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TASK REPRESENTATIVE STUDDED FOOTWEAR ASSESSMENT

Jim Emery
The Centre for Sports Engineering Research
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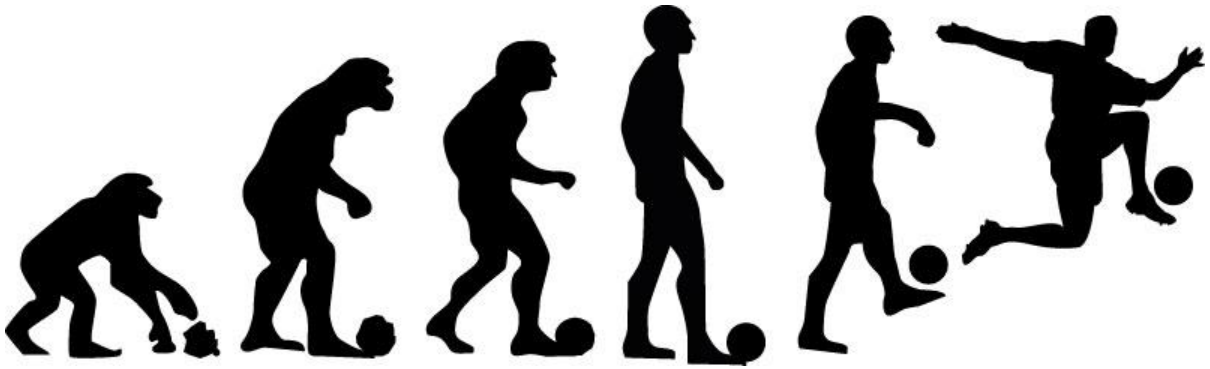
Small sided football



Sport England's Active People Survey (2014)

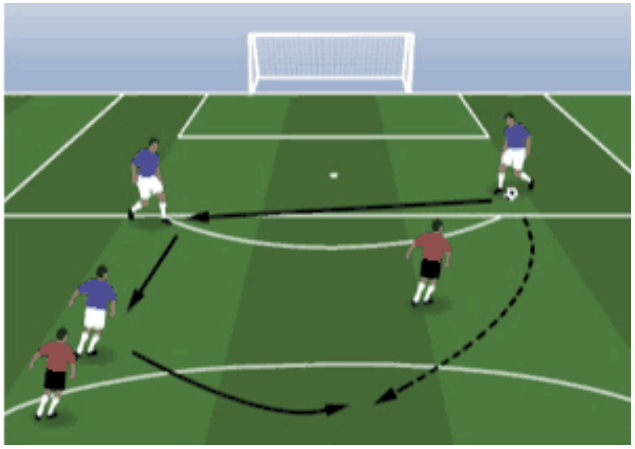
PhD aim and objectives

To design, validate, and implement a task representative studded footwear assessment tool for recreational small sided football boots (SSF)

Objectives

1. analyse the most demanding movements in recreational SSF
2. characterise the most popular SSF surfaces
3. develop a task representative simulated movement course for SSF
4. test a range of pitch relevant boots and identify differences in performance and/or movement strategies

1. SSF movement analysis



Current literature focusses on physiological & tactical demands of SSF on elite populations

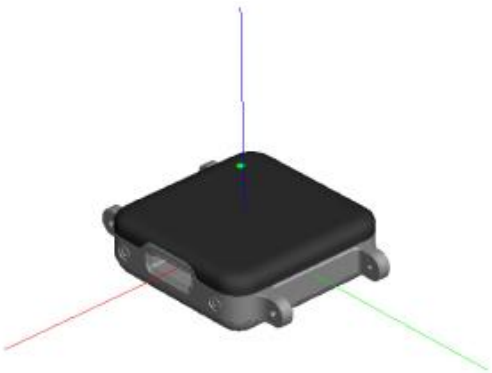
- ⇧ Exercise intensity, short passes, kicks, tackles, dribbles, goals scored and ball contacts per player
- ⇩ Blocks, interceptions, passes and receives

(Randers, 2014; Hill-Haas, 2011; Owen, 2011; Katis, 2009)

1. SSF movement analysis

'To reliably characterise horizontal plane high acceleration (HPHA) movements in recreational small sided football and establish normative movement profiles'

1. SSF movement analysis



(Opal sensors by APDM, Inc. USA)

(GoPro 3 Black Edition, GoPro, Inc. USA)

1. Inertial sensors to identify horizontal plane high accelerations

2. Video footage to manually describe the movements

1. SSF movement analysis

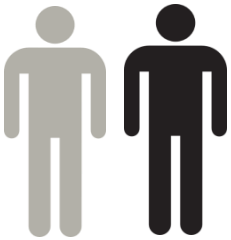
Primary movement

- Developed after a review of literature and unstructured observational analysis
- 14 Primary movements adapted from Bloomfield (2004)
- Turn detail added, on the ball activity described in movement terms.

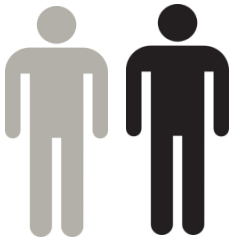
Modifiers

- Movement modifiers add extra descriptive detail to the primary movements
- 21 movement modifiers in six groups

1. SSF movement analysis



Experienced football players



Experienced football analysts

CAM1 (FRAMES)	CAM2 (FRAMES)	Possesion	Primary Movement	
26035	43400	Yes	Run	Fo
26058	43437	No		
30934	51573		Jump	
31296	52176		Land	
31313	52205		Stop	
31328	52230		Impact	
31354	52274		Swerve	
31358	52279		Turn_twist	
31363	52289		Side_cut	
			Crossover_cut	

CAM1 (FRAMES)	CAM2 (FRAMES)	Possesion	Primary Movement	
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1. SSF movement analysis

Cohen's Kappa statistic was used to quantify agreement

A Kappa value of 1 indicates perfect agreement and a kappa of 0 indicates agreement equivalent to chance

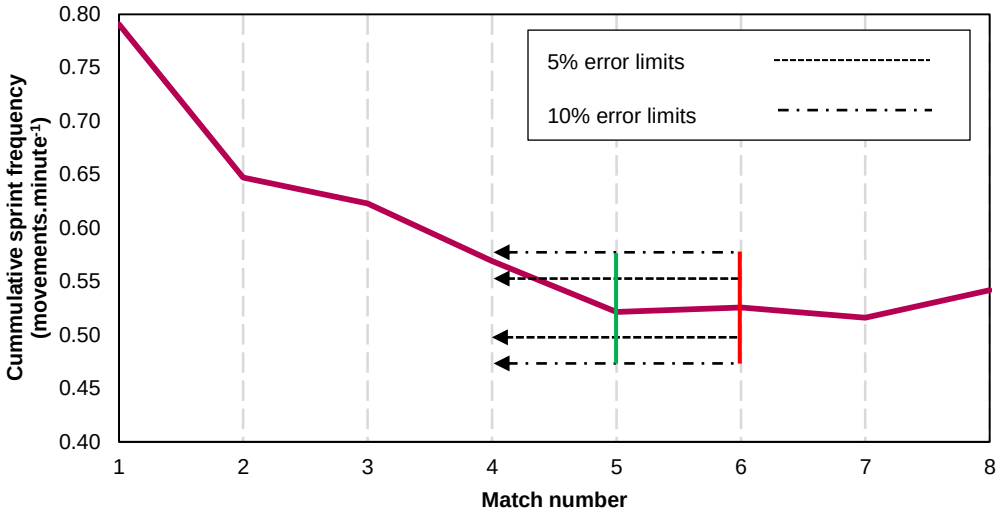
	Primary Movement		Modifier	
Between players	0.369 ($p<0.001$)	Fair agreement	0.416 ($p<0.001$)	Moderate agreement
Between analysts	0.603 ($p<0.001$)	Substantial agreement	0.605 ($p<0.001$)	Substantial agreement
Within analysts	0.638 ($p<0.001$)	Substantial agreement	0.612 ($p<0.001$)	Substantial agreement

Limits of agreement defined by Altman (1991)

1. SSF movement analysis

- Highest performing team in a local league (mean age ± SD 17.8 ± 0.26 years)
- Played or trained more than twice per week for a minimum of five years
- 12 matches were filmed over a season and 5 players were instrumented in each match

Limits of error for establishing normative profiles were set at 5% of the cumulative mean



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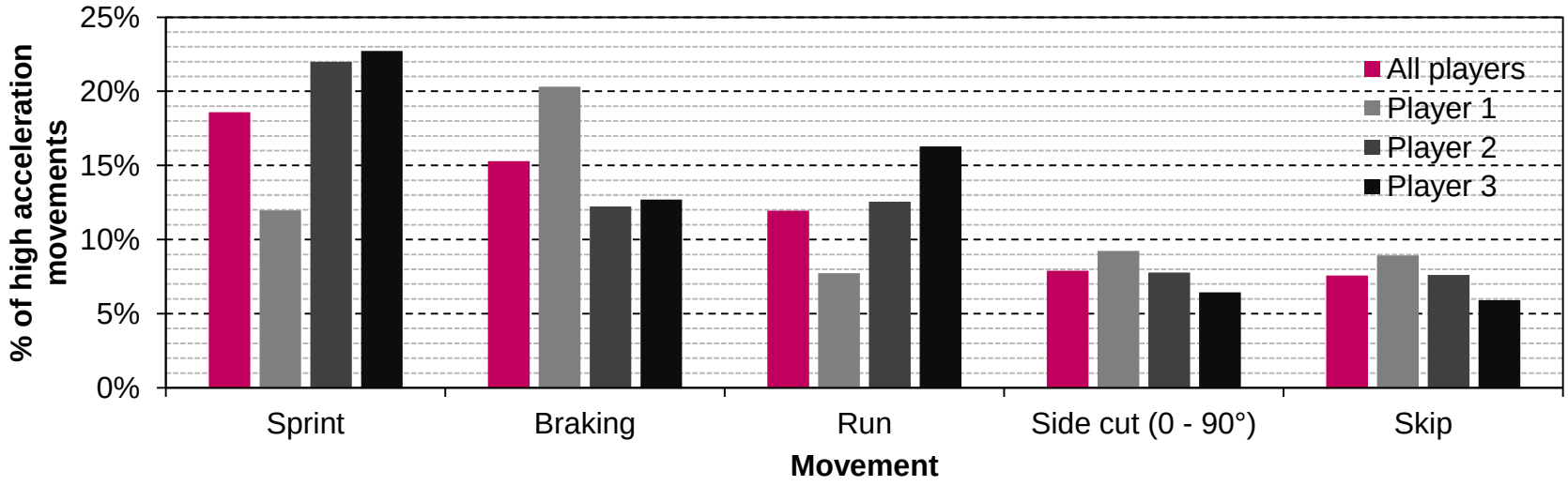
1. SSF movement analysis

A total of 1824 high acceleration movements were characterised during 450 minutes of match play



The percentages differ in prevalence and rank order between players

1. SSF movement analysis

Study Conclusions

- Presents a reliable method for characterising the high acceleration movements performed in small sided football

- Time effective alternative to the BMC, taking 8 minutes to analyse one minute of footage (7.5 times faster than the BMC)

- Presents initial insight into the movements that characterise recreational small sided football and suggests that players have different playing styles

- Provides acceleration profiles for movement types (e.g. side-cut, crossover cut etc.) which allows validation of simulated movement tasks

1. SSF Movement analysis

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11th conference of the International Sports Engineering Association, ISEA 2016

A method for characterizing high acceleration movements in small-sided football

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Abstract

Small sided football is the most popular area of adult football in the UK, with an estimated 1.5m adults playing every week. Matches are played on smaller pitches using different rules to the 11-a-side game; this results in less stoppage time and a higher volume of ball activity per player. Despite these established differences in playing style and the increase in participation, the types and frequencies of movements performed are not fully understood due to the time consuming nature of current notational analysis methods.

Understanding movements is of particular interest to researchers and developers seeking task representative protocols and products for small sided football. The importance of movement type, specifically those with high horizontal plane accelerations, has been demonstrated by recent findings linking traction and shoe stiffness to injury and performance in a number of team sports.

2. SSF pitch quality

Current literature focusses on municipal, institutional or elite surfaces

Rapid expansion in the number of centres offering SSF leagues

No regulations despite the Football Association's new accreditation scheme

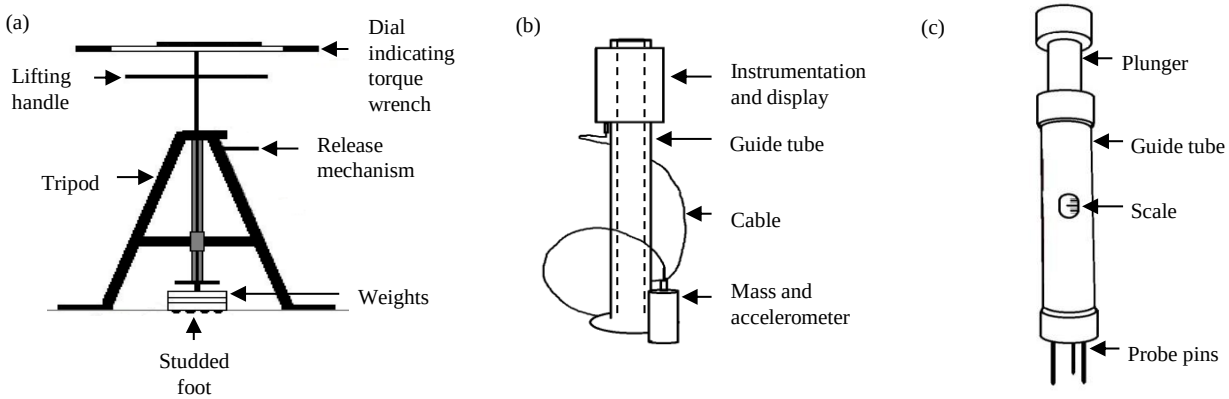
Difficult to relate to acute injury, however, links between surface variance and acute injuries have been suggested

(Meyers, 2004; Flemming, 2011; Wannop, 2012; Hopper, 2014; Twomey, 2014)

2. SSF pitch quality

'To reliably characterise pitch quality at commercial small sided football centres in northern England using portable and accessible methods'

2. SSF pitch quality



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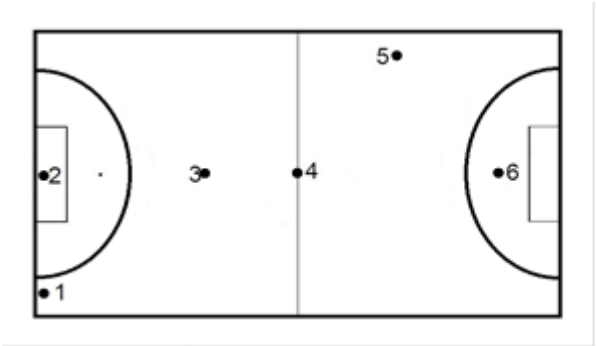
2. SSF pitch quality

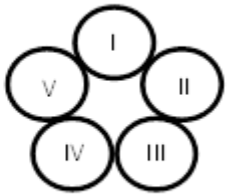
Test methods;

- FIFA rotational traction test device to quantify traction
- Clegg Hammer (0.5 kg, 600 mm drop height) to quantify surface compliance
- Infill depth probe to quantify infill distribution and compaction

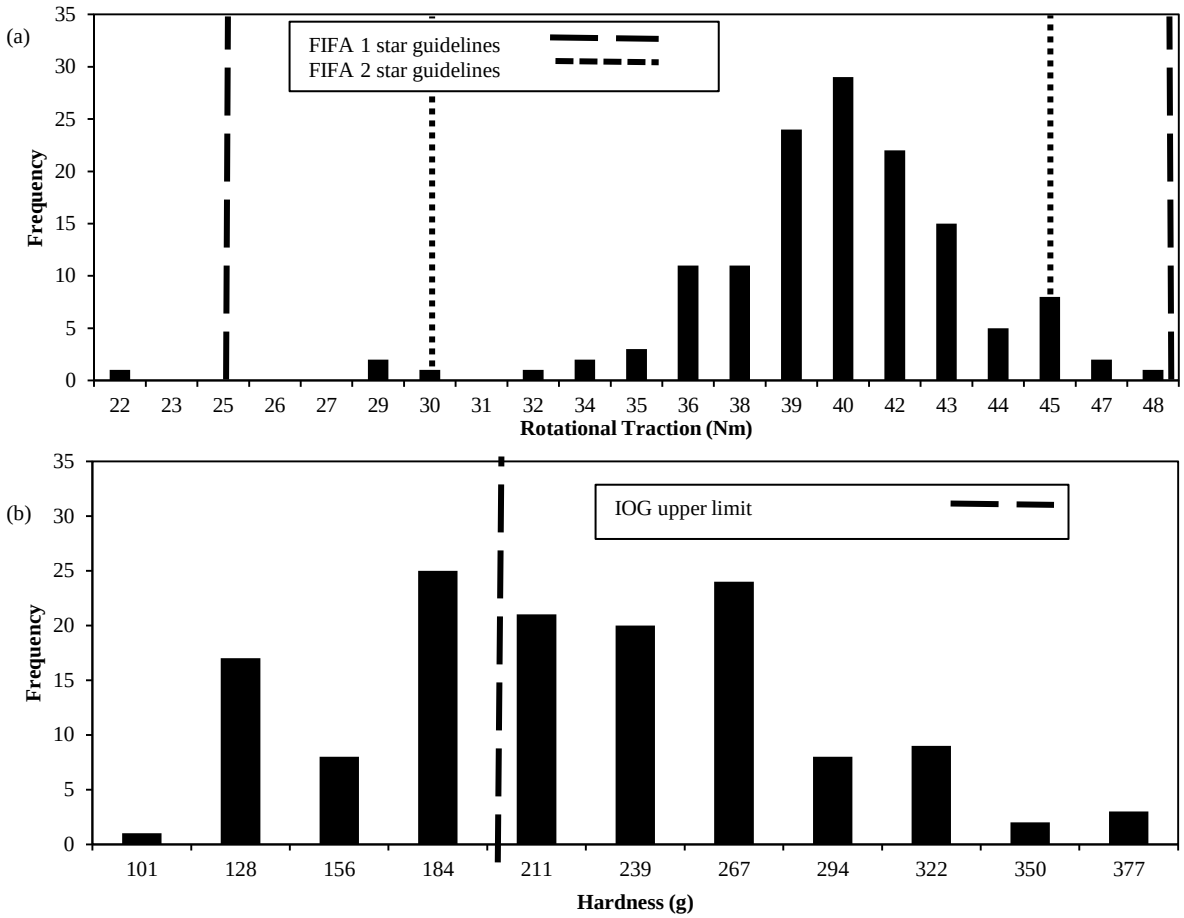
The test locations on each pitch followed FIFA guidelines

Clegg Hammer and rotational traction tests were performed 5 times at each test location, the mean of these results are presented





2. SSF pitch quality



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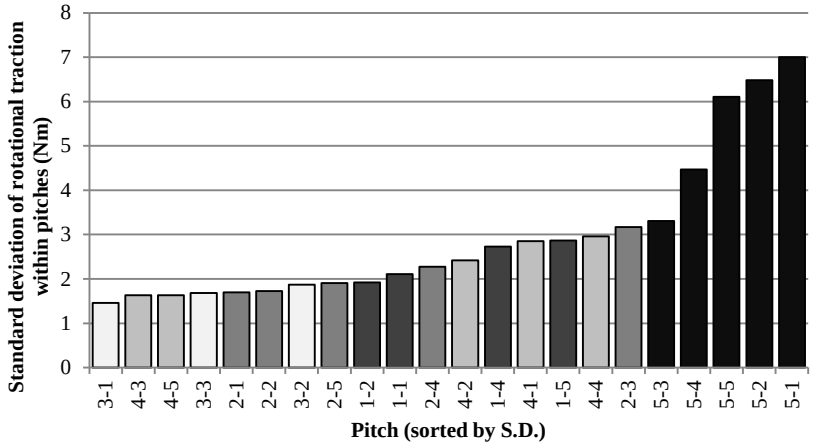
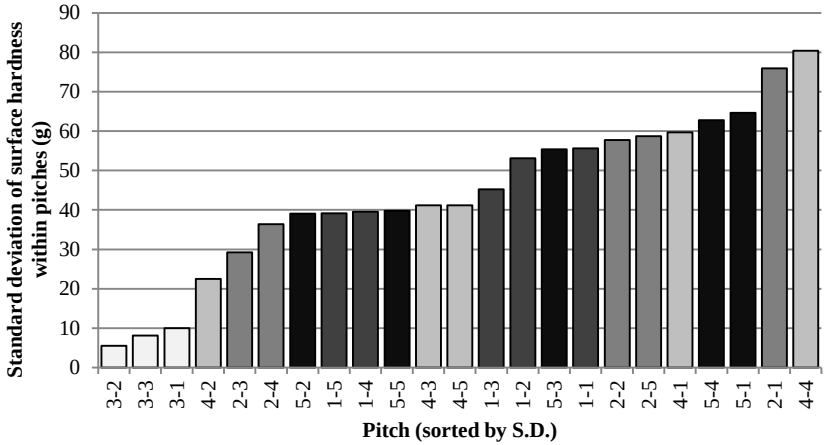
2. SSF pitch quality



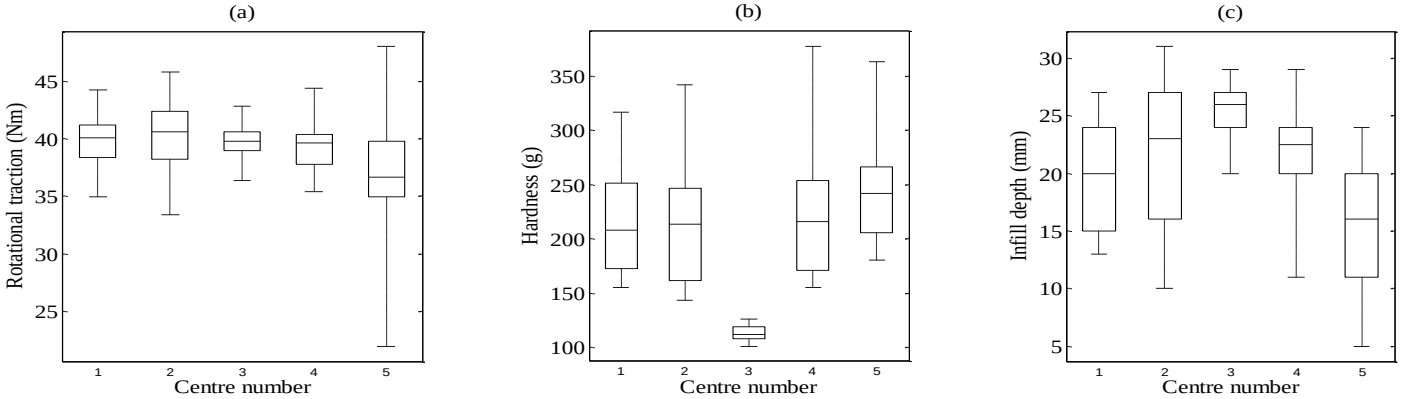


Standard deviation of measures of each pitch (football centre - pitch) sorted from smallest to largest; (a) rotational traction, (b) hardness

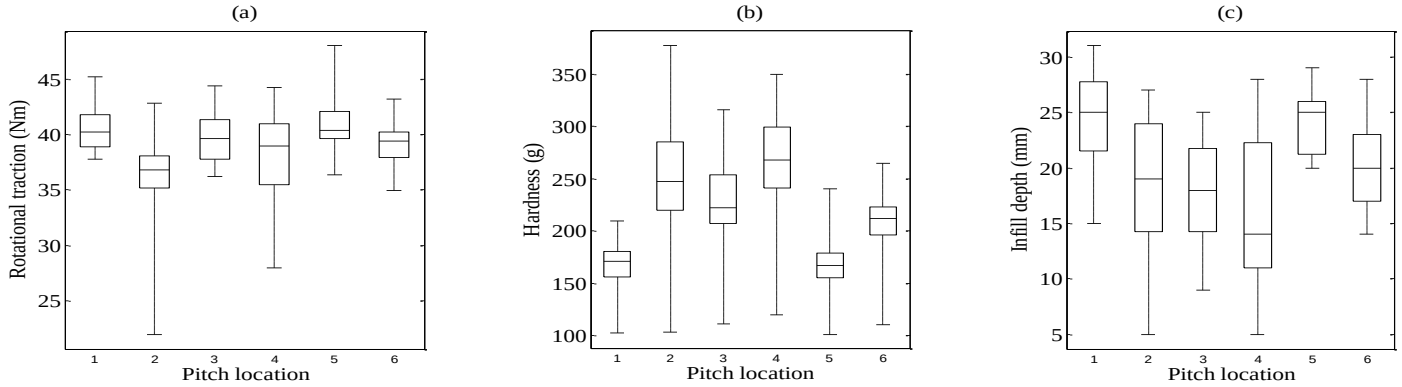
Variance within pitches is large in some cases and more prevalent at particular football centres.

This high variance of traction and hardness may increase injury risk due to the unpredictable and inconsistent surface response (Wannop et al. 2012, Hopper at al. 2014).

2. SSF pitch quality



Surface measures with respect to commercial football centre number; (a) rotational traction, (b) hardness, (c) infill depth



Surface measures with respect to pitch location; (a) rotational traction, (b) hardness, (c) infill depth

2. SSF pitch quality

Study Conclusions

- Large variance in traction and hardness across centres and pitches
- Maintenance procedures are minimal to non-existent at some centres
- The variance in traction and hardness across recreational pitches suggests that footwear research and development should focus on producing adaptable boots for these inconsistent surfaces

2. SSF pitch quality

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11th conference of the International Sports Engineering Association, ISEA 2016

Third generation artificial pitch quality in commercial football centers

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Abstract

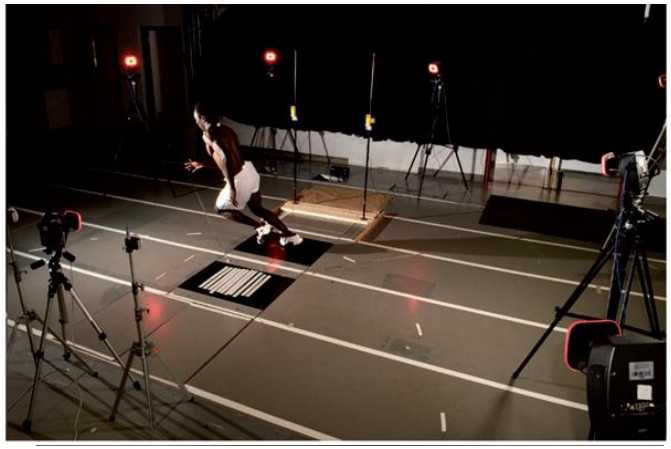
Small sided football is the most popular and fastest growing area of adult football in the UK with an estimated 1.5m adults playing every week. The sport's popularity has led to an influx of commercial football centers offering organized 5, 6 and 7-a-side leagues on third generation artificial pitches.

The range of quality and maintenance of these pitches is not fully understood despite the established links between surface quality, player performance and injury. Currently researchers and manufacturers use national governing body standards as guidelines for quality; however, many commercial centers are not approved by governing bodies and therefore are not obliged to meet these criteria.

In this paper we characterize the quality of 23 pitches at five, UK based, commercial football centers using portable, low cost methods including; the FIFA rotational resistance test, the Clegg Impact Hammer and an infill depth probe. This paper describes the range of qualities observed, alongside maintenance procedures and usage statistics.

To the authors knowledge this is the first study that characterizes commercial football center pitches. Twenty-two of the 23 pitches met the FIFA 1 star guidelines for rotational resistance (25 - 50 Nm), however, mean Clegg Impact Hammer readings are high (208 G), suggesting surface compliance in commercial centers falls outside FIFA standards. Within pitch variance was common at all centers and was an order of

3. Simulated movement course



Current research uses grossly simplified, often isolated, movements which are abstracted from real match play

- Simplified movements are recommended to elicit performance differences
- Surface compliance found to influence sprints, whereas traction is reportedly effects turning movements - both must be included in a task representative footwear assessment course

(Sterzing, 2009; Luo, 2011; McGhie, 2013; Schrier, 2014)

3. Simulated movement course

To design a studded footwear assessment course which represents the high acceleration movement demands of match play, as measured in study one

Objectives:

1. Feasibility study
2. Preliminary designs
3. Detailed design
4. Compare reactive vs. non-reactive movement constraints on movement similarity using notational analysis
5. Compare simulated movement acceleration magnitudes to those measured in match play
6. Quantify the reliability of the final design

3. Simulated movement course

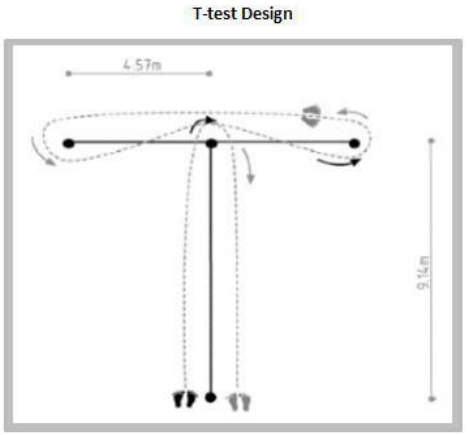
3.1. Feasibility study

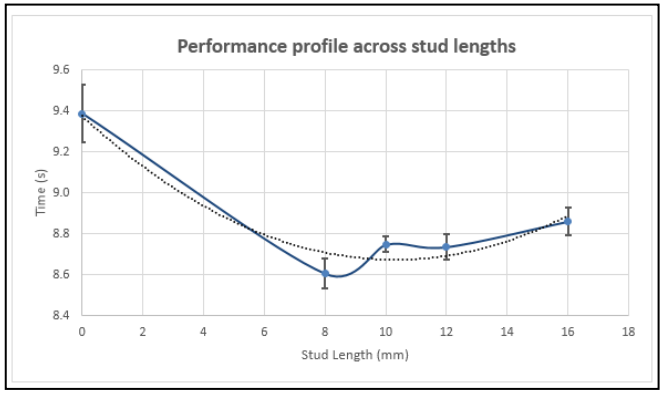
1) course design and participant selection

2) course reliability and sensitivity

3) footwear testing

- *Five footwear conditions achieved by grinding screw in studs*
- *One participant*
- *Seven repeats*





3. Simulated movement course

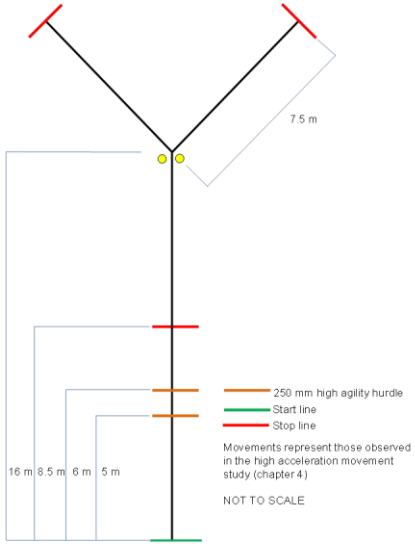
3.2. Preliminary designs

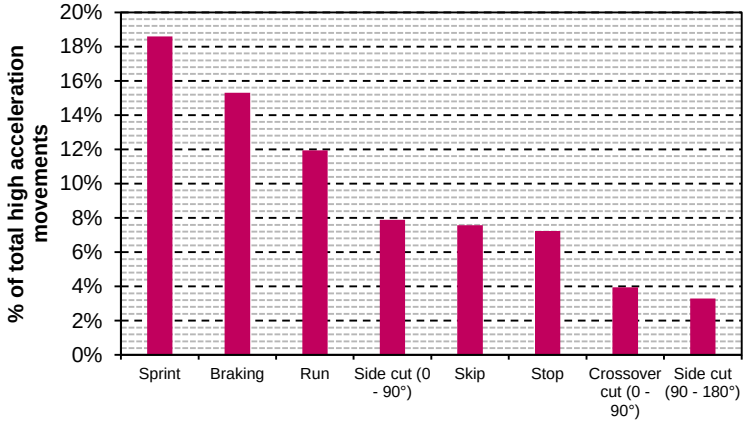
1) Courses designed with movement analysis data

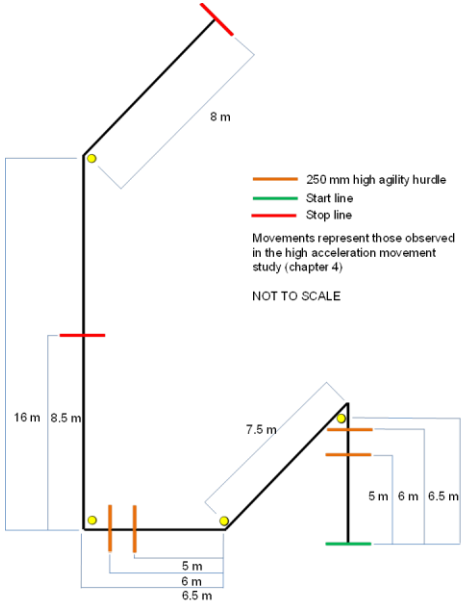
2) Piloted for repeatability and sensitivity

3) Initial player feedback was negative

4) Players unable to complete course two







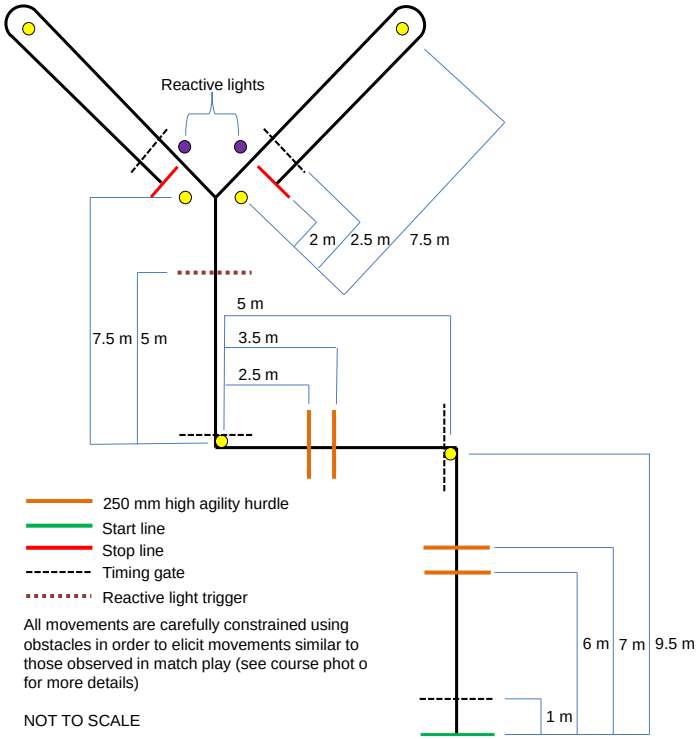
3. Simulated movement course

3.3. Detailed design

1) Task constraints modified to improve movement representation

2) Pilot tests revealed:

- *improved reliability and footwear sensitivity*
- *improved player feedback*



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3. Simulated movement course

3.4. Reactive vs. non-reactive

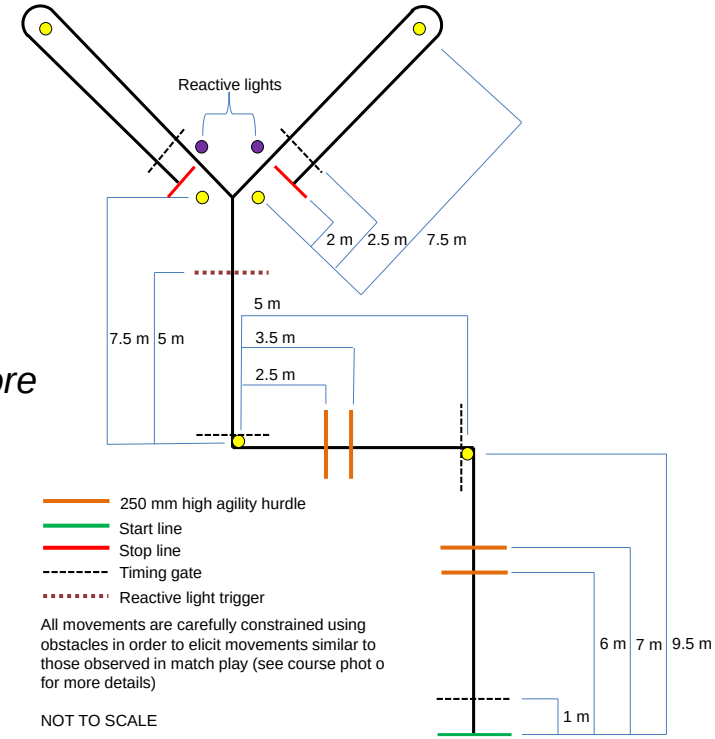
1) *Effect of reactive course element investigated:*

- *horizontal plane acceleration magnitudes compared*
- *movement classification compared using three experienced analysts*

2) No significant differences in acceleration maxima

3) Reactive movements were classified correctly 65% more often using reactive course

(kappa 0.83 (p<0.001) substantial agreement)

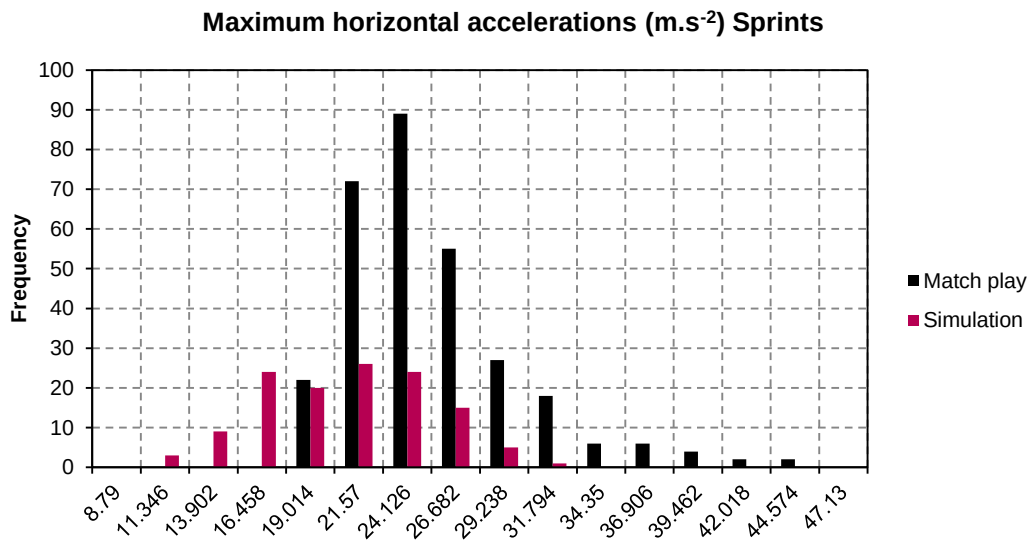


3. Simulated movement course

3.5. Simulated vs. match play acceleration profiles

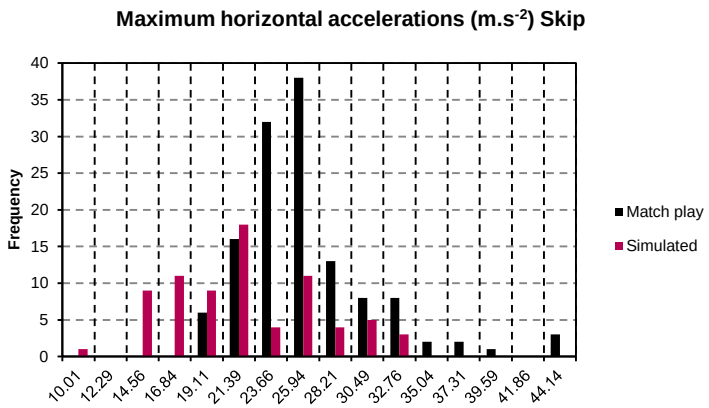
1) Match play acceleration distributions were non parametric. The high acceleration threshold resulted in a positive skew in all distributions

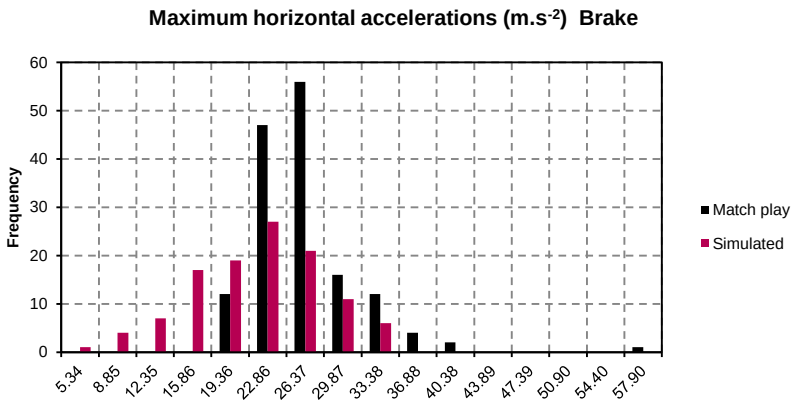
2) Positive skew in match play data due to acceleration threshold prohibited the use of statistical tests

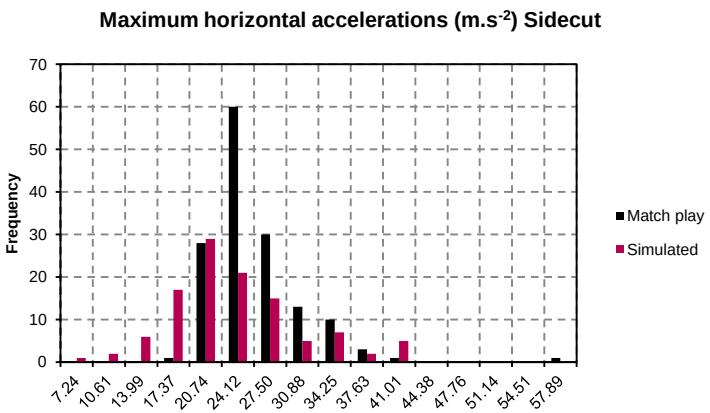


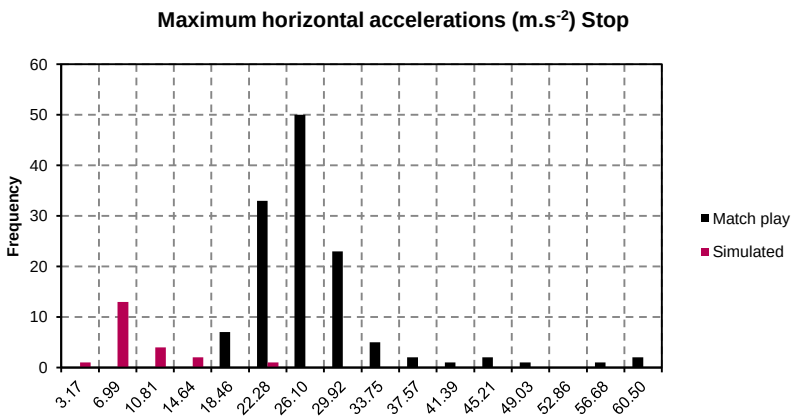
3. Simulated movement course

3.5. Simulated vs. match play acceleration profiles





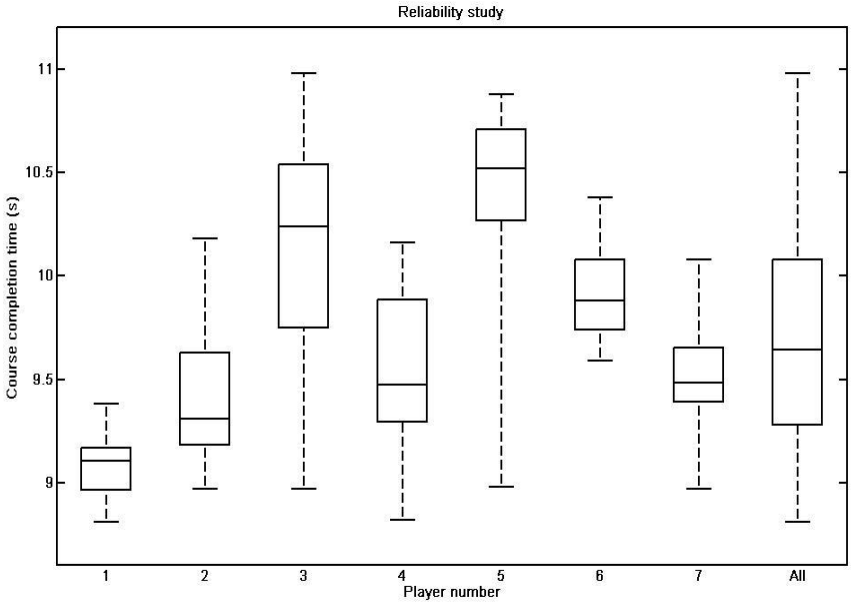




3. Simulated movement course

3.6. Course reliability

- *Ten players recruited - 30% attrition*
- *Own footwear*
- *Two sessions*
- *Controlled warm-up*
- *Ten trials per session*
- *Most consistent five players invited to footwear intervention*



3. Simulated movement course

Study Conclusions

- The only empirically justified footwear test course in the literature
- Course movements proportionally represent those observed in match play
- The horizontal plane accelerations elicited are similar to those measured during match play
- Five most consistent participants were selected for footwear intervention

4. Footwear intervention

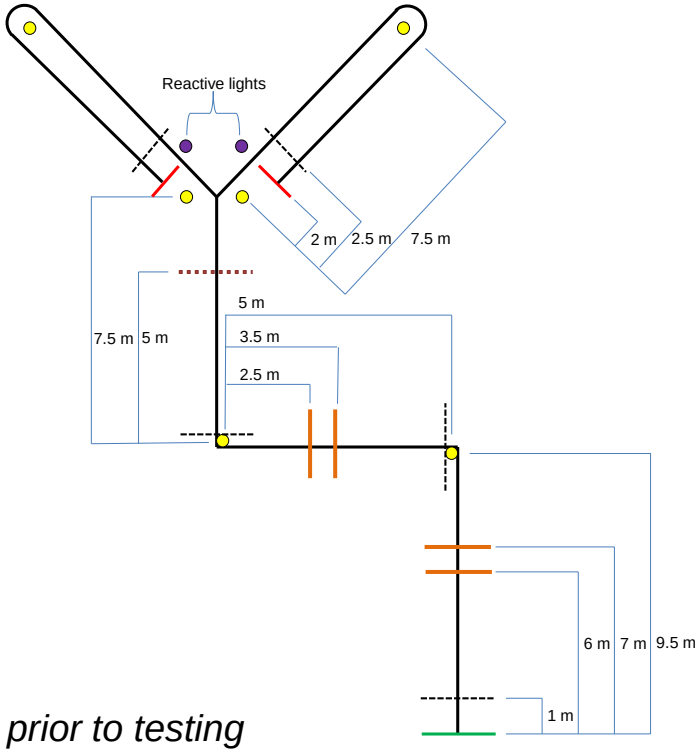
To determine the effect of three pitch relevant boots on recreational small sided football player performance

- Task representative movement course
- Course completion time and adaptation metrics used as key performance indicators
- Surface mapped and found to be representative of commercial football centre surfaces

4. Footwear intervention

Protocol

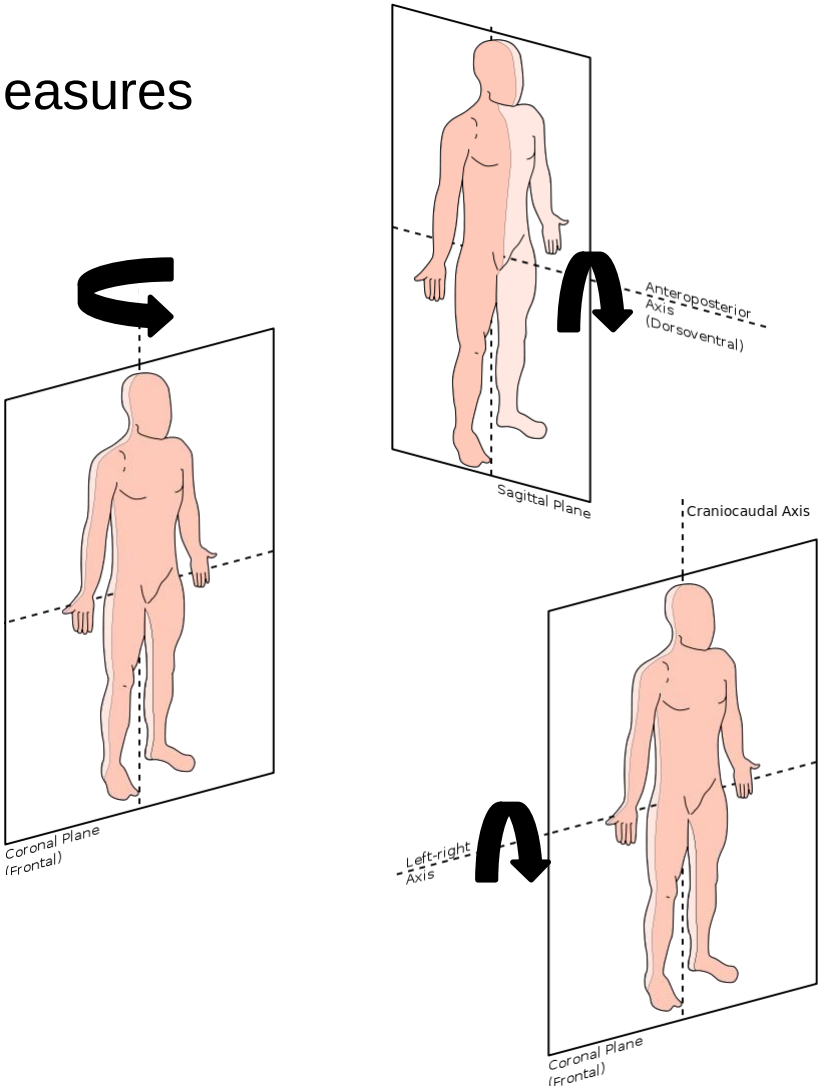
- *Five players*
- *Three footwear conditions*
- *Six trials per boot*
- *Controlled warm-up*
- *Minimum of two minutes rest between trials*
- *Footwear and reactive direction randomised*
- *Players asked to wear all three boots in the two weeks prior to testing*



4. Footwear intervention

Performance measures

- *Course completion times (light gates)*
- *Sector completion times (video footage)*
- *Peak horizontal plane acceleration*
- *Cadence*
- *Lean angle (medio-lateral & antero-posterior)*
- *Angular velocity about gravitational axis*



4. Footwear intervention

Results, discussion and conclusion are confidential. For further information please contact Jim Emery - j.emery@shu.ac.uk