FACULTY OF ENGINEERING AND INFORMATION TECHNOLOGY

UTS greyhound safety and welfare research update 12 June 2018

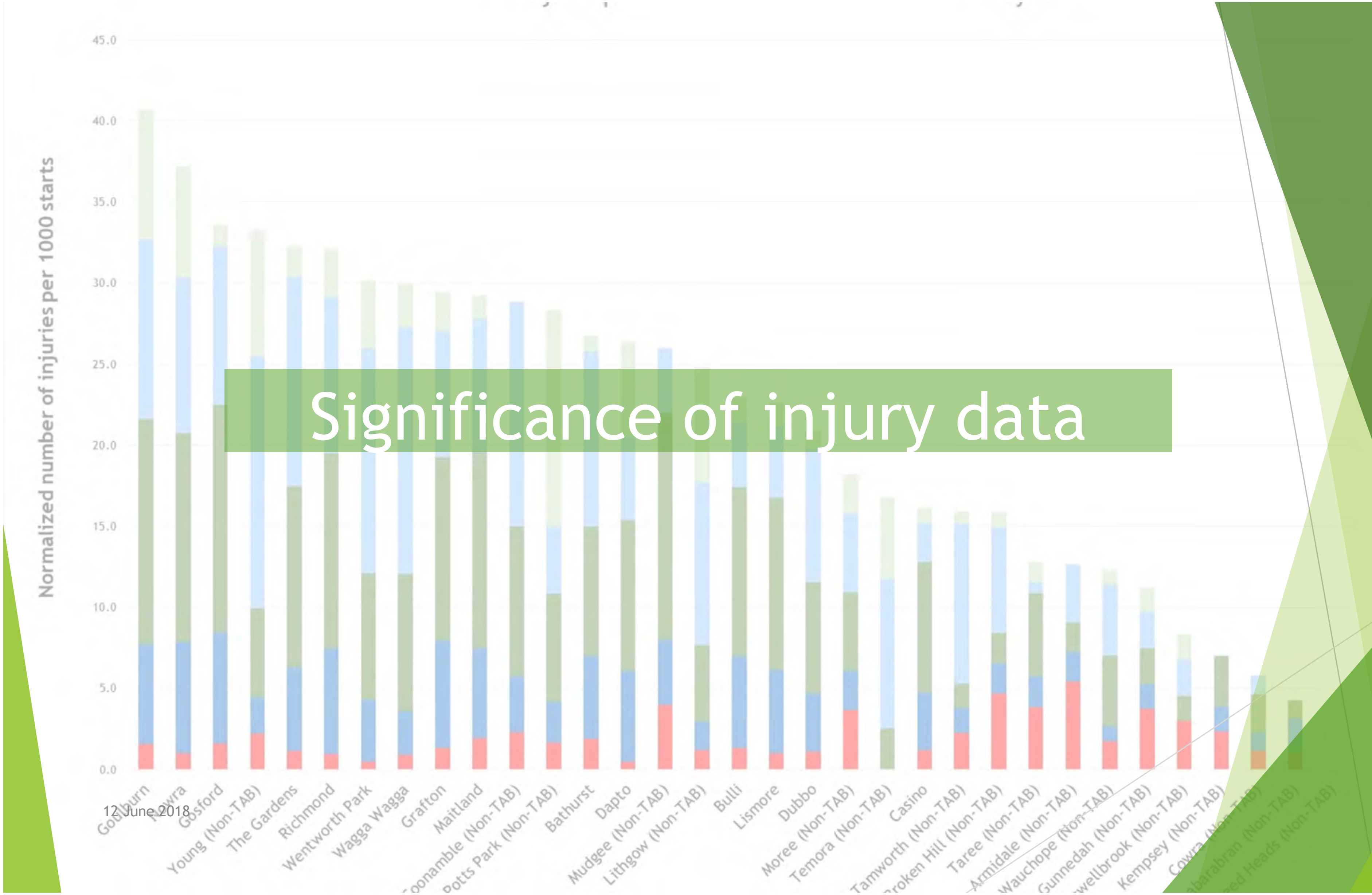
David Eager

University of Technology Sydney

Outline

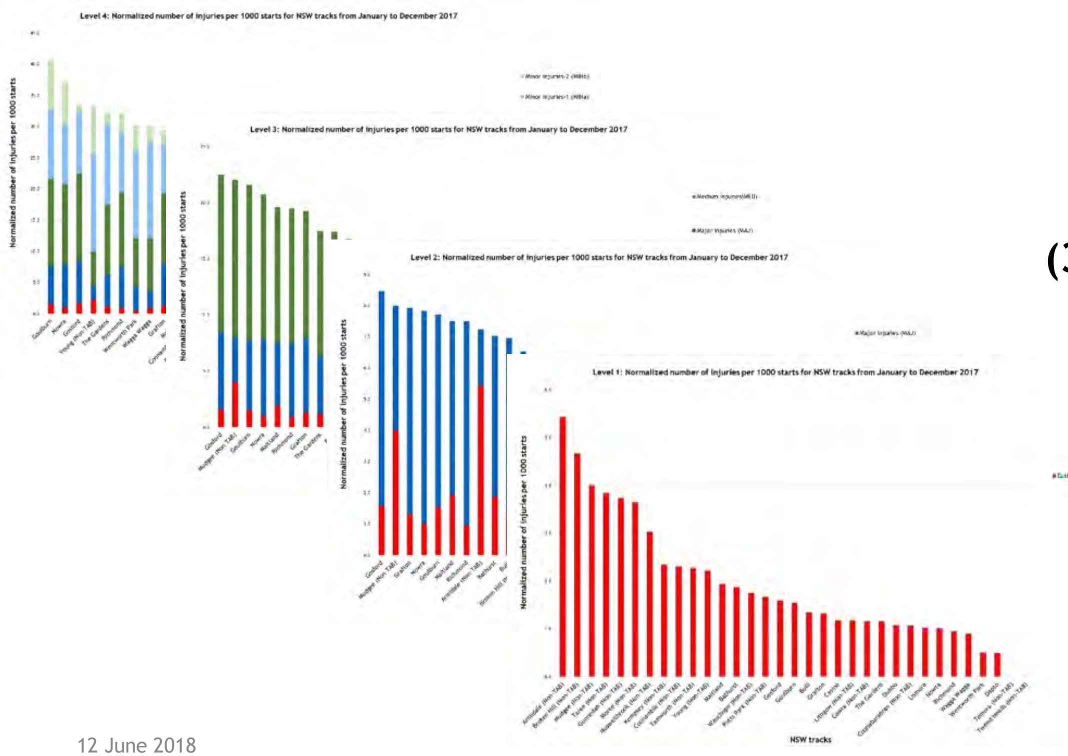
1. Significance of injury data
2. Kinematic (motion) study: HFR data analysis
3. Kinetic (forces) study: iKMS data analysis
4. Surface safety analysis
5. Track modelling and race simulation
6. Q & A

Significance of injury data

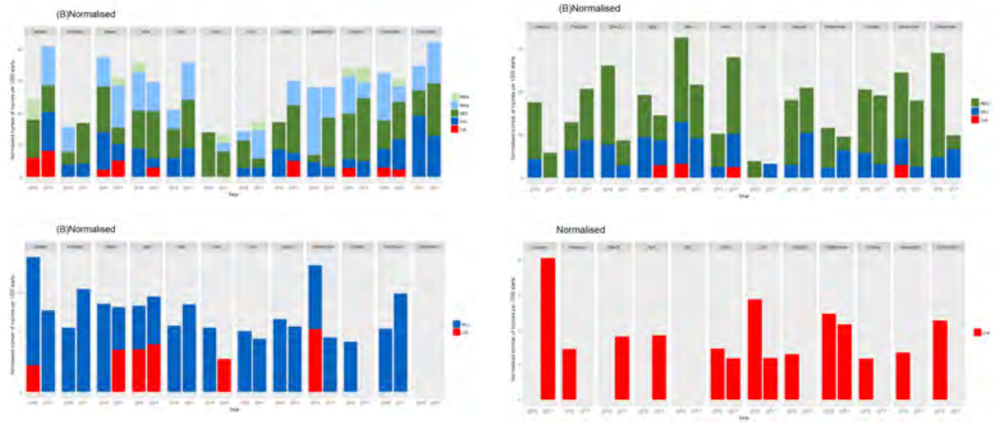


Data analysis in a glance

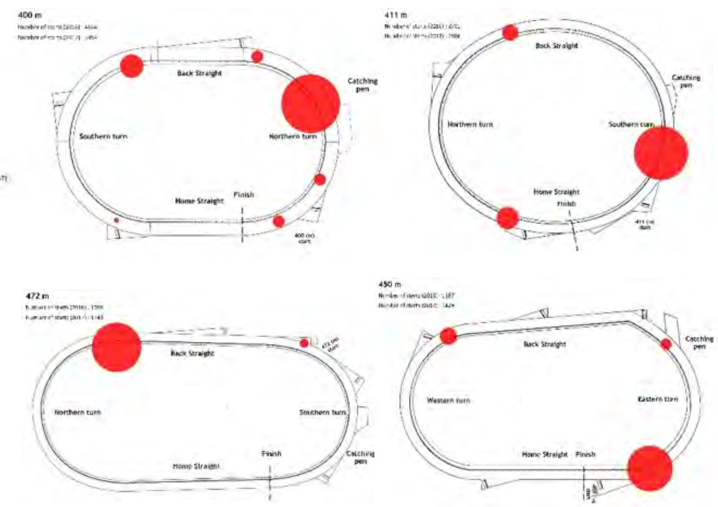
(1)



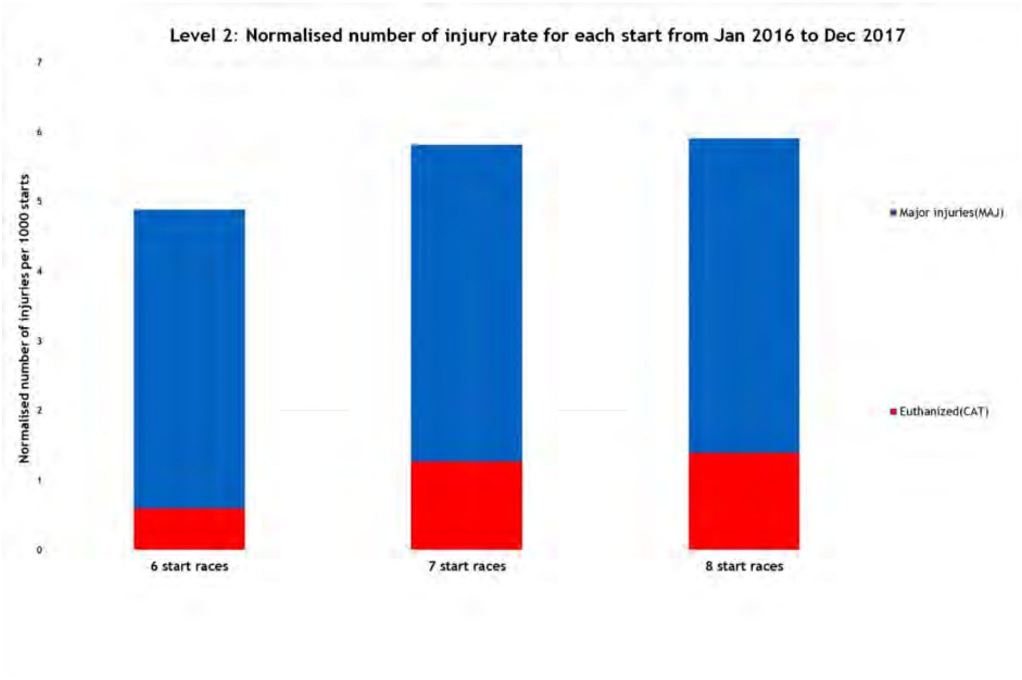
(2)



(3)



Retrospective review: 6 vs 8 runners

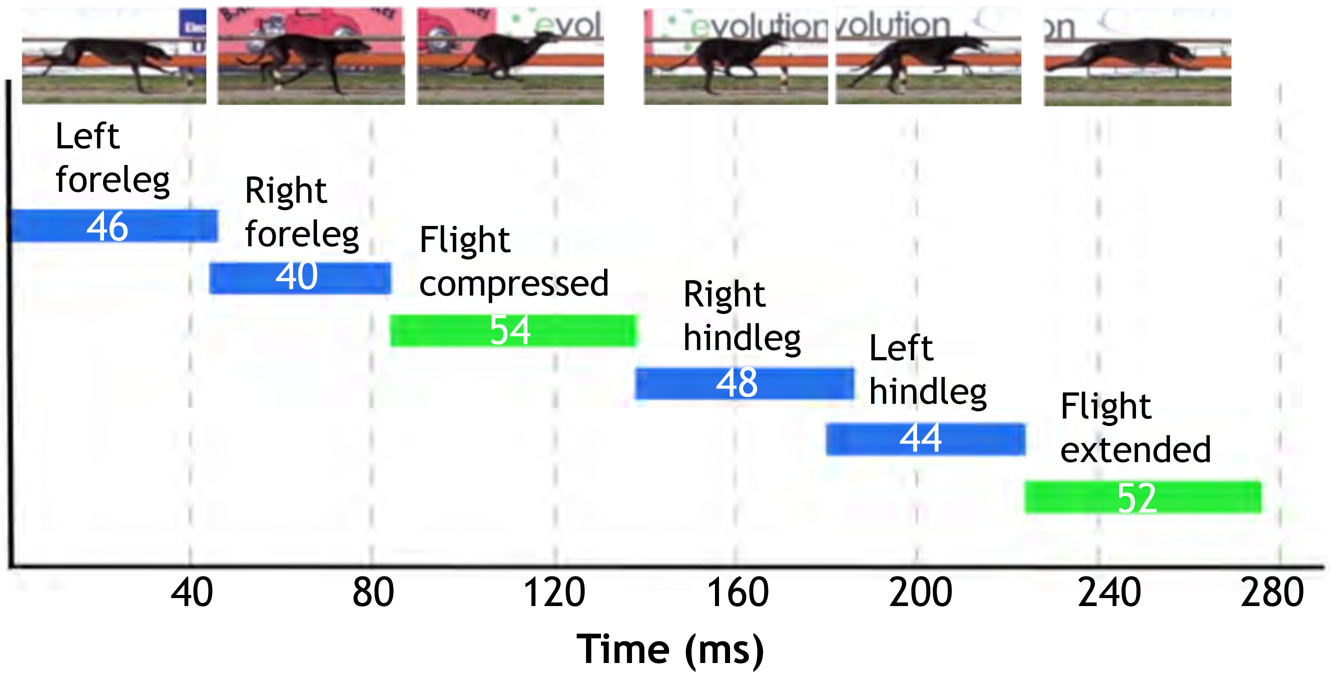


	2016 Deceased	2016 Starts	2017 Deceased	2017 Starts	Normalised per 1000 starts (2017 & 2016)
6 Start races	3	4032	2	4356	0.6
7 Start races	23	15435	15	14483	1.3
8 Start races	103	70128	92	69952	1.4

Kinematic ‘motion’ study: HFR data analysis

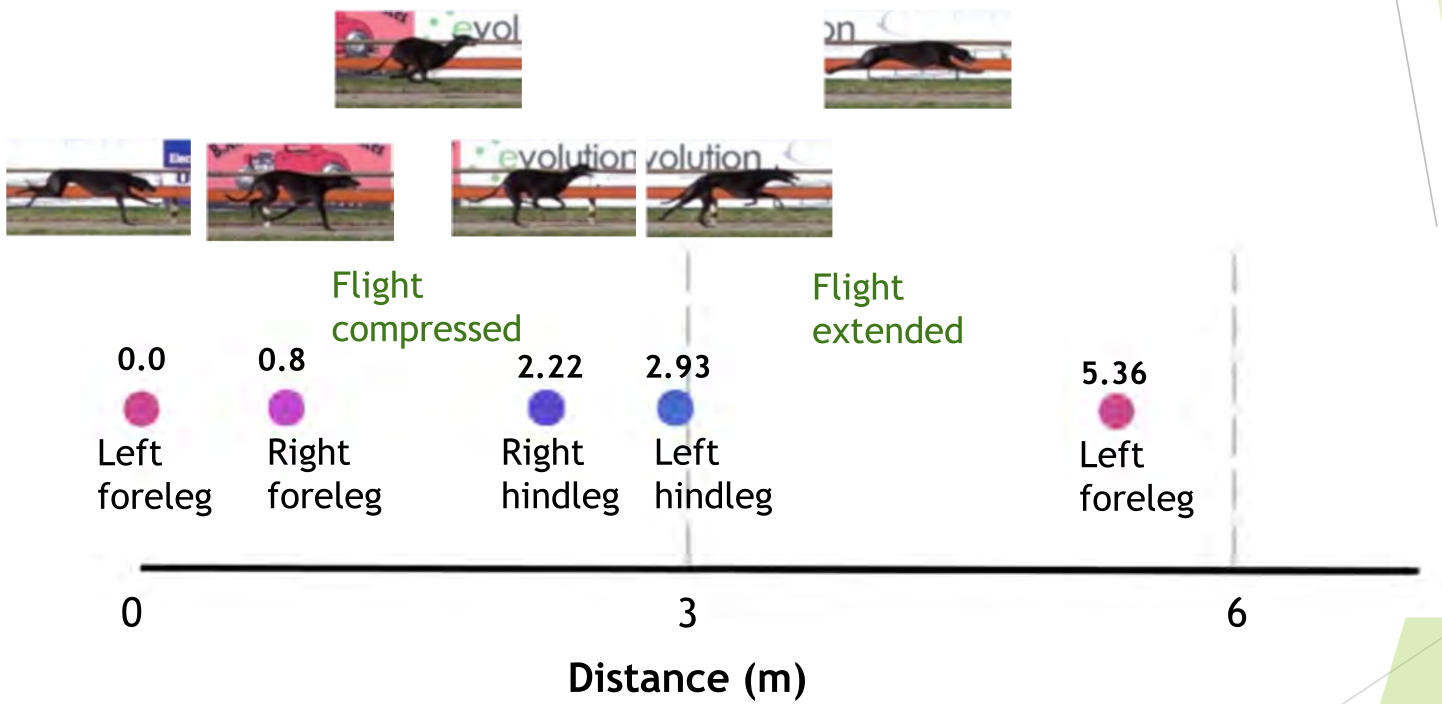
Greyhounds stride analysis

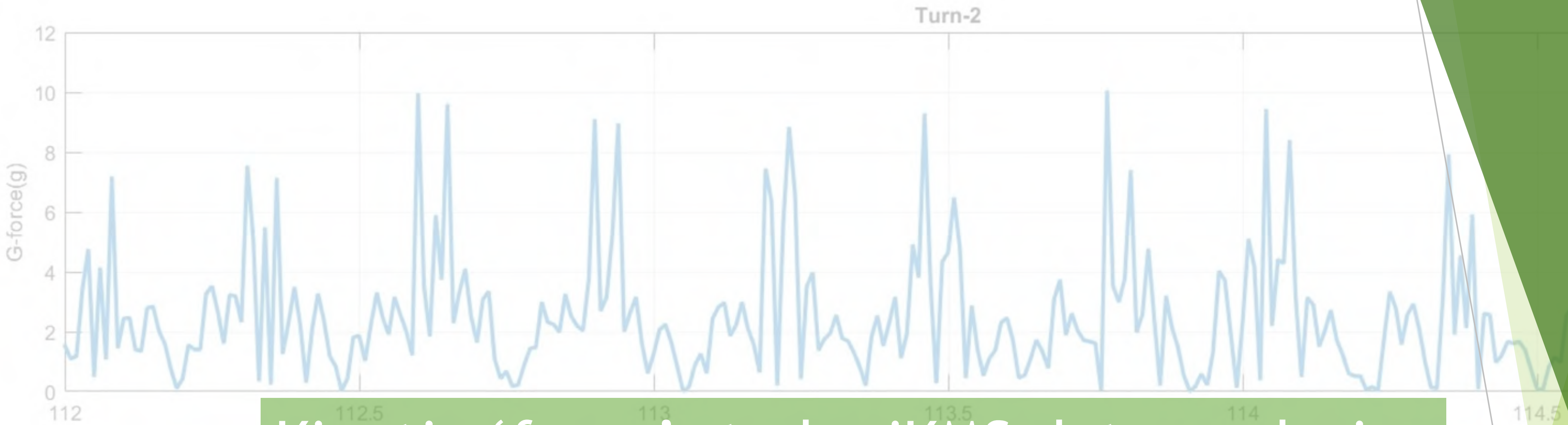
Straight running



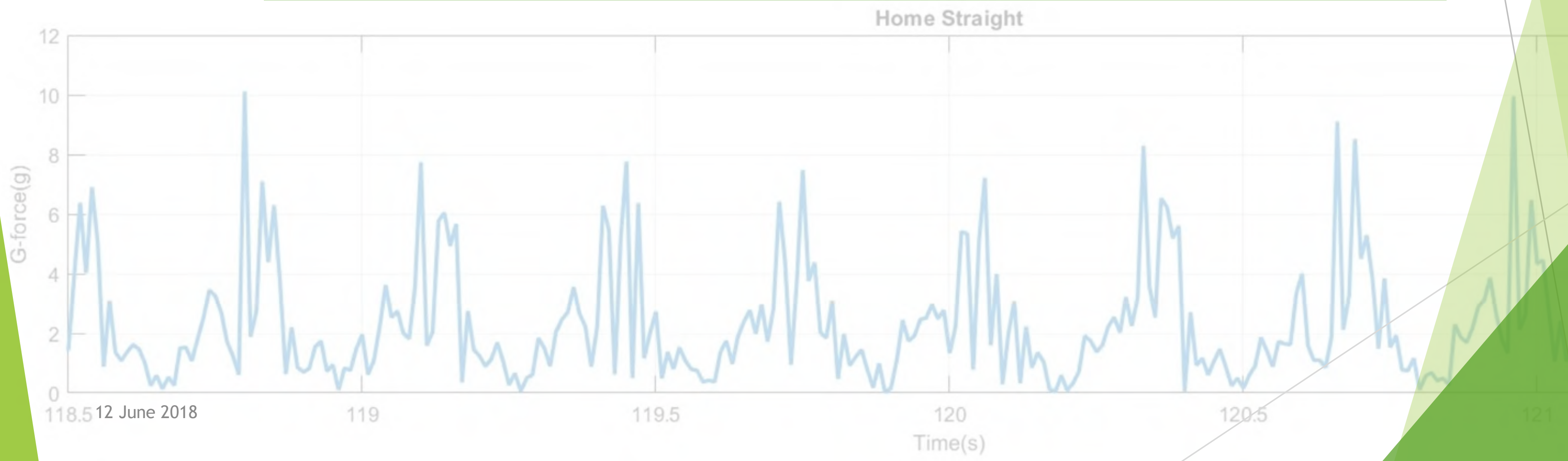
Greyhounds stride analysis

Straight running



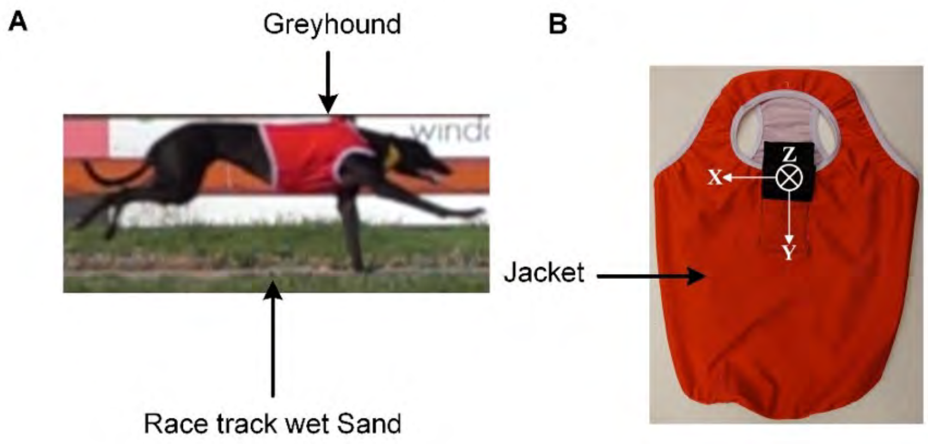


Kinetic ‘force’ study: iKMS data analysis

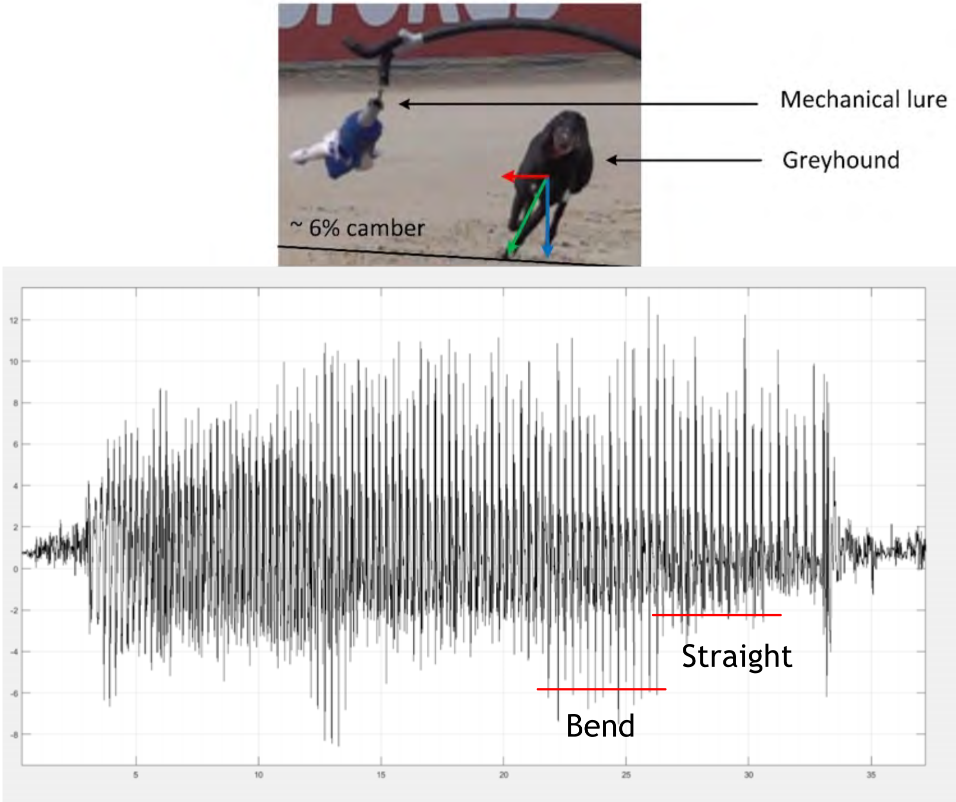


UTS developed data acquisition device (iKMS)

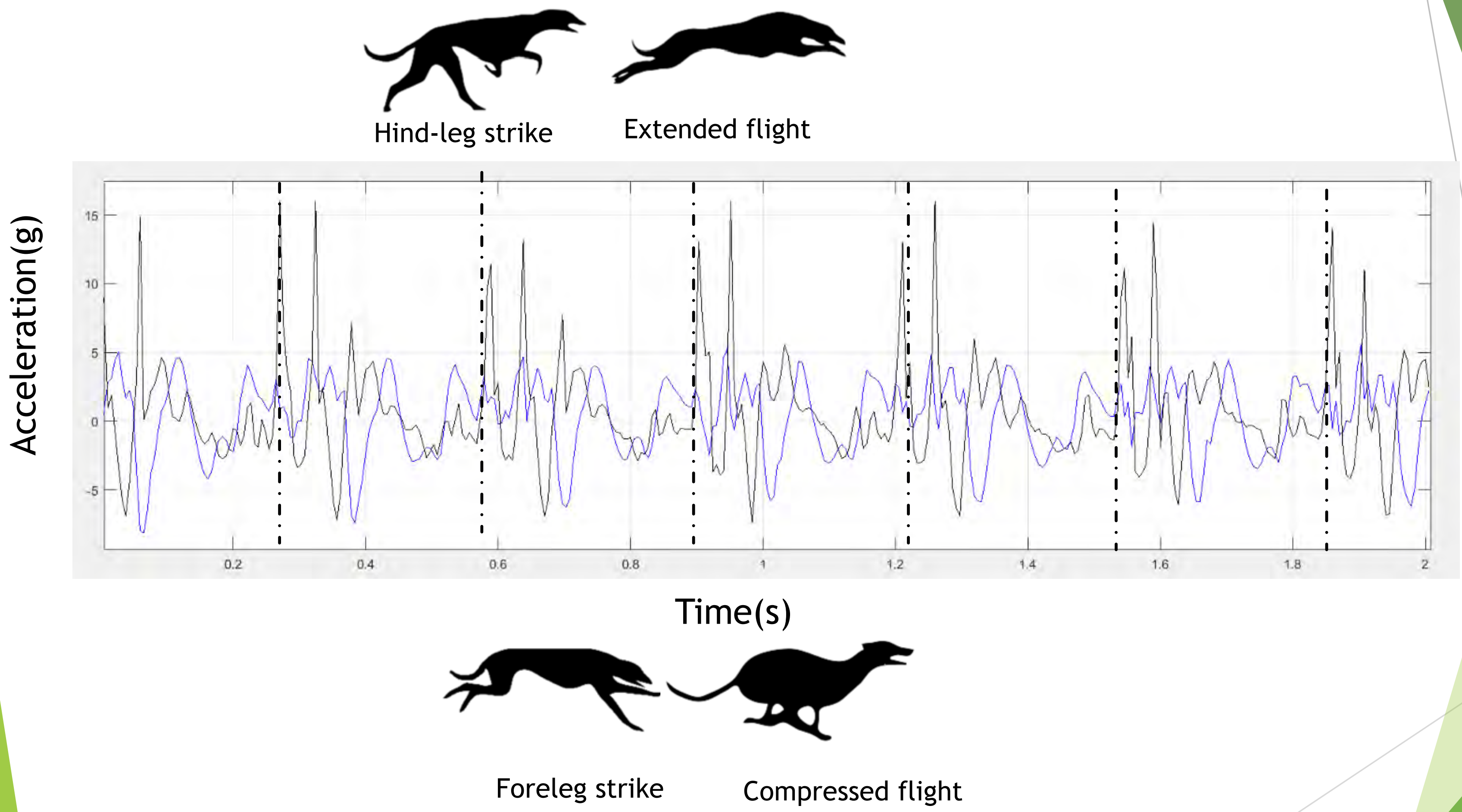
iKMS V1.1 central acquisition unit



A greyhound wearing a jacket with embedded Integrated Kinematic Measurement System (iKMS)

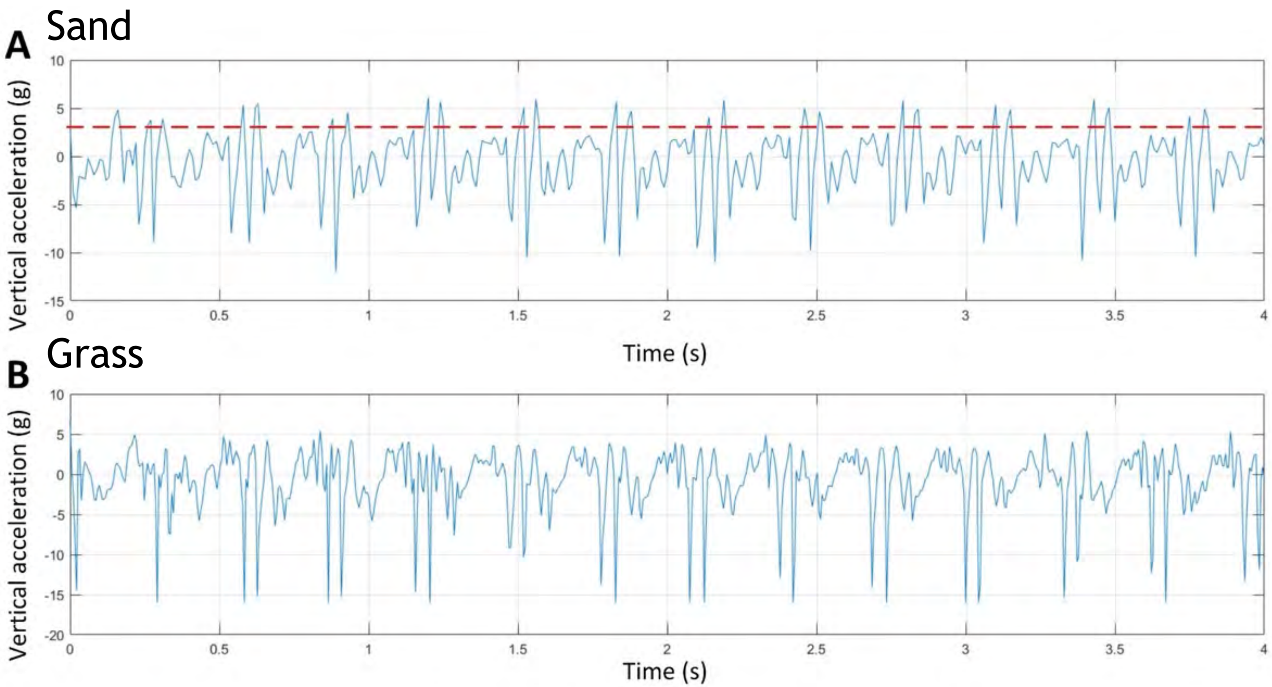


Example of Integrated Kinematic Measurement System (iKMS) raw data



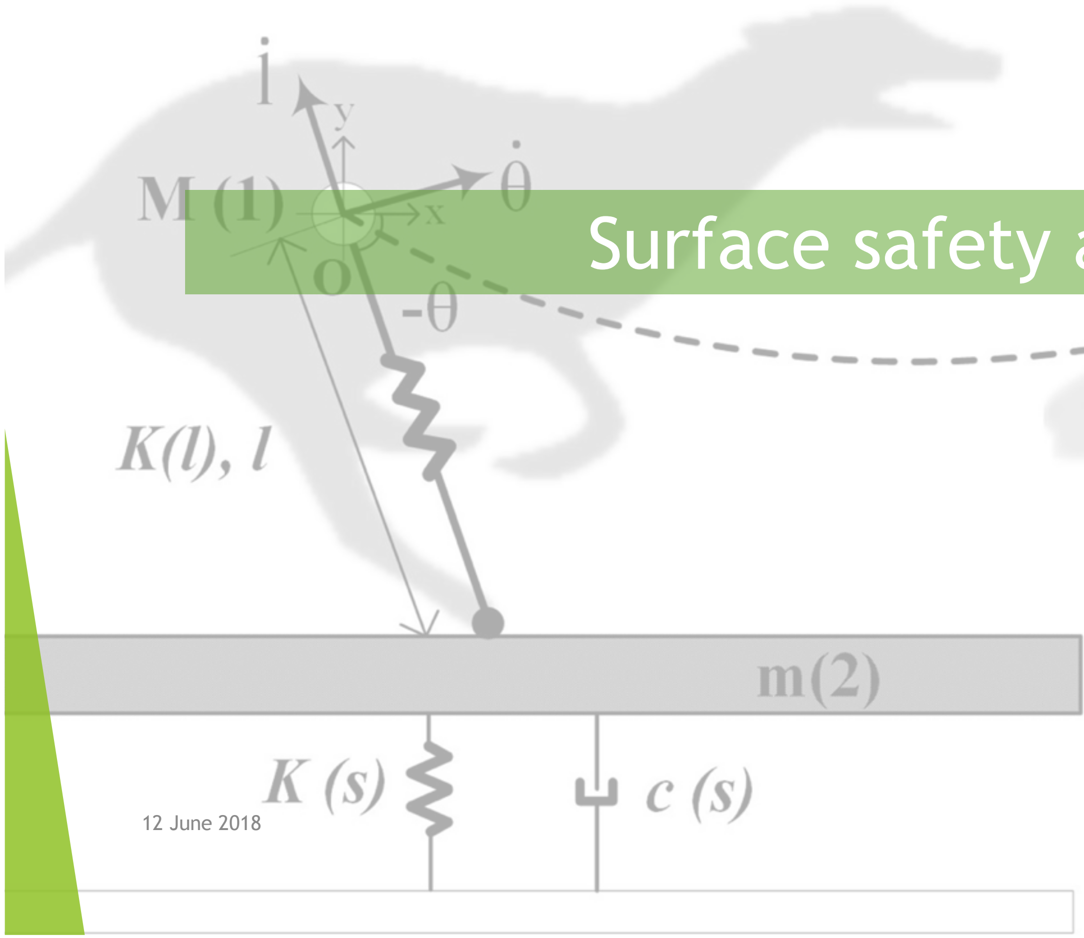
Hind-leg strike
Extended flight
Acceleration(g)
15
10
5
0
-5
0.2
0.4
0.6
0.8
1
1.2
1.4
1.6
1.8
2
Time(s)
Foreleg strike
Compressed flight

Comparison of sand track vs grass track

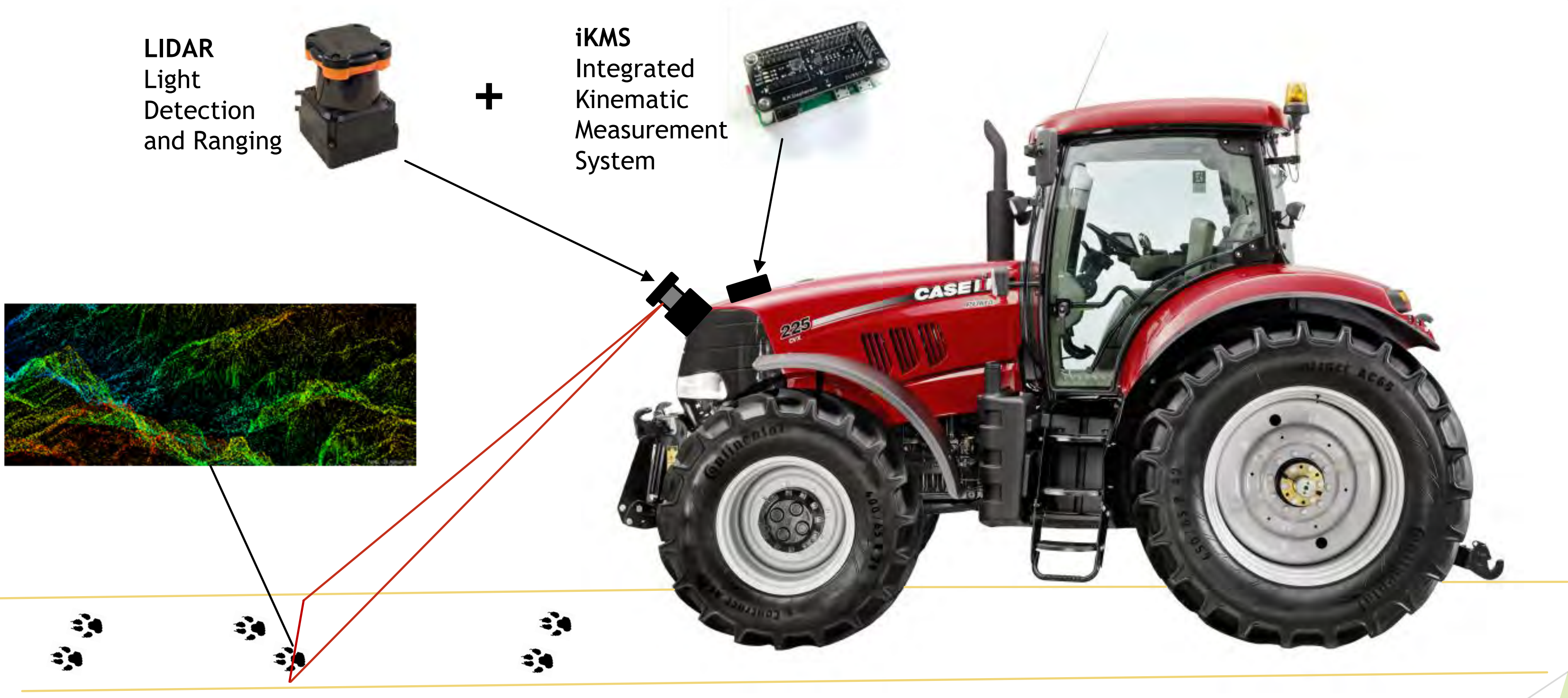


Parameters	Value
Peaks of vertical acceleration (sand-bend)	7.4 g
Peaks of vertical acceleration (sand-straight)	5.0 g
Peaks of vertical acceleration (grass-bend)	7.1 g
Peaks of vertical acceleration (grass-straight)	4.3 g
Stride frequency (sand-bend)	3.60 Hz
Stride frequency (sand-straight)	3.50 Hz
Stride frequency (grass-bend)	3.85 Hz
Stride frequency (grass-straight)	3.45 Hz

Surface safety analysis



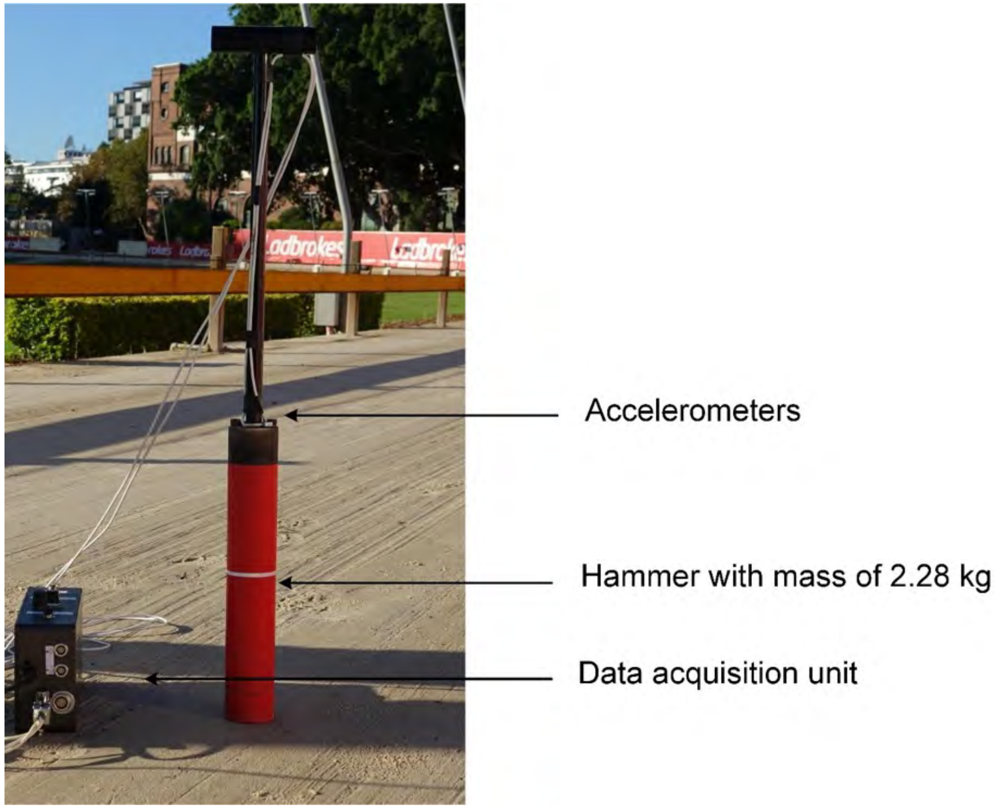
Advanced 3D paw imprint reconstruction

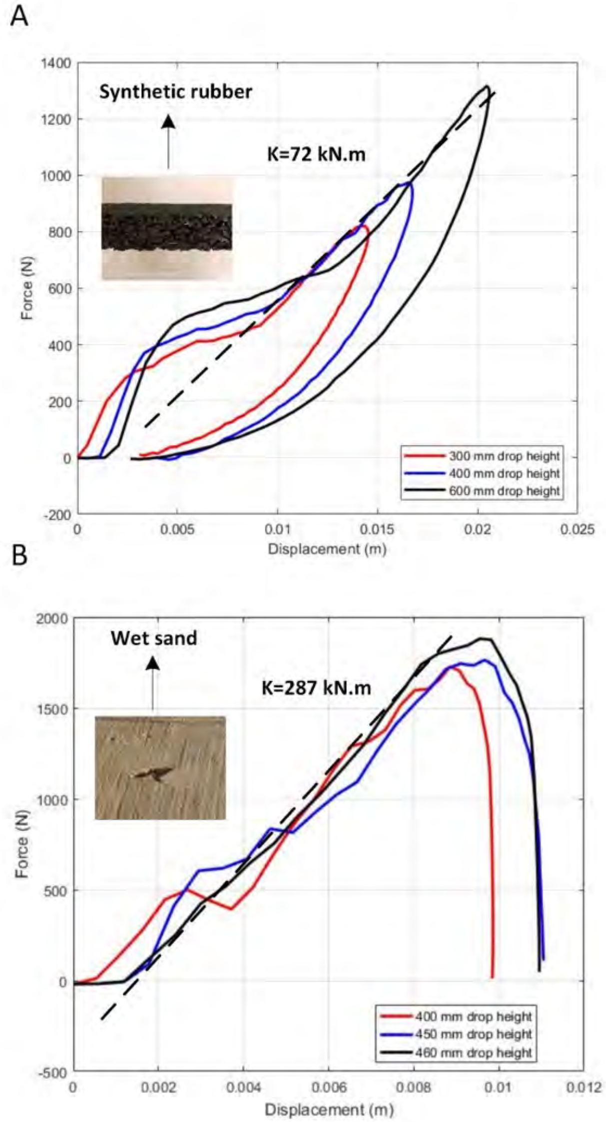


Advanced 3D paw imprint reconstruction

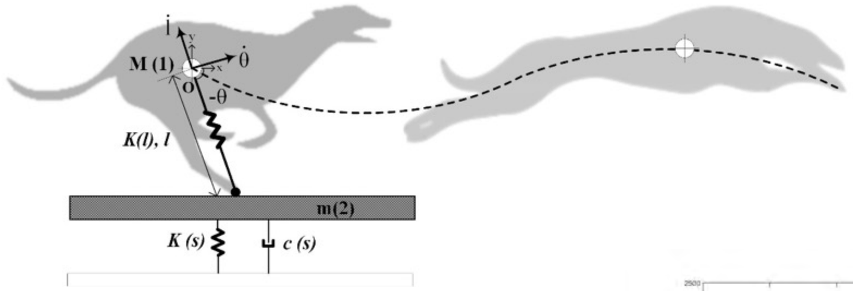
- Paw imprints can be seen as an objective measurement of track surface properties
- It is hypothesised that optimum paw imprint will allow standardisation of current track surface analysis techniques such as penetrometer, moisture and impact testing
- Print shape and depth may be correlated with variables such as compaction and moisture content
- Change of surface preparation philosophy: Instead of changing variables to chase performance the greyhound racing industry chooses the performance and change the variables accordingly
- Analysis may concluded that different surfacing properties are required where the greyhounds are subjected to different forces ie bend and straight may require different sand, moisture and/or preparation to optimise the performance
- Additionally, paw imprint reconstruction allows analysis of previously unobtainable stride, gait and surface information

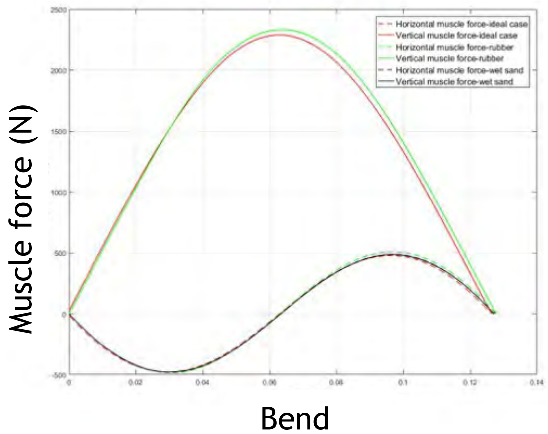
Modified 2.28 kg Clegg hammer



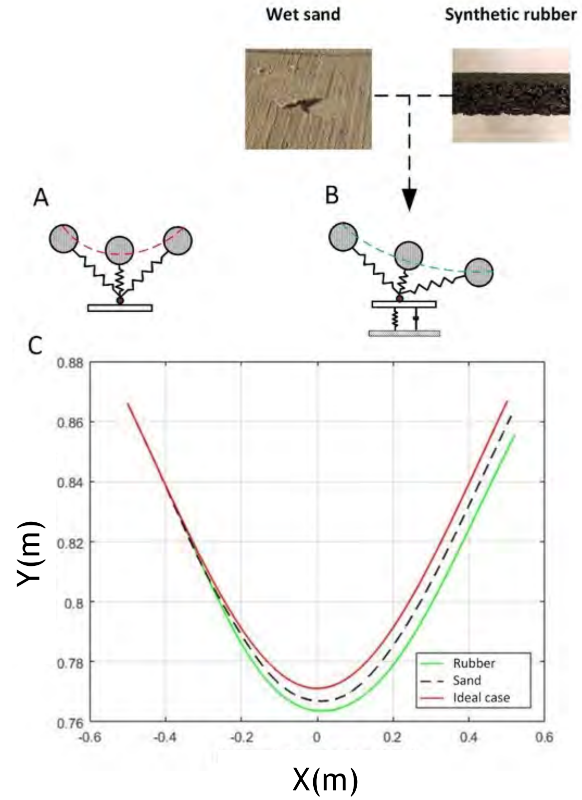


Dynamic model of galloping greyhound



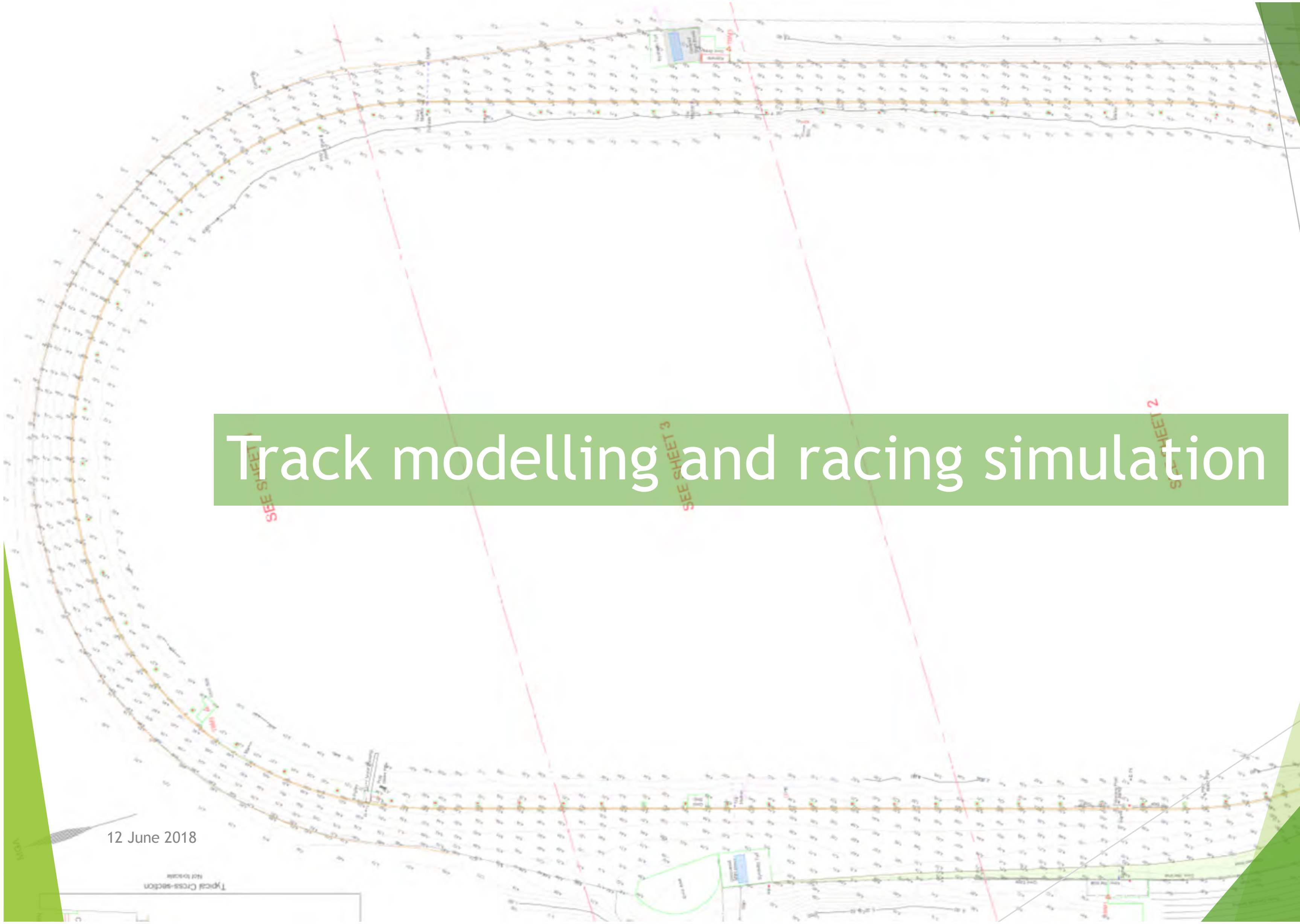


Estimated muscle force of a galloping greyhound on sand and synthetic rubber surface



Centre of mass trajectory line of greyhounds while galloping on sand and synthetic rubber

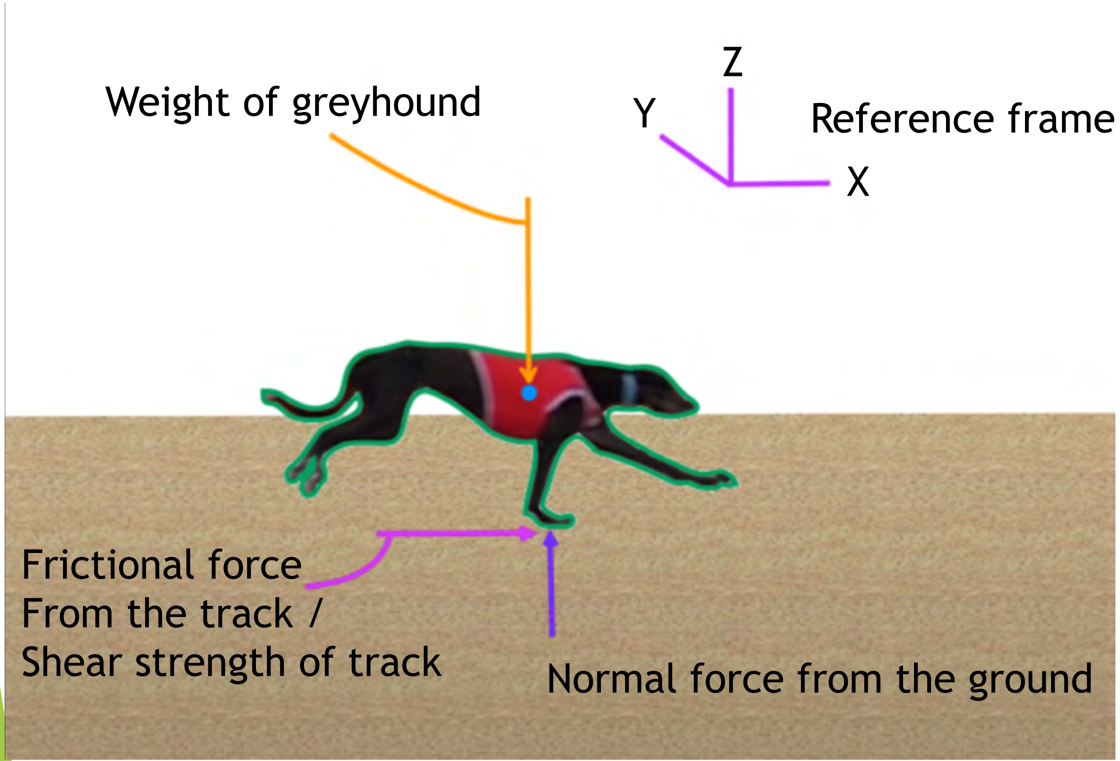
Track modelling and racing simulation



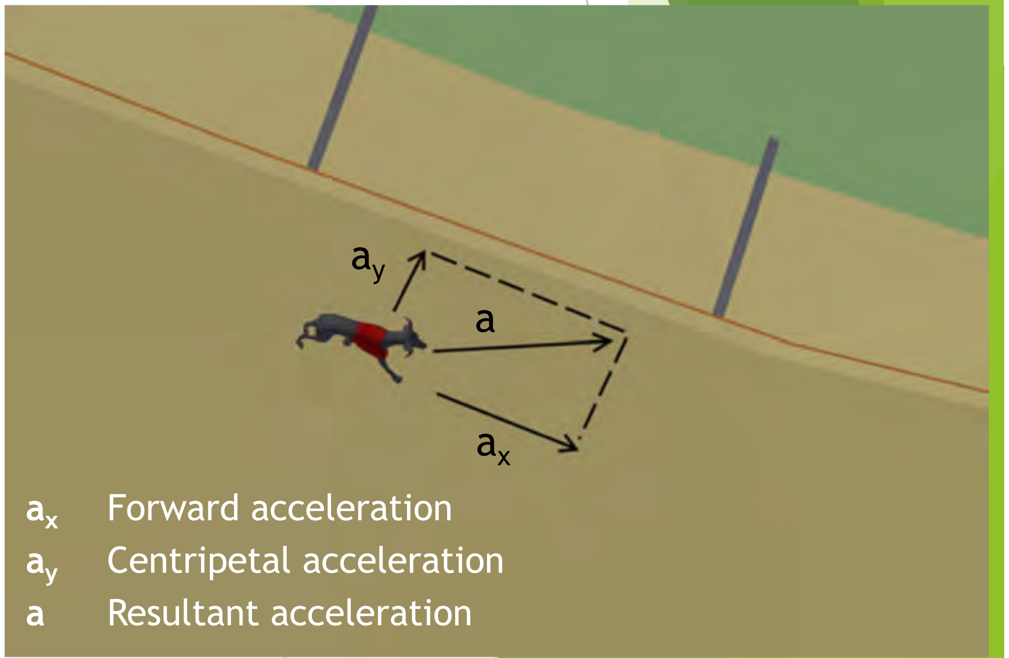
12 June 2018

Track design investigation

Greyhounds on the bends



Major forces acting on a greyhound on the straight side view



Accelerations of a greyhound on the bend top view

Track design investigation

Greyhounds on the bends

Maximum constant galloping speed possible for greyhounds

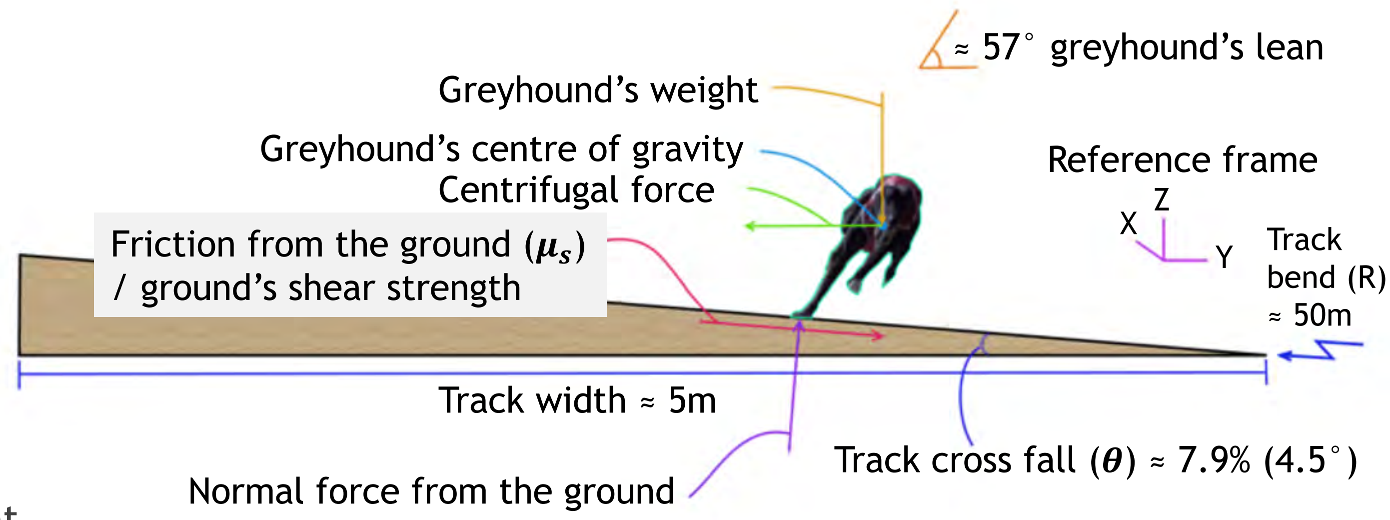
R Bend

g Acceleration due to gravity

Track's coefficient of static friction

θ Cross fall of the track

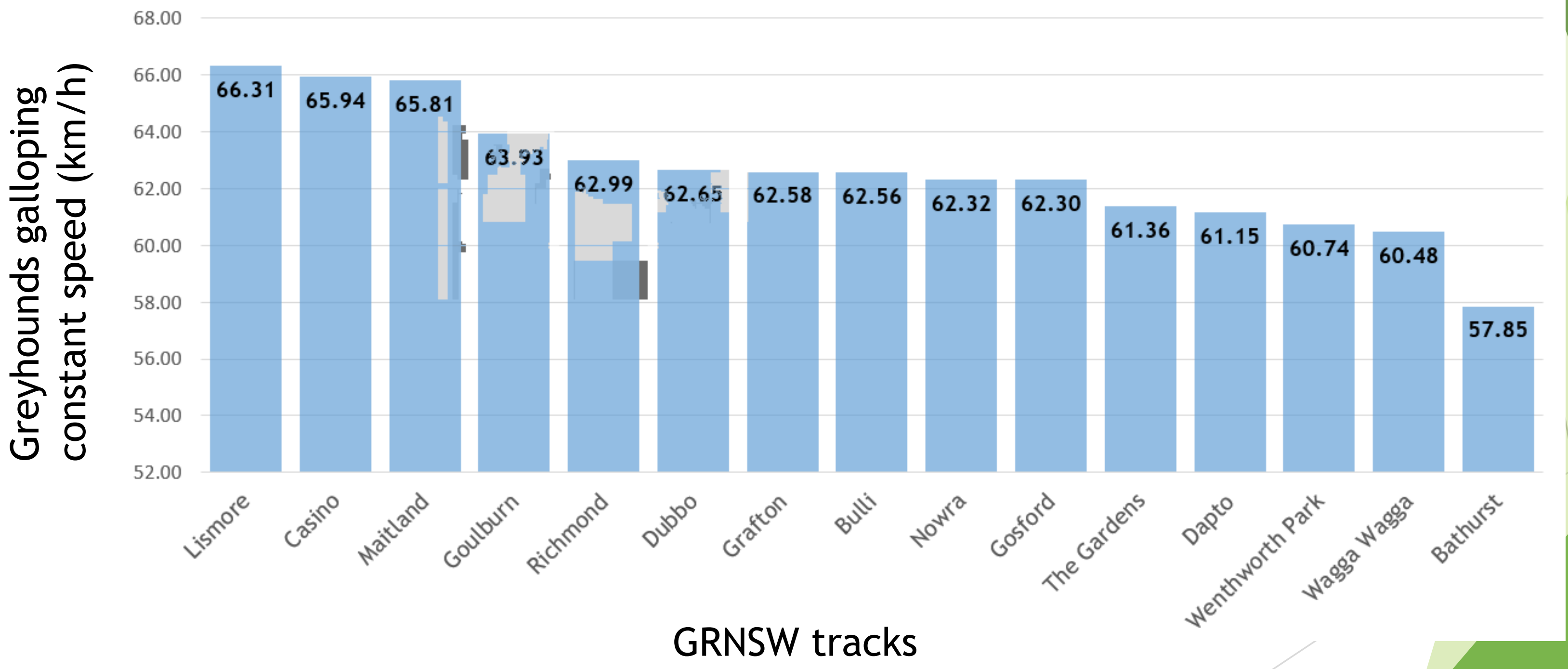
v Greyhounds maximum constant speed



Forces acting on a greyhound on the bend front view

Track design investigation

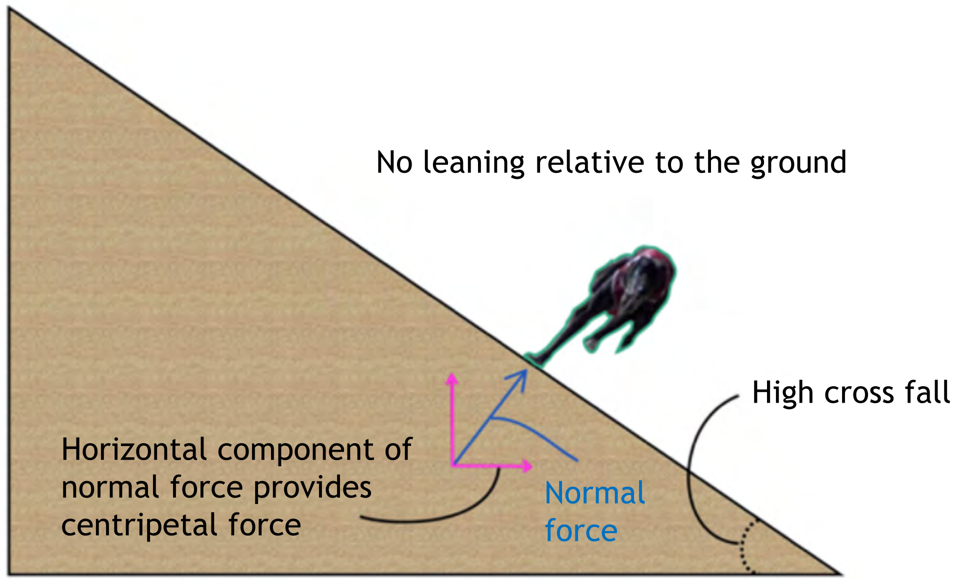
Maximum speeds of greyhounds as limited by the physics



*An averaged value of static friction coefficient is considered for the data above

Track design investigation

What can be done for cross falls at the tracks

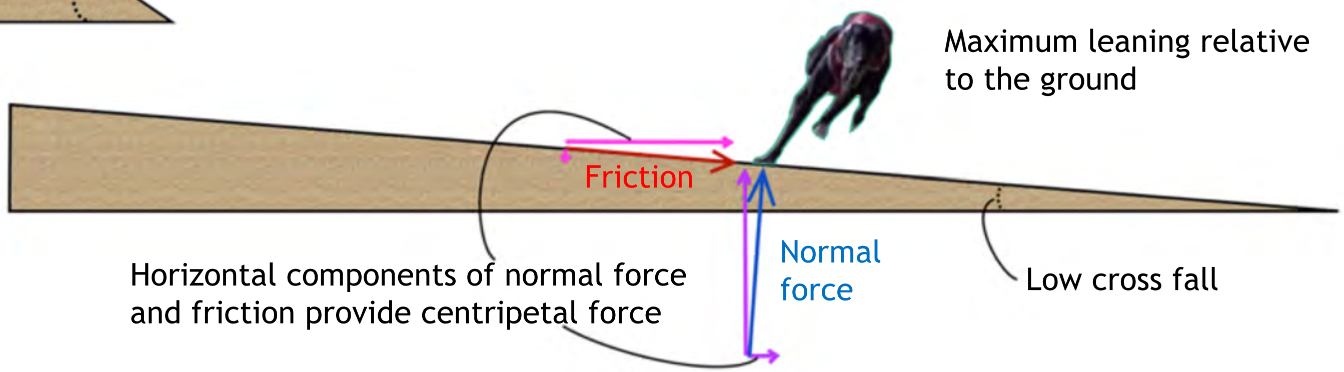


Optimum

Optimum cross falls

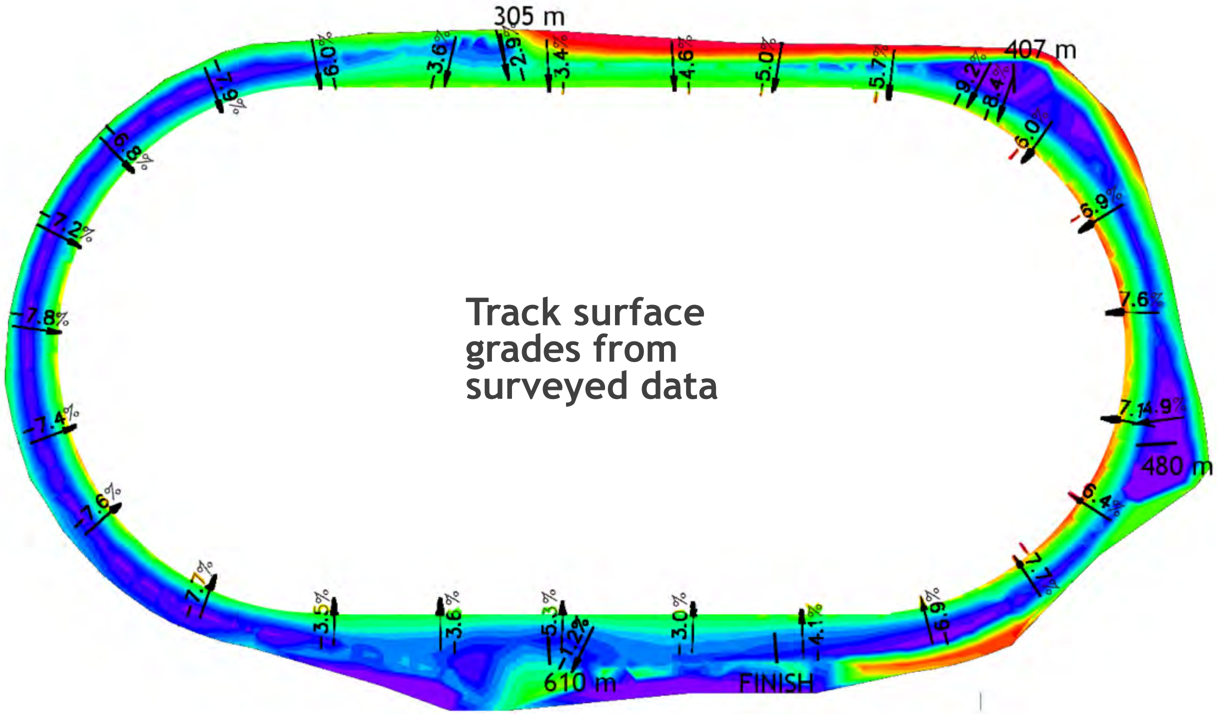
Track bend (m)	Track cross falls (%)	Track cross falls (deg.)
45	78.1	38
50	70	35
55	62.5	32
60	57.7	30
65	53.2	28
70	46.6	25

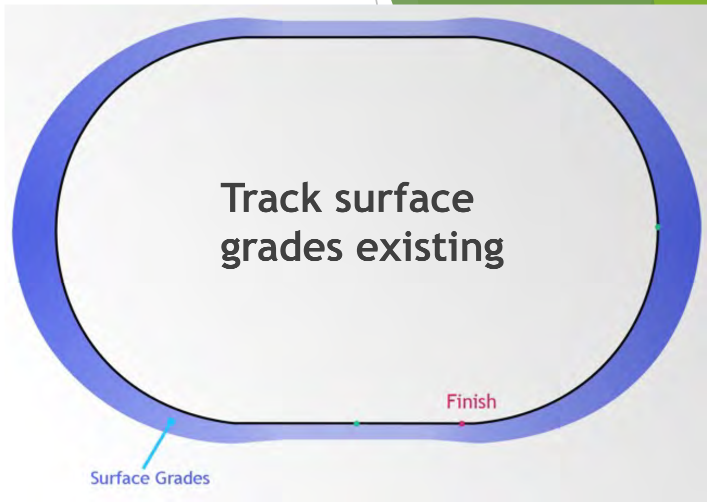
Current

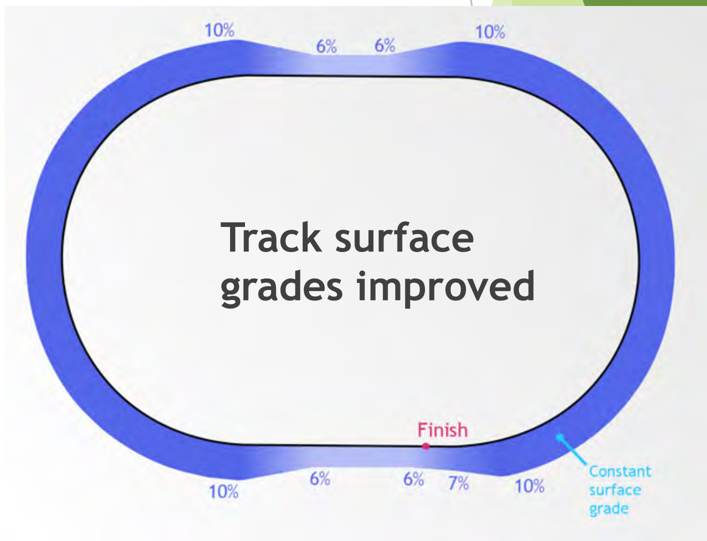


Track design investigation

What can be done for cross falls at the tracks

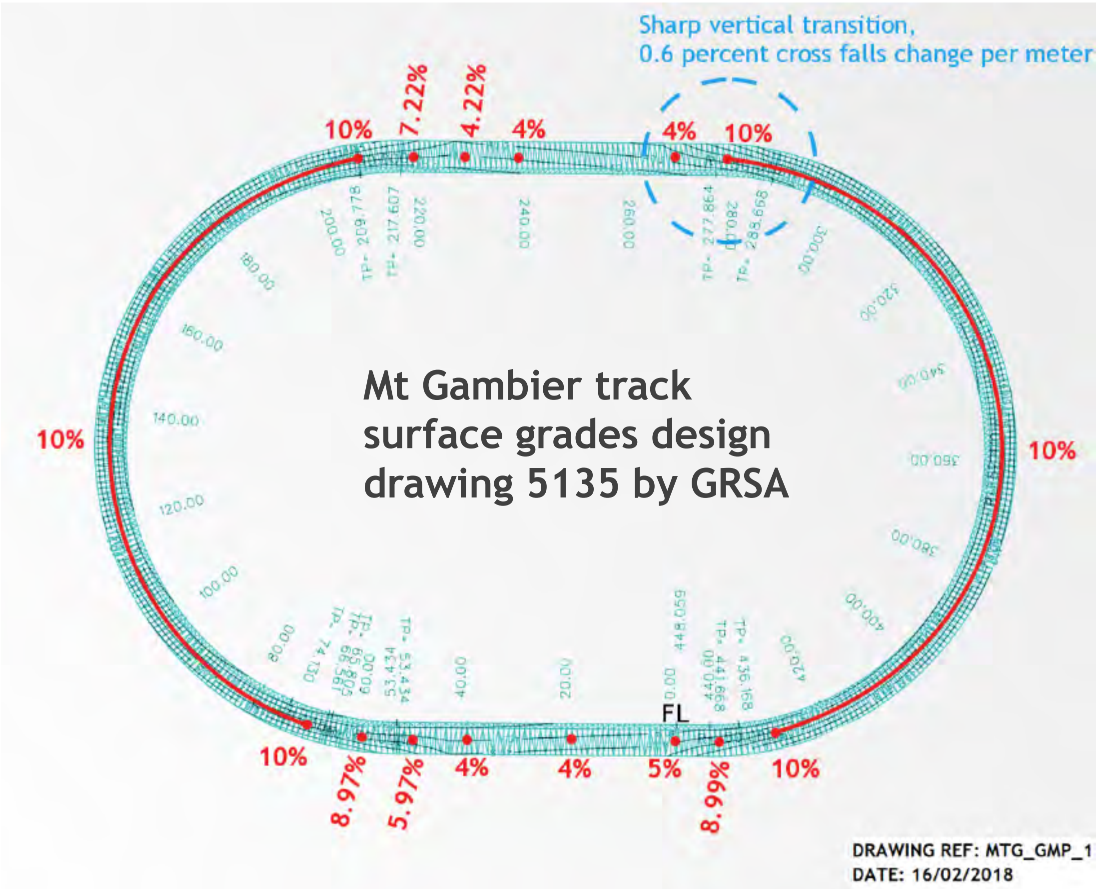


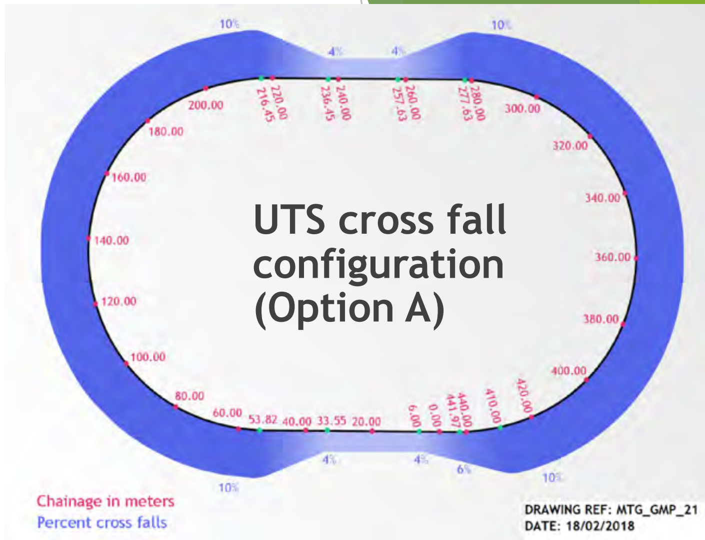


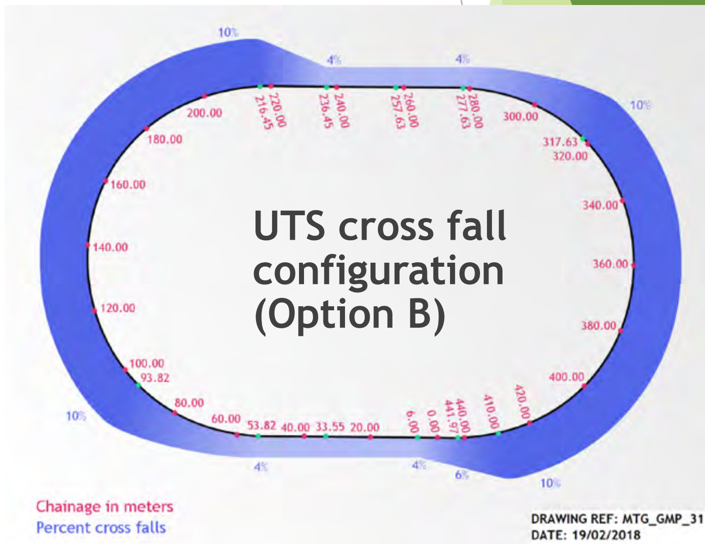


Track design investigation

What can be done for cross falls at the tracks



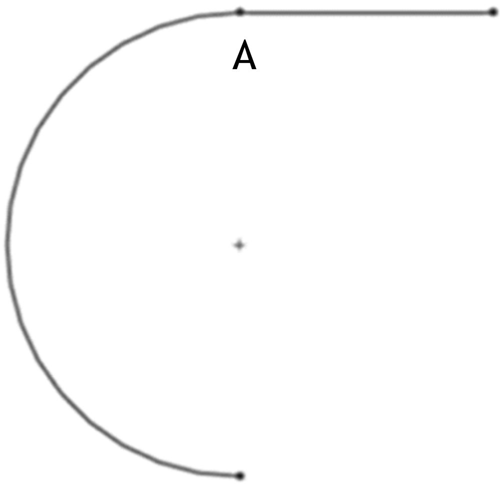




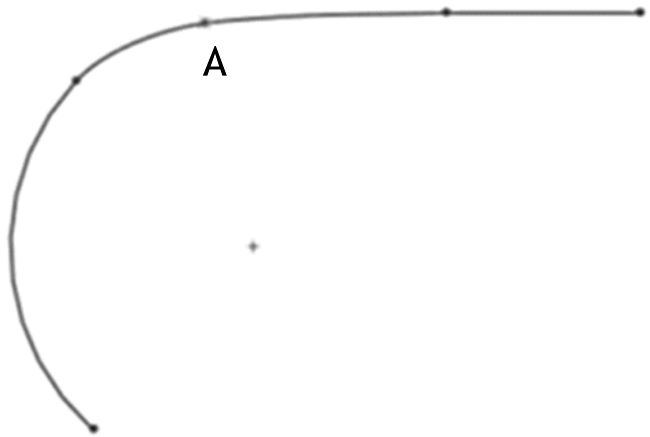
Track design investigation

Continuity of a track path

First order

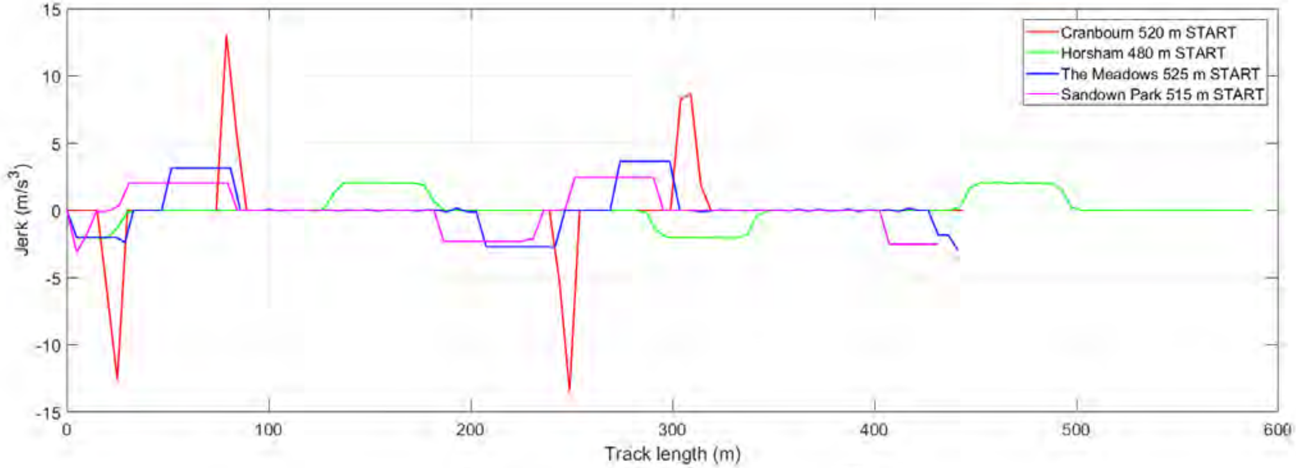


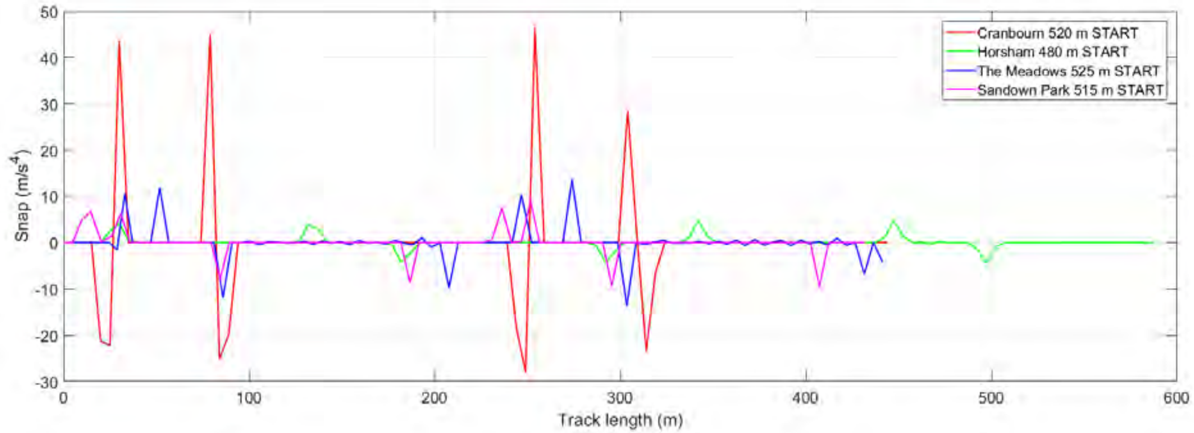
Second order



Track design investigation

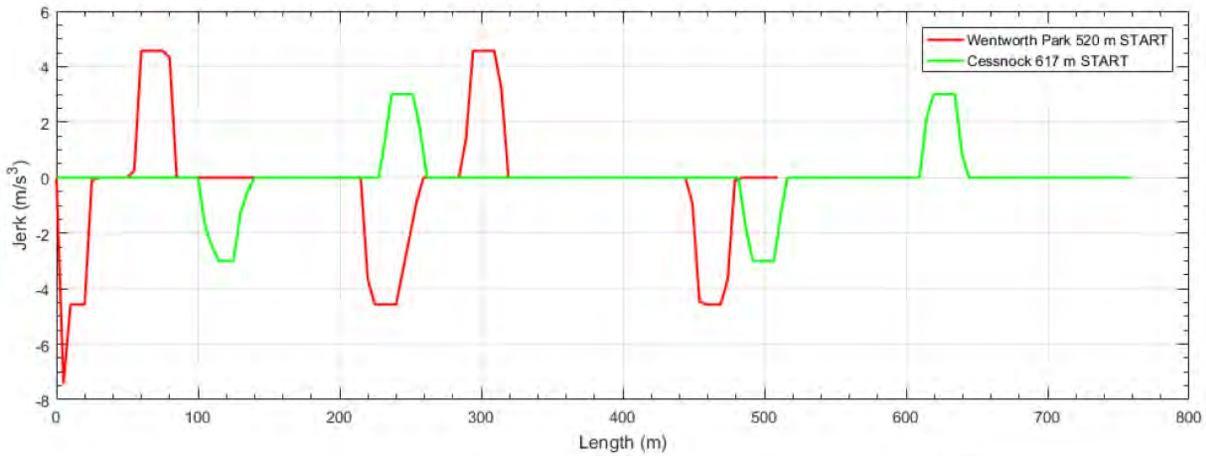
Continuity of a track path and lateral dynamics

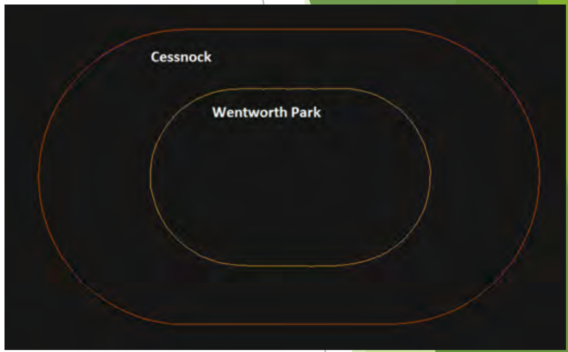




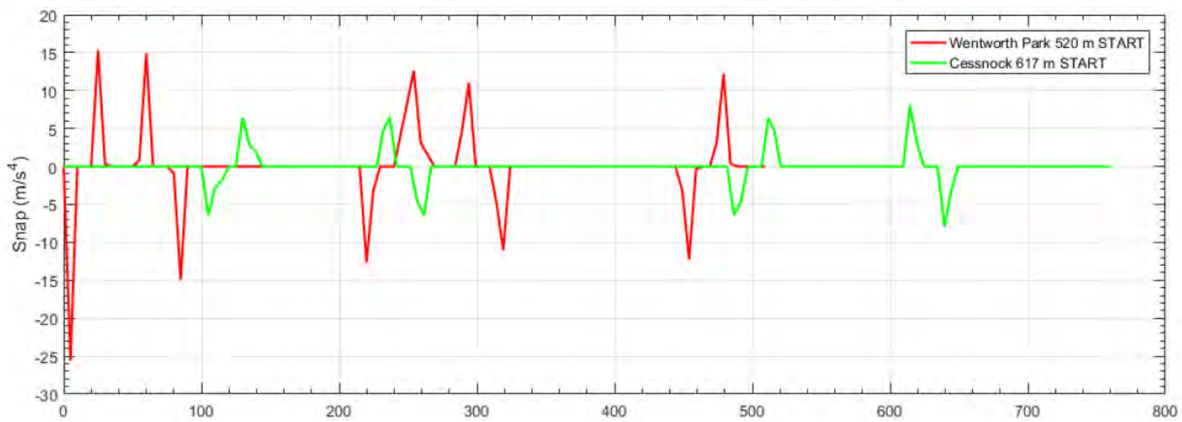
Track design investigation

Continuity of a track path and lateral dynamics



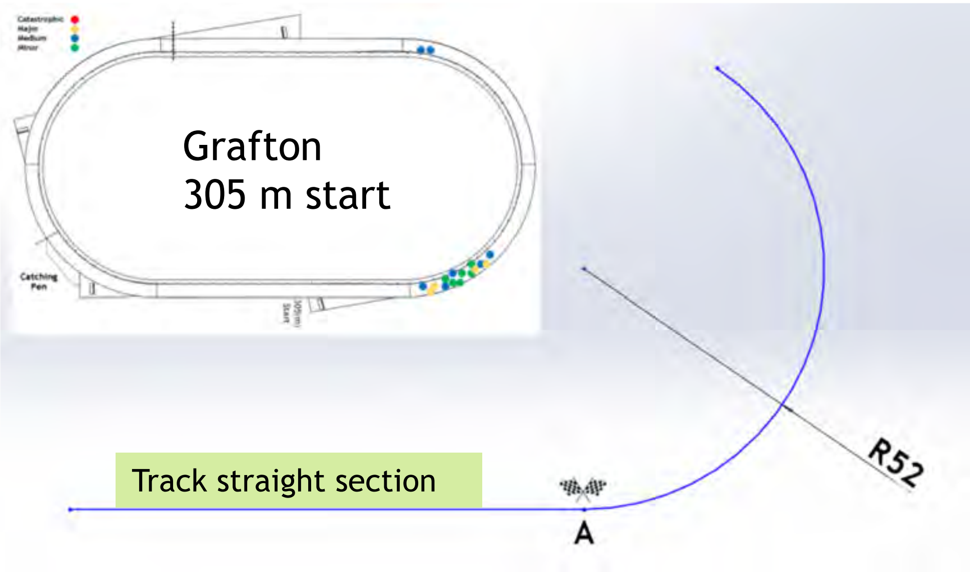


Cessnock and Wentworth Park tracks size comparison

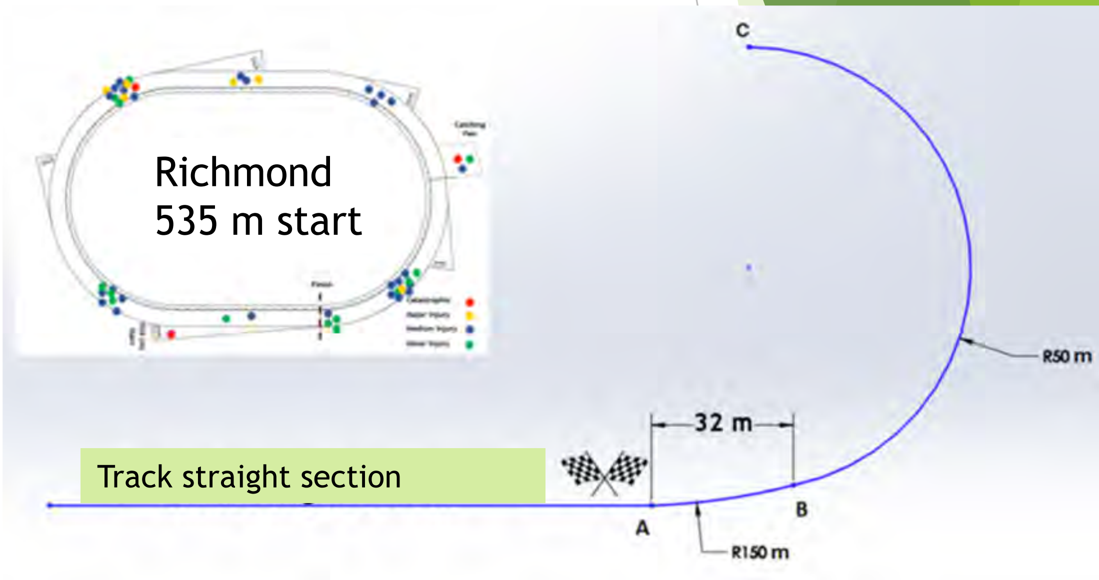


Track design investigation

Straight to bend path types in GRNSW tracks



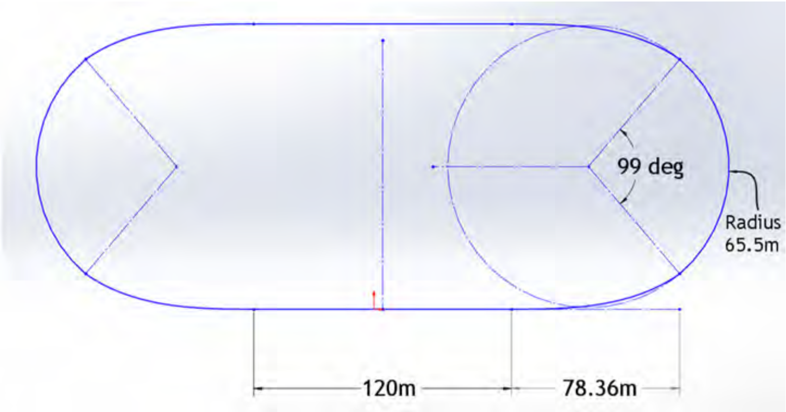
No transition (N)



Part transition (P)

Track design investigation

Straight to bend path with proper Euler transition

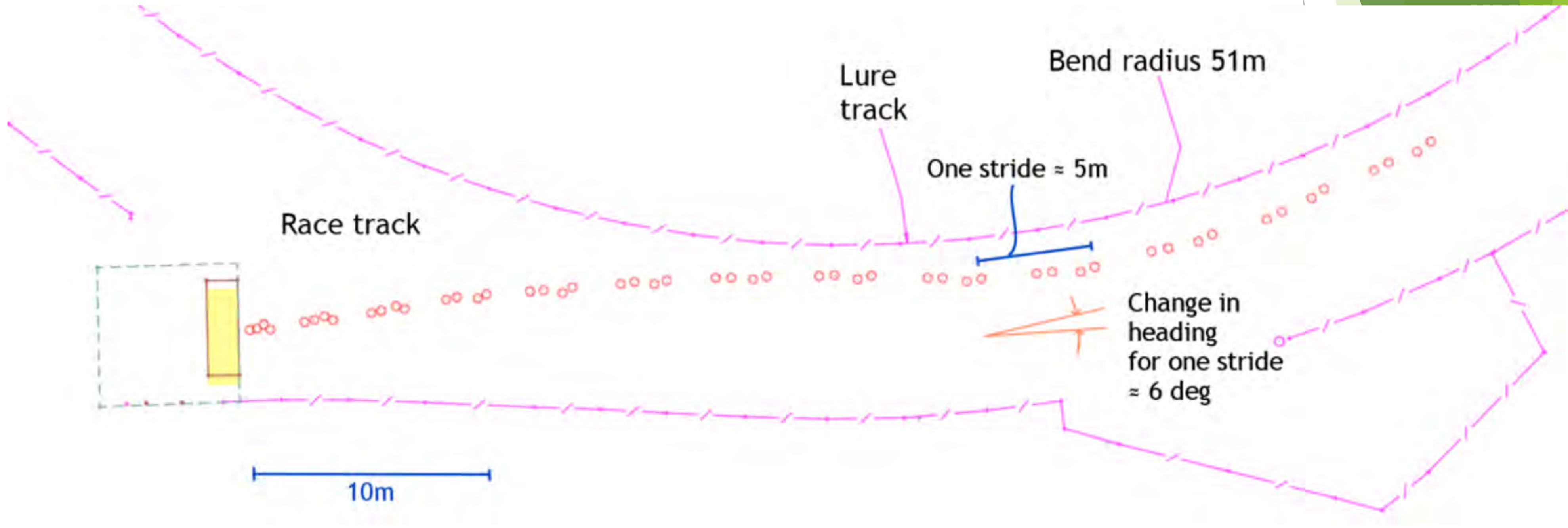


Hypothetical track design with minimal centrifugal acceleration jerk (plan view)

Greyhound run video for hypothetical track with minimal centrifugal acceleration jerk (greyhound view)

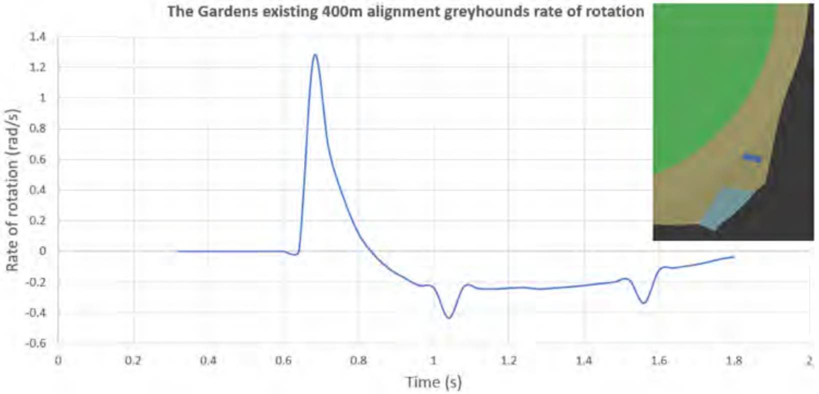
Track design investigation

Rate of rotation (yaw rate) of greyhounds for Richmond 400 m starts immediate bend

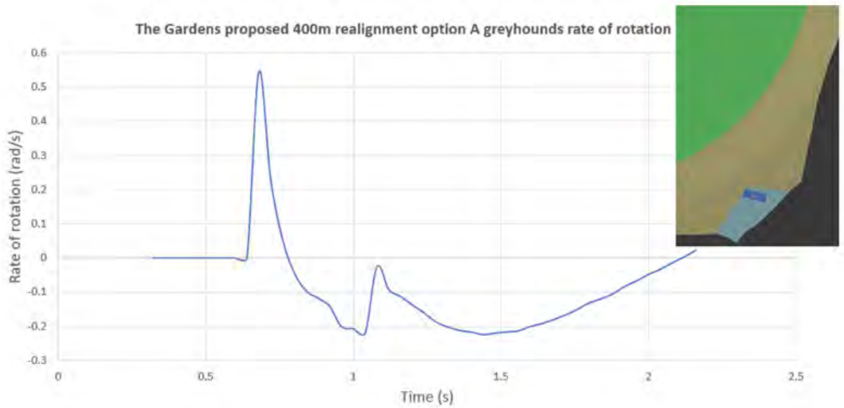


Track design investigation

The Gardens starting box alignment



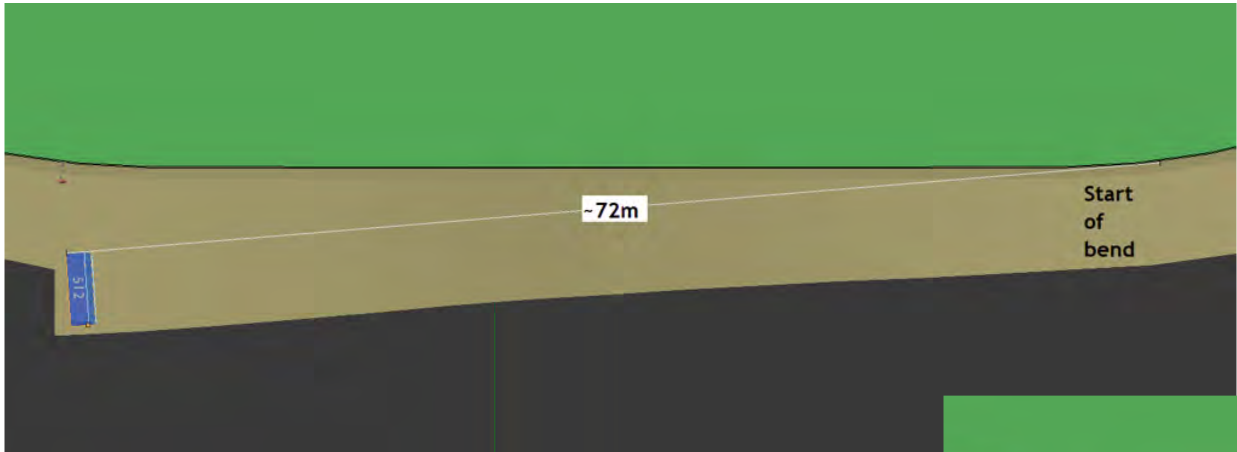
Old boxes alignment



New boxes alignment (proposed)

Starting boxes realignment options for 400 m start

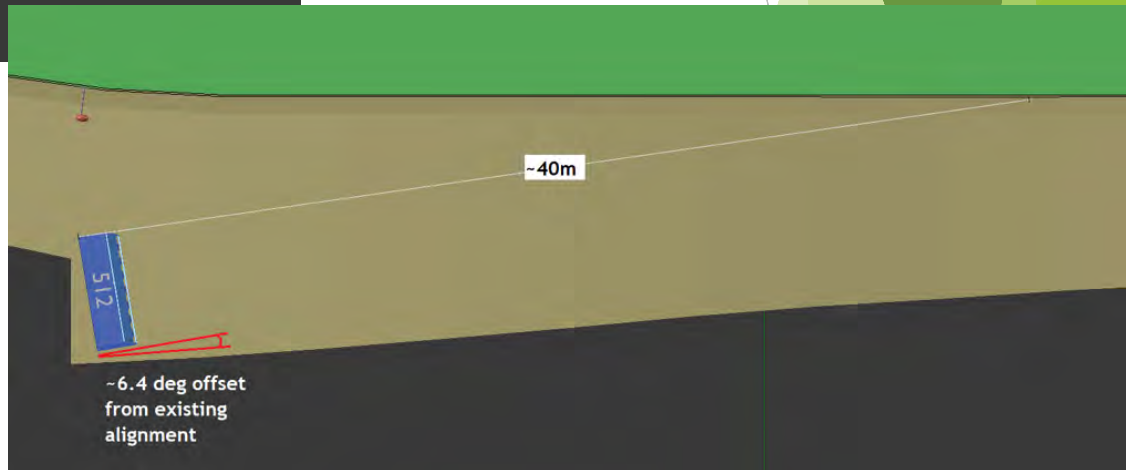
Track design investigation
Mt Gambier starting box alignment



Old boxes alignment

Maximum transitional rate of rotation

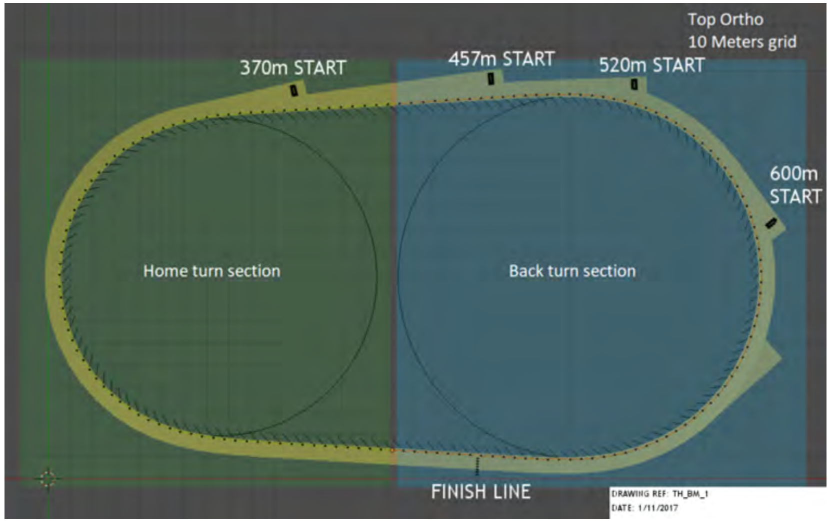
Boxes alignment for distance start	Rate of rotation (rad/s)
Existing 512 m	2.63
Improved 512 m	1.73



New improved boxes alignment

Track design investigation

Alternative design options for Tweed Heads

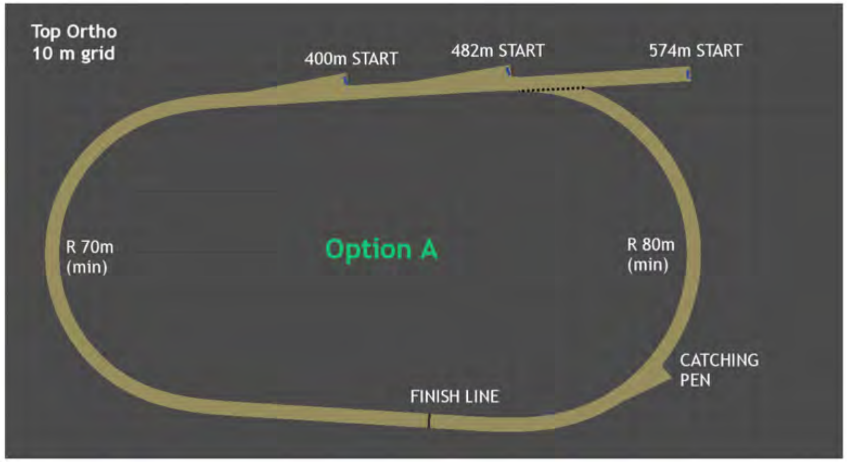


Tweed Heads track design proposed by club

Tweed Heads design developed by UTS

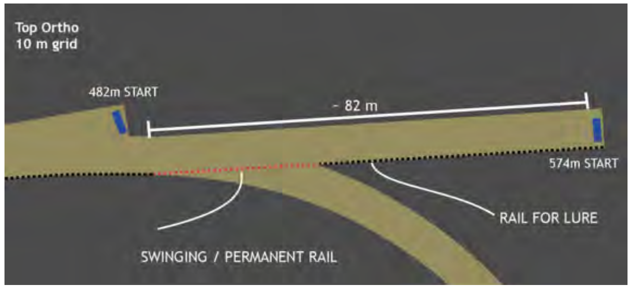
Track design	Jerk magnitude (m/s^3)
Alternative design Option C	0.42
Alternative design Option B	0.72
Alternative design Option D	1.1
Alternative design Option A	1.69
Richmond	5.5
Wentworth Park	10.5

Track design investigation
Alternative design options for Tweed Heads



Tweeds Head proposed design by UTS

Tweed Heads design developed by UTS



Tweeds Head proposed design by UTS with extended straight start

Q & A