Title	WIMU instrumentation of assassin trainer & skeleton sled
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Publication date	2012-07
Original citation	GAFFNEY, M., COLYER, S., WALSH, M., DRAWER, S., SALO, A., O'FLYNN, B. & Ó MATHÚNA, S. C. 2012. WIMU instrumentation of skeleton "ASSASSIN" trainer and sled. In: "Engineering of Sports 9: ISEA's 9th International Sports Engineering Conference". Lowell, Massachusetts, United States. 9-13 July 2012.
Type of publication	Conference item
Link to publisher's version	http://continuinged.uml.edu/isea2012/default.htm
	Access to the full text of the published version may require a subscription.
Item downloaded from	http://hdl.handle.net/10468/973

WIMU INSTRUMENTATION OF SKELETON "ASSASSIN" TRAINER & SLED

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SKELETON

Winter Olympic Sled Sport
1km+ Downhill Ice Course
High Speeds (140km/h)
Large Accelerations (5g)
Fractions of Second Crucial!

Pushing

THE "START"

20-30m Pushing & Loading
Complex Explosive Motion
Critical to Performance
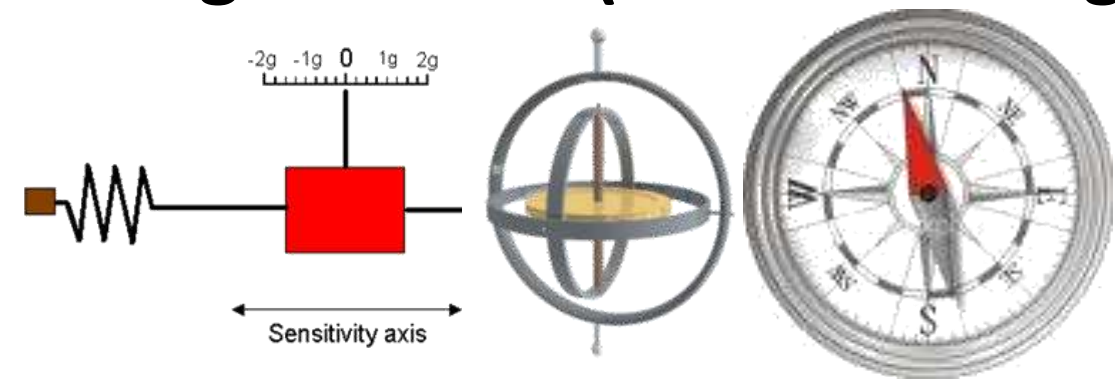Not Well Studied
Room for Improvement?

Loading

COLLABORATION

Tyndall's Sensor Expertise
University of Bath Facilities
UK Sport Access to Athletes
Olympic Athletes & Trainers
Investigate Start Period & Training
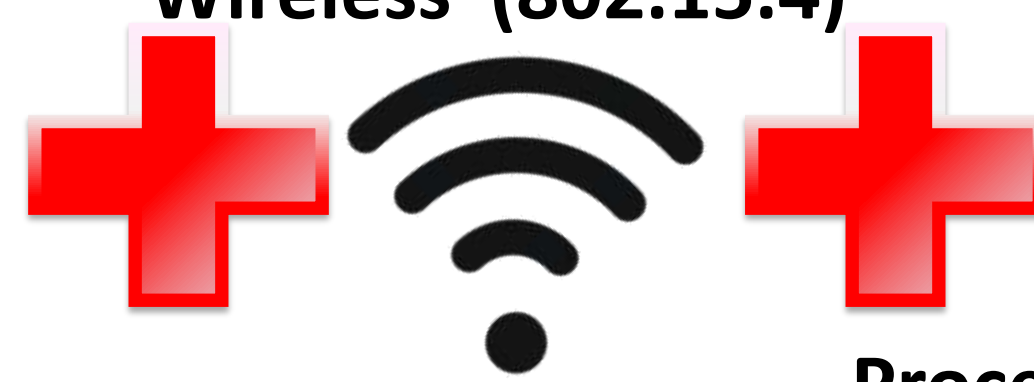Improve Athlete Performance?

WHAT IS A WIMU?

Multi-Range Sensors (Inertial & magnetic)

Sensitivity axis

Tyndall WIMU v3

WIMUv3

Wireless (802.15.4)

Processing (Atmega)

Battery (Li-Ion)

Smart Firmware (Tiny OS)

WIRELESS
INERTIAL
MEASUREMENT
UNIT

ASSASSIN START TRAINER

Training System for Sled Starts
Rolling Sled on Adjustable Incline
2-3 WIMUs on Sled Spars
Resistance Bands & Weights
2 Light-Gates for Basic Timing
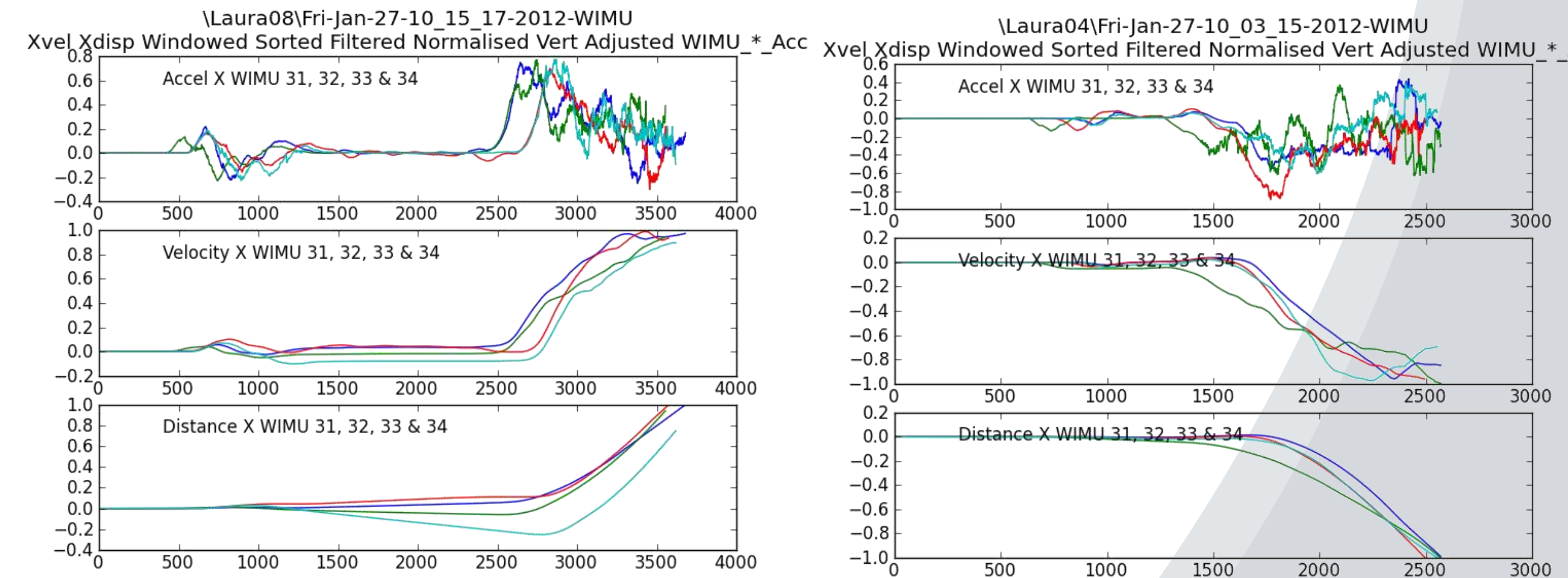37 Runs - Different Weights & Inclines

WIMU on Assassin

SKELETON TEST TRACK

Practice Track for Sled Start
Wheeled Sled on Metal Rails
4 WIMUs on Sled Corner Plates
Base-station Near Brow of Hill
13 Light-Gates for Accurate Timing
12 Runs - Different Step# & Push Type

WIMU on Skeleton

\Test18\Thu-Jan-26-11_06_54-2012-WIMU
Windowed Sorted Normalised Vert Adjusted WIMU_32_Accelerometer and deltaT with Peak Detect

Peak Decel [m/s^2]:80.9819837296
Impact point @ data point 821
Average Filter Window Width=50

Raw Accelerometer (blue)
Filtered Accelerometer (green)
Estimated Velocity (red)
Estimated Displacement (cyan)
Impact point (dotted black line)
Heel Strike (green circle)
Toe Off (red circle)

Assassin Data with Estimated Velocity & Displacement: Step and Impact Events can be Identified

\Laura08\Fri-Jan-27-10_15_17-2012-WIMU
Xvel Xdisp Windowed Sorted Filtered Normalised Vert Adjusted WIMU_*_Acc

Accel X WIMU 31, 32, 33 & 34
Velocity X WIMU 31, 32, 33 & 34
Distance X WIMU 31, 32, 33 & 34

\Laura04\Fri-Jan-27-10_03_15-2012-WIMU
Xvel Xdisp Windowed Sorted Filtered Normalised Vert Adjusted WIMU_*_A

Accel X WIMU 31, 32, 33 & 34
Velocity X WIMU 31, 32, 33 & 34
Distance X WIMU 31, 32, 33 & 34

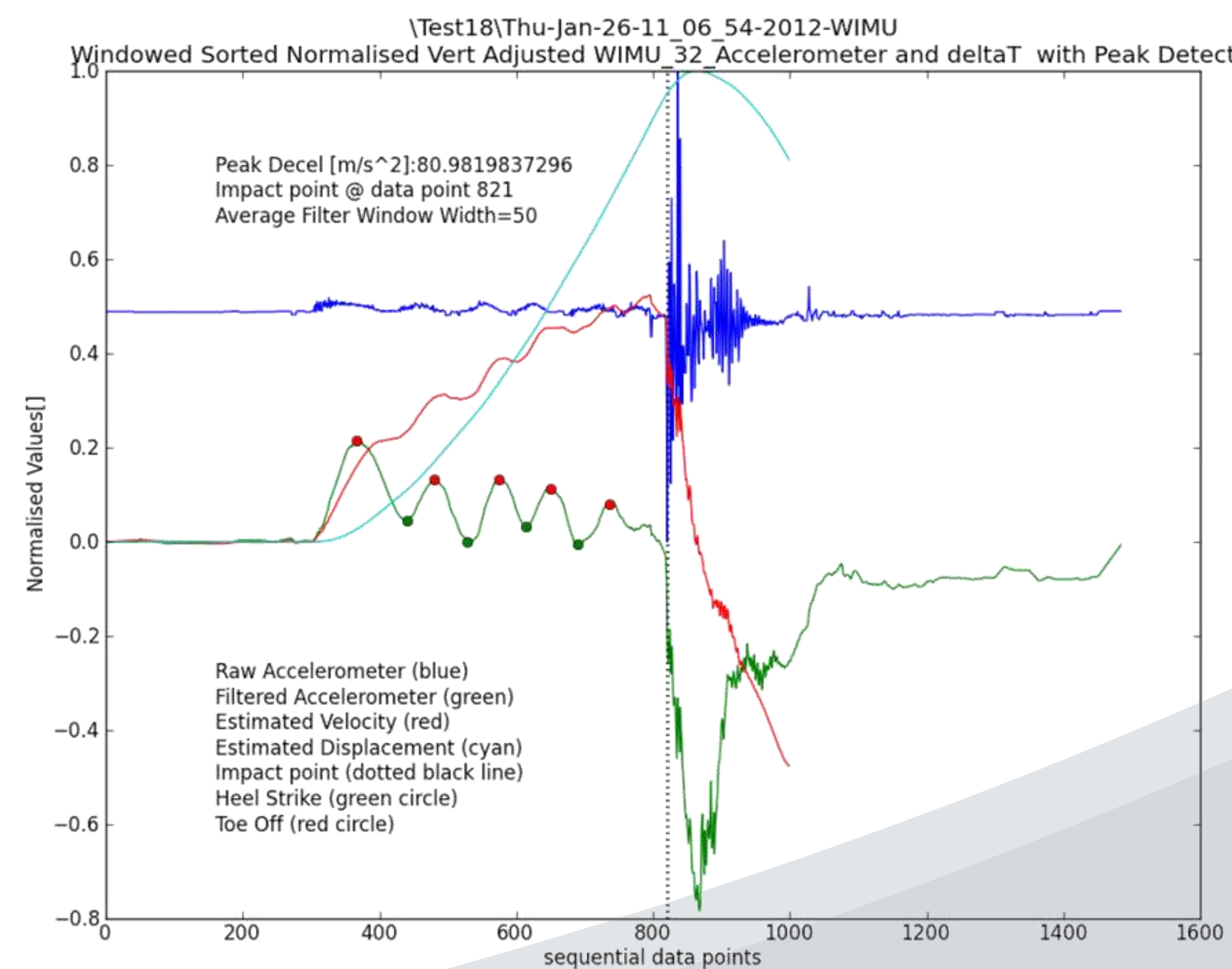**Skeleton Acceleration Data with Estimated Velocity & Displacement: Left and Right Handed Pushing can be Distinguished**

Sensor Type	Sensor Part	Range	Target	Assassin	Skeleton
Accelerometer	ADXL345	±16g	256Hz	257Hz/Axis	216Hz/Axis
Gyroscope	IDG/ISZ-650	±2000°/s	256Hz	263Hz/Axis	214Hz/Axis
Magnetometer	HM5843	±0.7Ga	50Hz	55Hz/Axis	42Hz/Axis
Combined Sensing Rate				3450Hz	5660Hz

OUTCOME

WIMU Data was successfully recorded for 34 Assassin & 11 Skeleton runs with average device sampling rates close to the target. System wide sensing rates were in 1000's of Hz. Slight decreases in performance were seen for the Skeleton track due to a more challenging RF environment. Additional light-gate based timing and video data are also available for many of these runs and are being used to validate the initial results. Algorithmic identification of individual step candidates & initial calculations of sled direction, velocity and distance look promising.

FUTURE

WIMU based systems hold great potential to aid & automate skeleton performance analysis and become part of training and coaching regimes for elite athletes. Future work will involve additional data recording, further instrumenting the athlete, analysing technique and focusing on post loading features. This will allow the Olympic level athletes involved to bring their training from the Lab to the track.