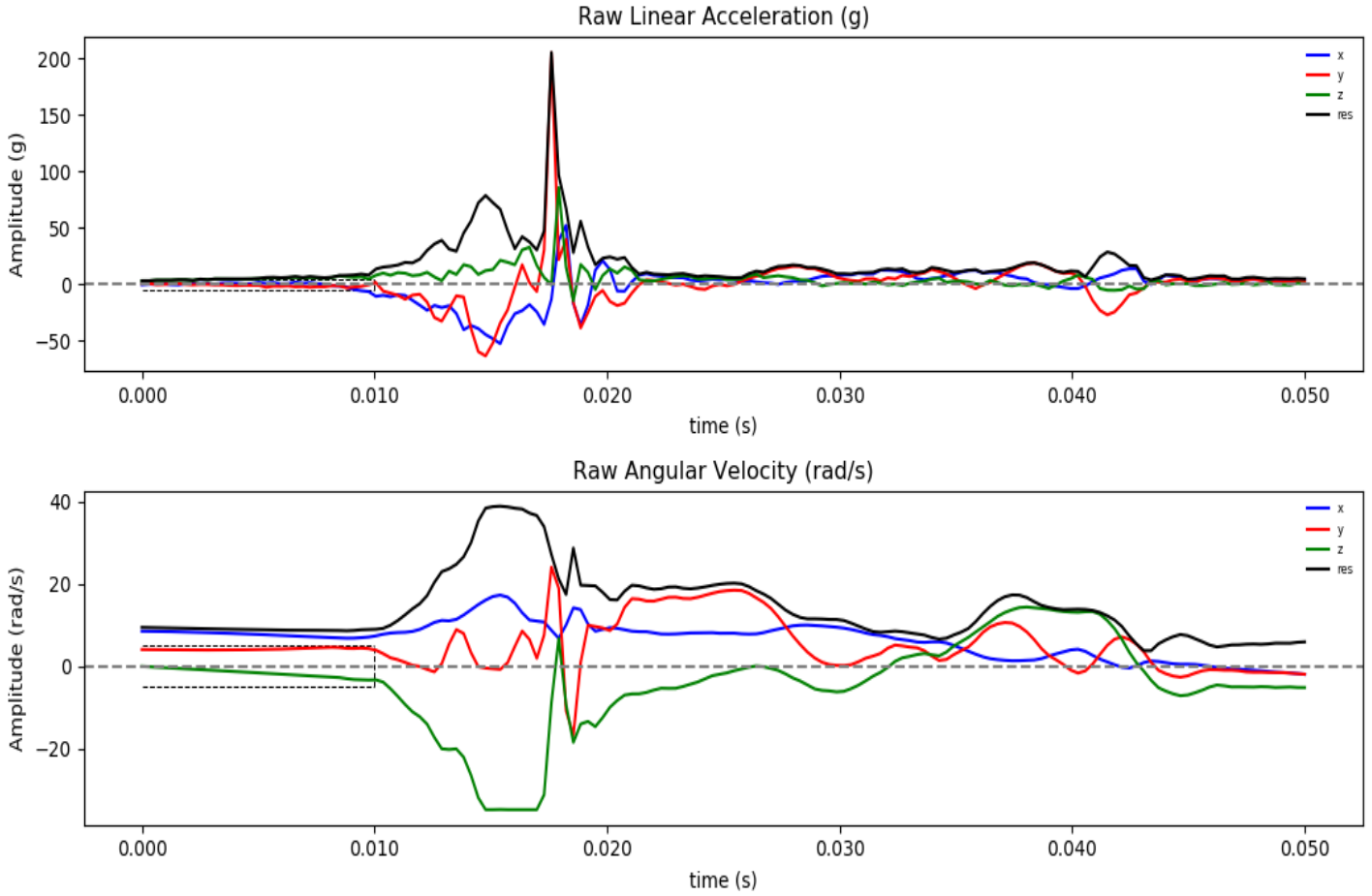
Quality Control: Verification vs Context

40+ g events

Quality Control: Verification vs Context

Data processing: Common Sources of Noise

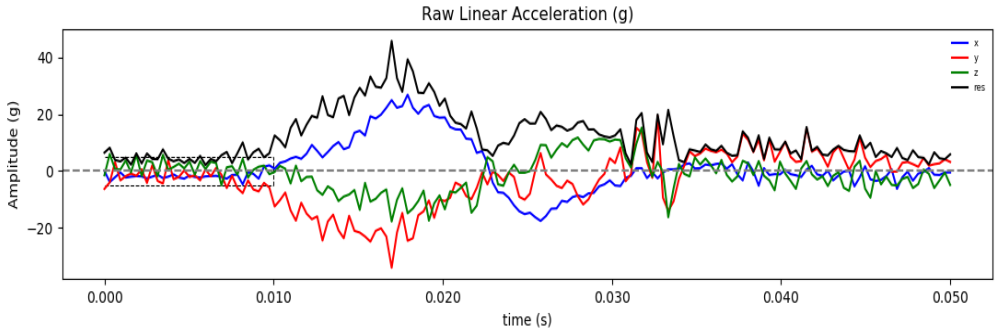


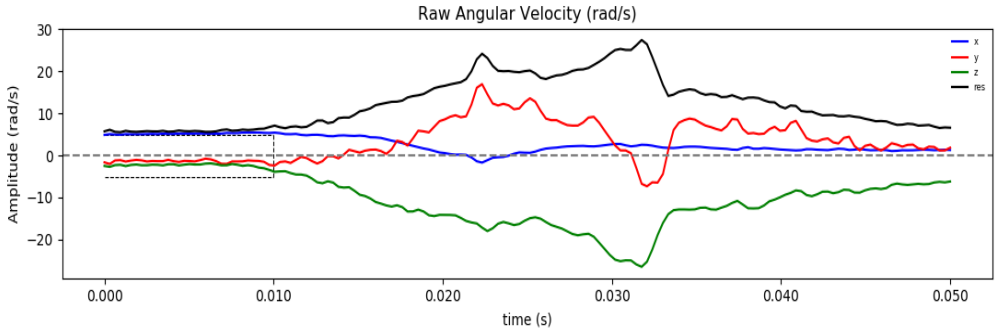


Data processing: Common Sources of Noise

Raw – noise

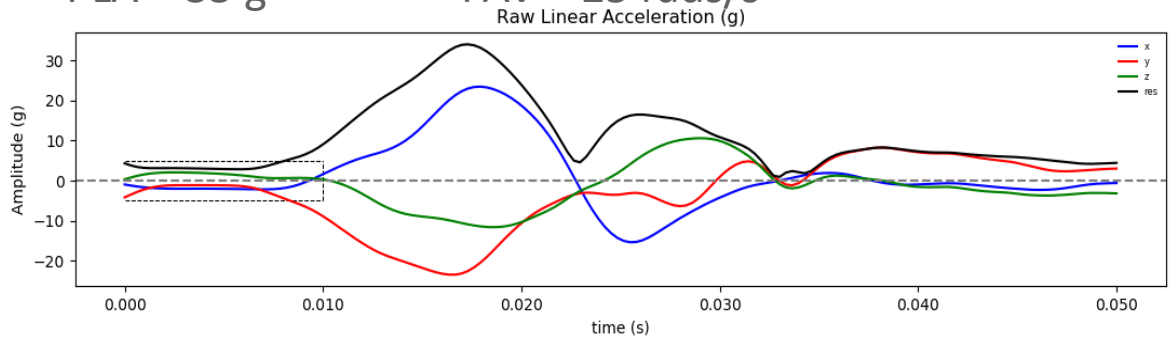
PLA = 45 g PAV = 27 rads/s

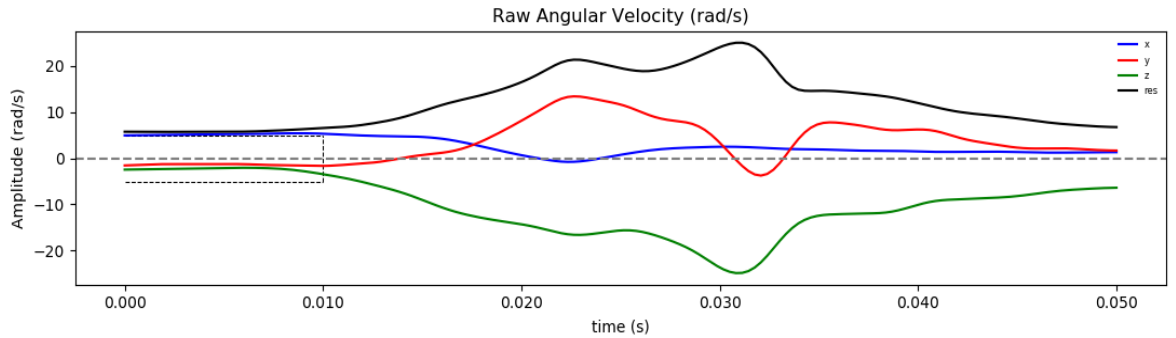




300 Hz, 4th order Butterworth

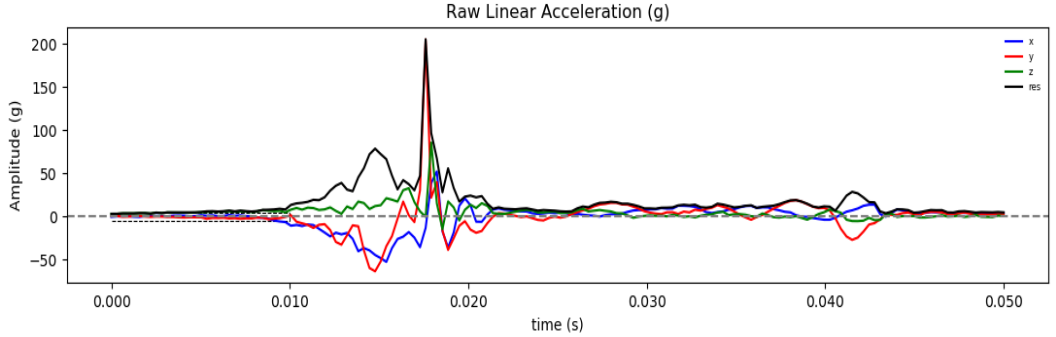
PLA = 35 g PAV = 25 rads/s

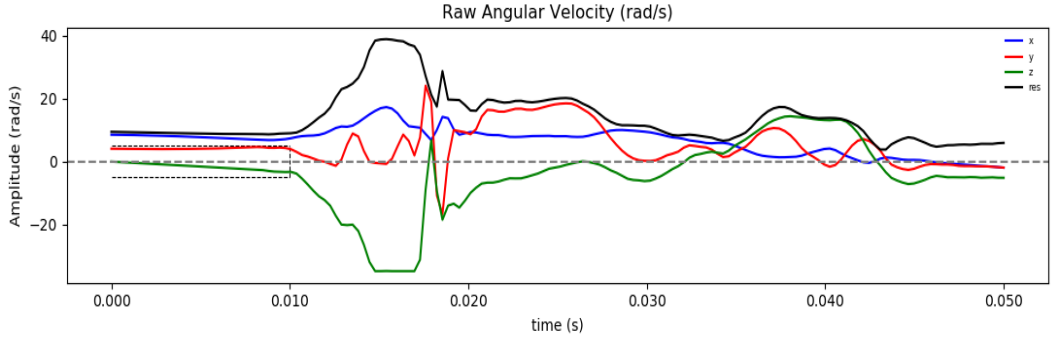




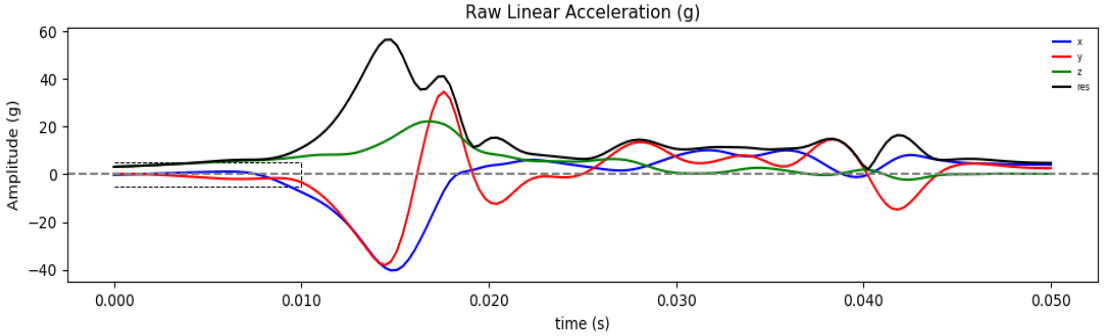
Data processing: Common Sources of Noise

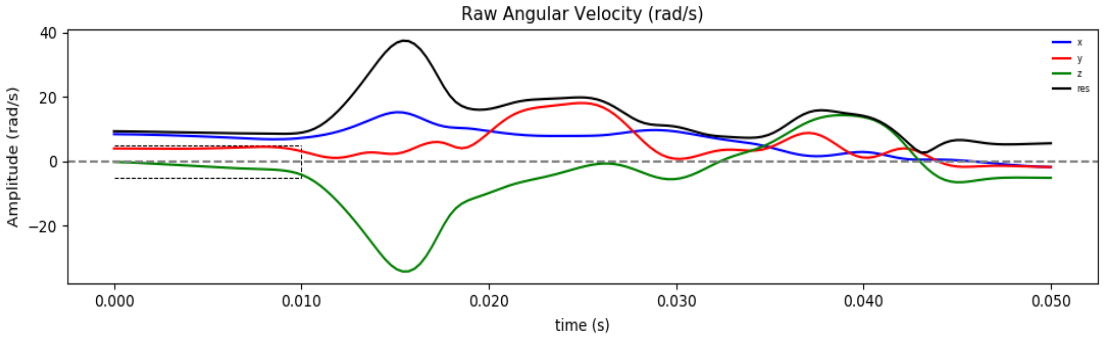
Raw
PLA = 205 g PAV = 39 rads/s





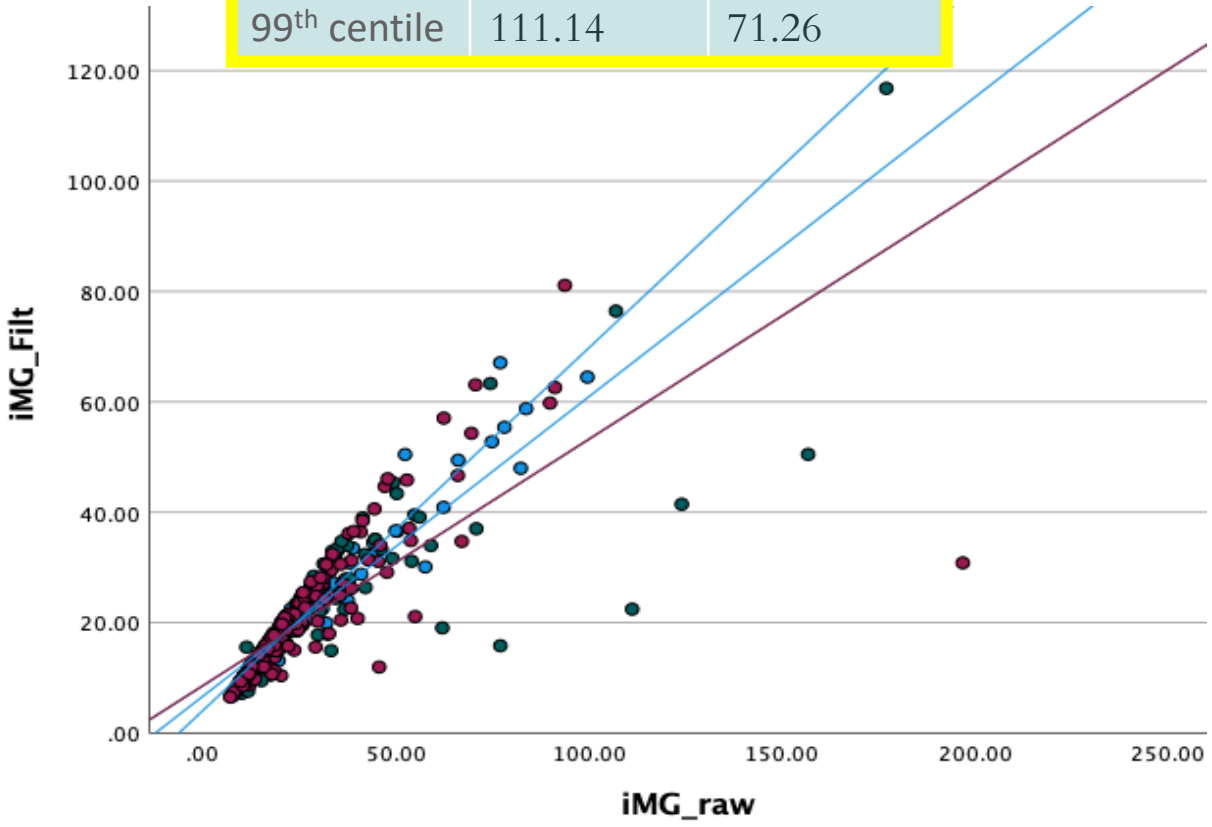
300 Hz, 4th order Butterworth
PLA = 56 g PAV = 38 rads/s





Data processing: Common Sources of Noise

	iMG_Raw	iMG_Filt
Median	17.73	15.74
Range	198.82	111.05
99th centile	111.14	71.26



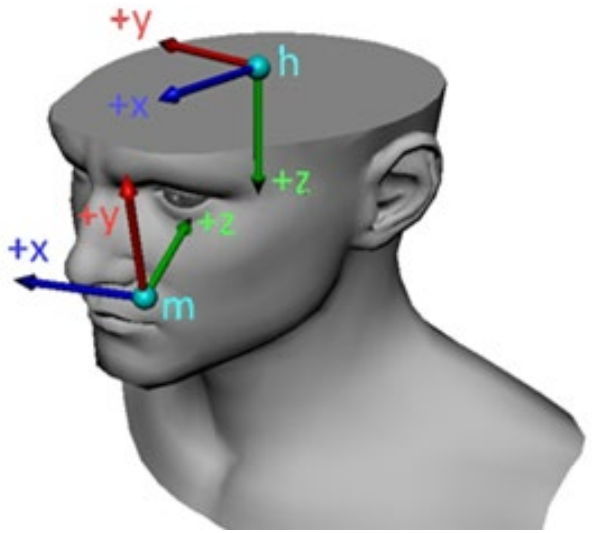
Back_High R^2 = 0.95
Excellent Agreement

Front_High R^2 = 0.70
Moderate Agreement

Top R^2 = 0.59
Poor to Fair Agreement

60% of Impact events

Data processing: Normalization



Open access Original research

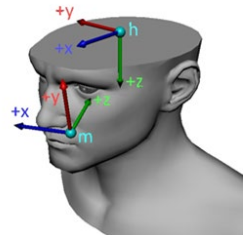
BMJ Open Sport & Exercise Medicine

Influence of the frame of reference on head acceleration events recorded by instrumented mouthguards in community rugby players

Melanie Dawn Bussey ,[1] Peter Davidson,[1] Danielle Salmon,[2] Janelle Romanchuk,[1,2] Darryl Tong,[3] Gisela Sole[4]

TRANSFORMING IMG TO $HEAD_{CG}$

Agreement between iMG and $Head_{CG}$



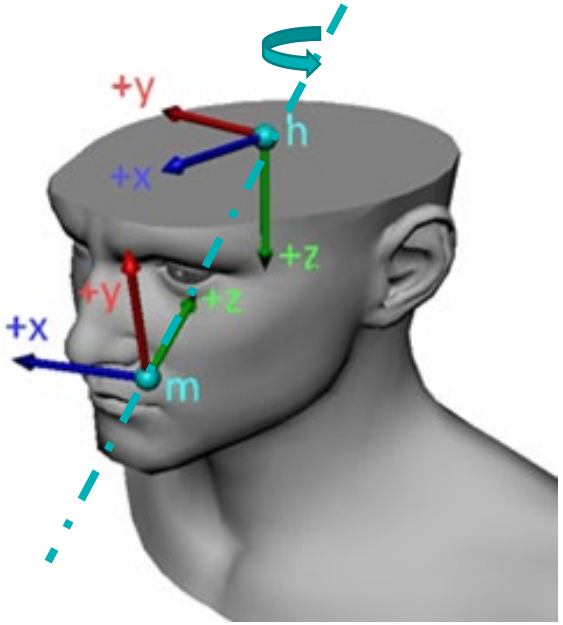
	iMG_Raw	iMG_Filt	$Head_{CG}$ Acc_Filt_g	$Head_{CG}$ Gyr_Filt_g	$Head_{CG}$ All_Filt_g	PAA (rads/s^2)
Median	17.73	15.74	20.66	18.74	16.91	1185.79
Range	198.82	111.05	599.72	184.78	90.42	10111.16
99th centile	111.14	71.26	235.05	102.75	64.28	6140.73

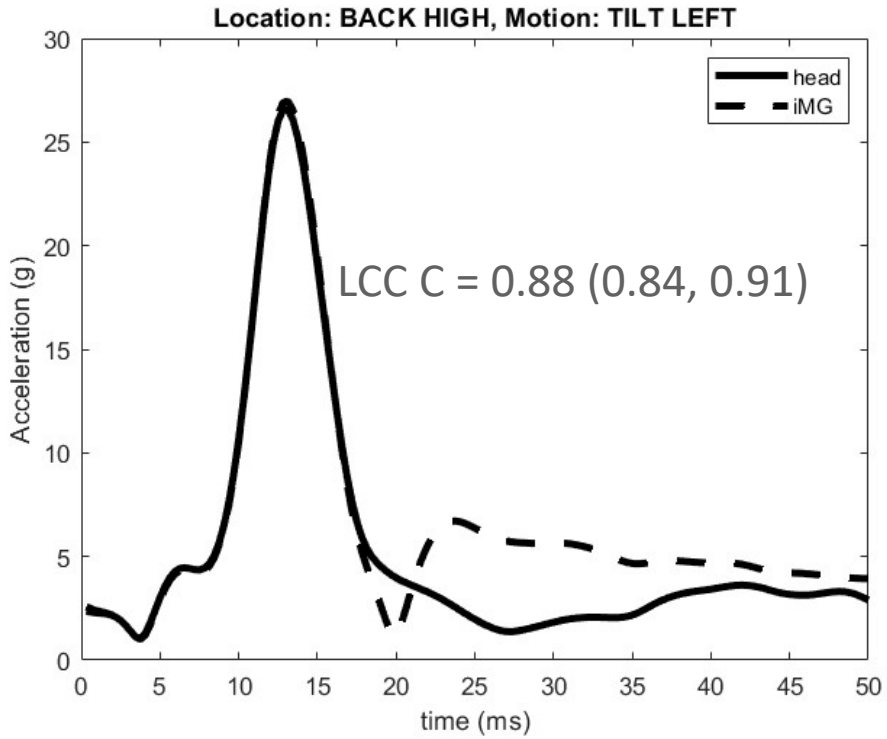
55% HEA iMG < $Head_{CG}$

45% HEA iMG > $Head_{CG}$

Agreement between iMG and $Head_{CG}$: By Location x Rotation

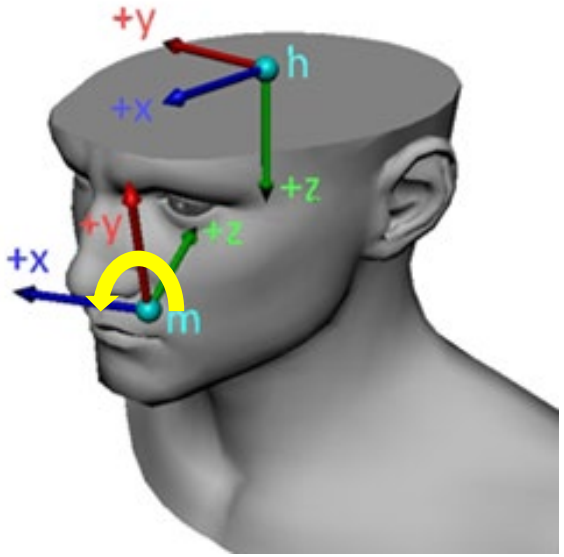
iMG will agree with PLA at CG

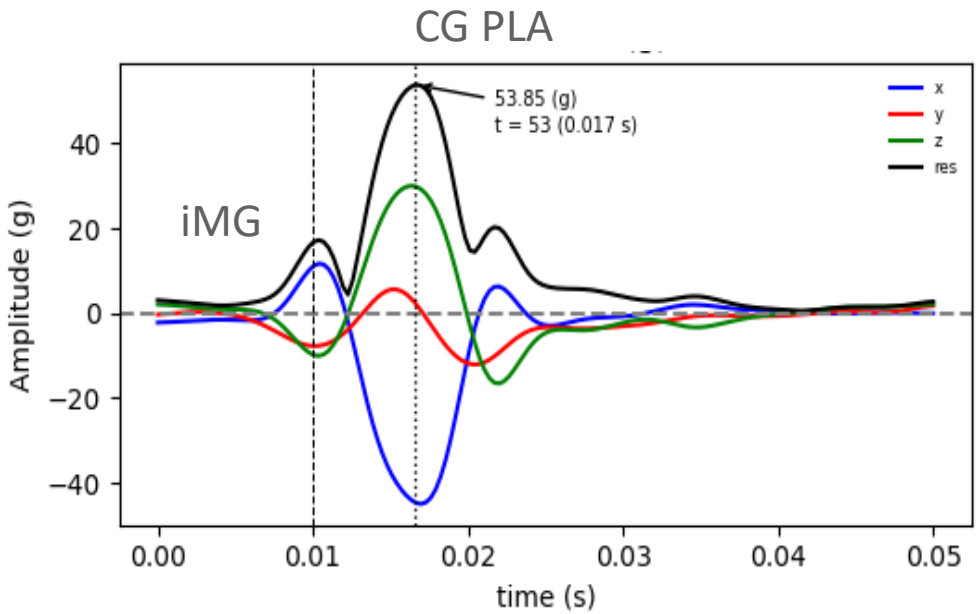




Agreement between iMG and $Head_{CG}$: By Location x Rotation

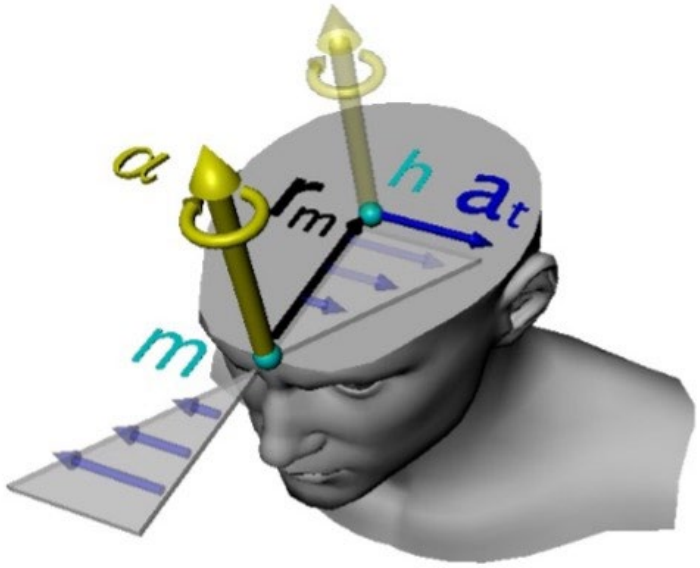
iMG may miss PLA at CG





LCCC = 0.51 (0.27, 0.67)

Data processing: Normalization

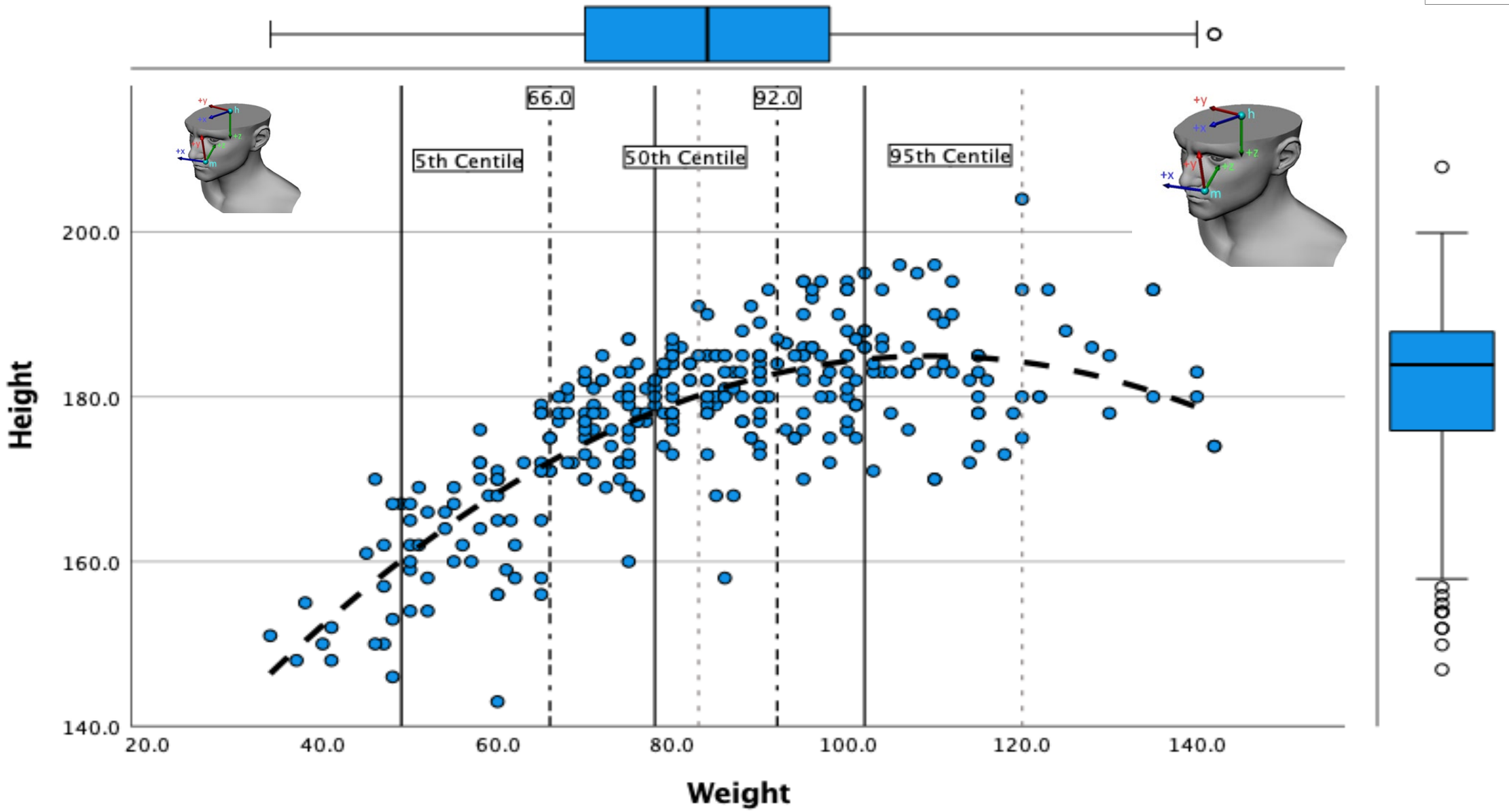


Due to the tangential component of the acceleration.

Untransformed iMG data will most often under-measure or over-measure the acceleration of the head mass.

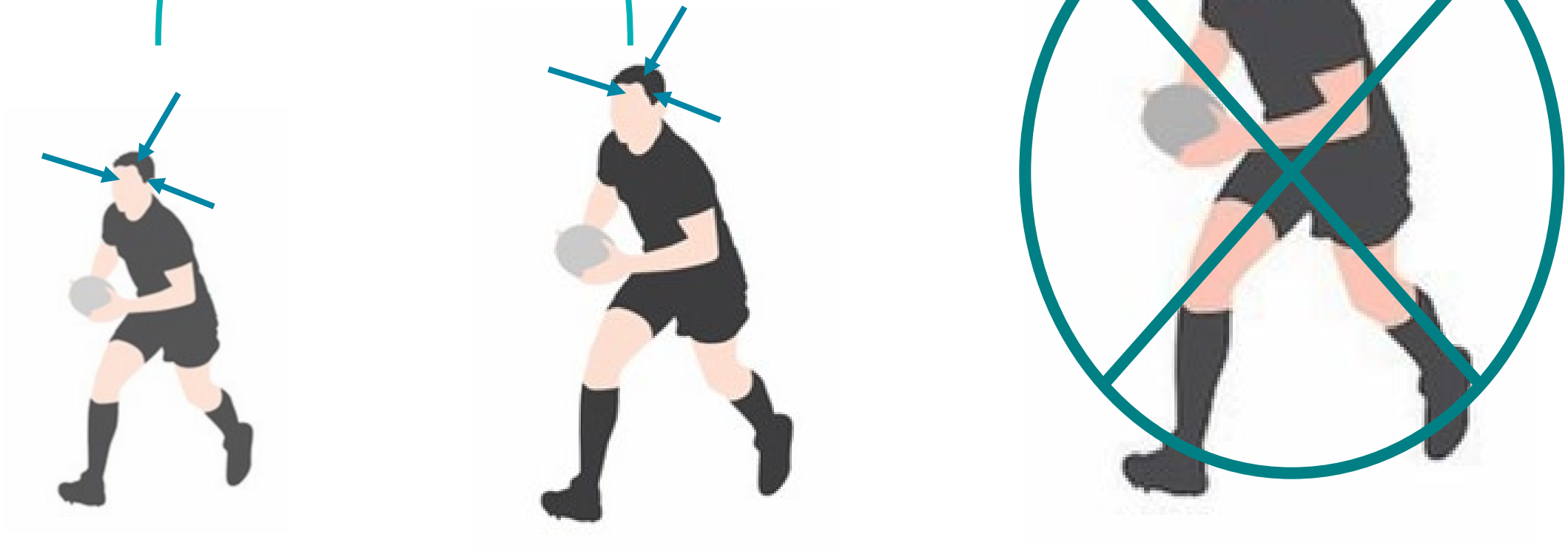
May result in 40-50% difference in the PLA measures.

Data processing: Anthropometrics

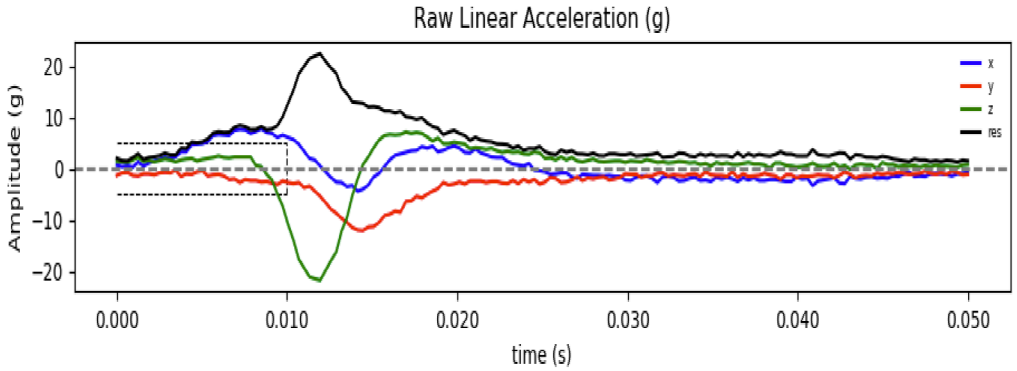


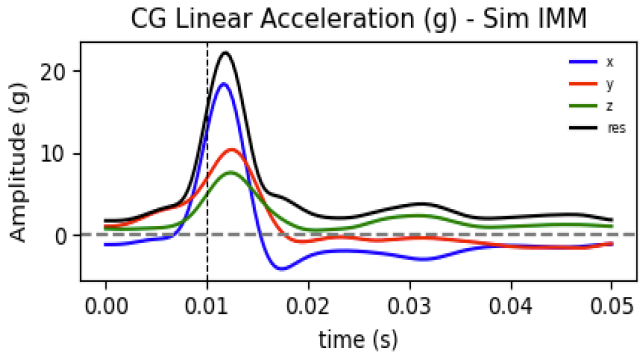
P > 0.05

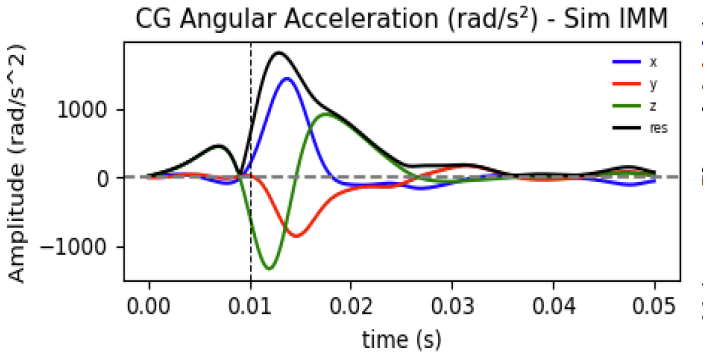
P < 0.001

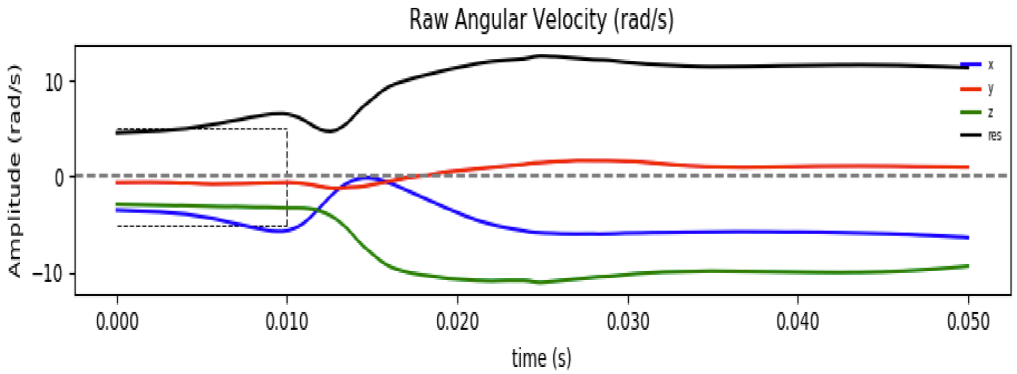


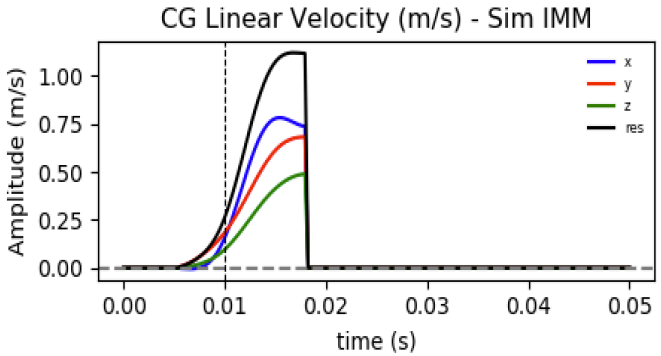
Future Directions: Energy – Cumulative load

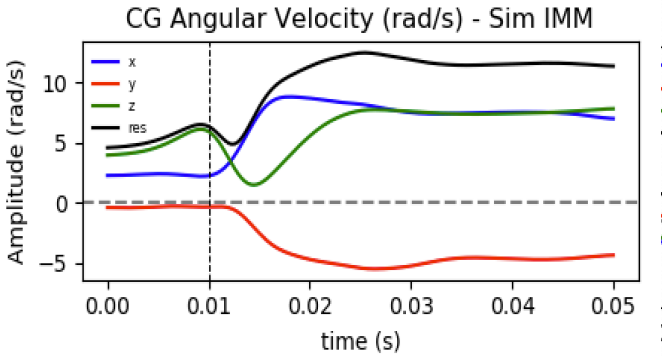












Learnings/Directions

1. **Careful approach is required**
2. **It takes a village**
3. **Industry census required**
   - **Best practice**
   - **Data normalization**

Thanks to Our research team

OTAGO

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Postdoctoral Fellow
Dr Peter Davidson

PhD Student
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Josh Policarpio
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Dr Gregory Tierney
James Tooby

Thanks for listening

Have questions? Please get in touch!

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