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Validation of a method to assess offside technologies in dynamic movement

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Validation of a method to assess offside technologies in dynamic movement

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Background

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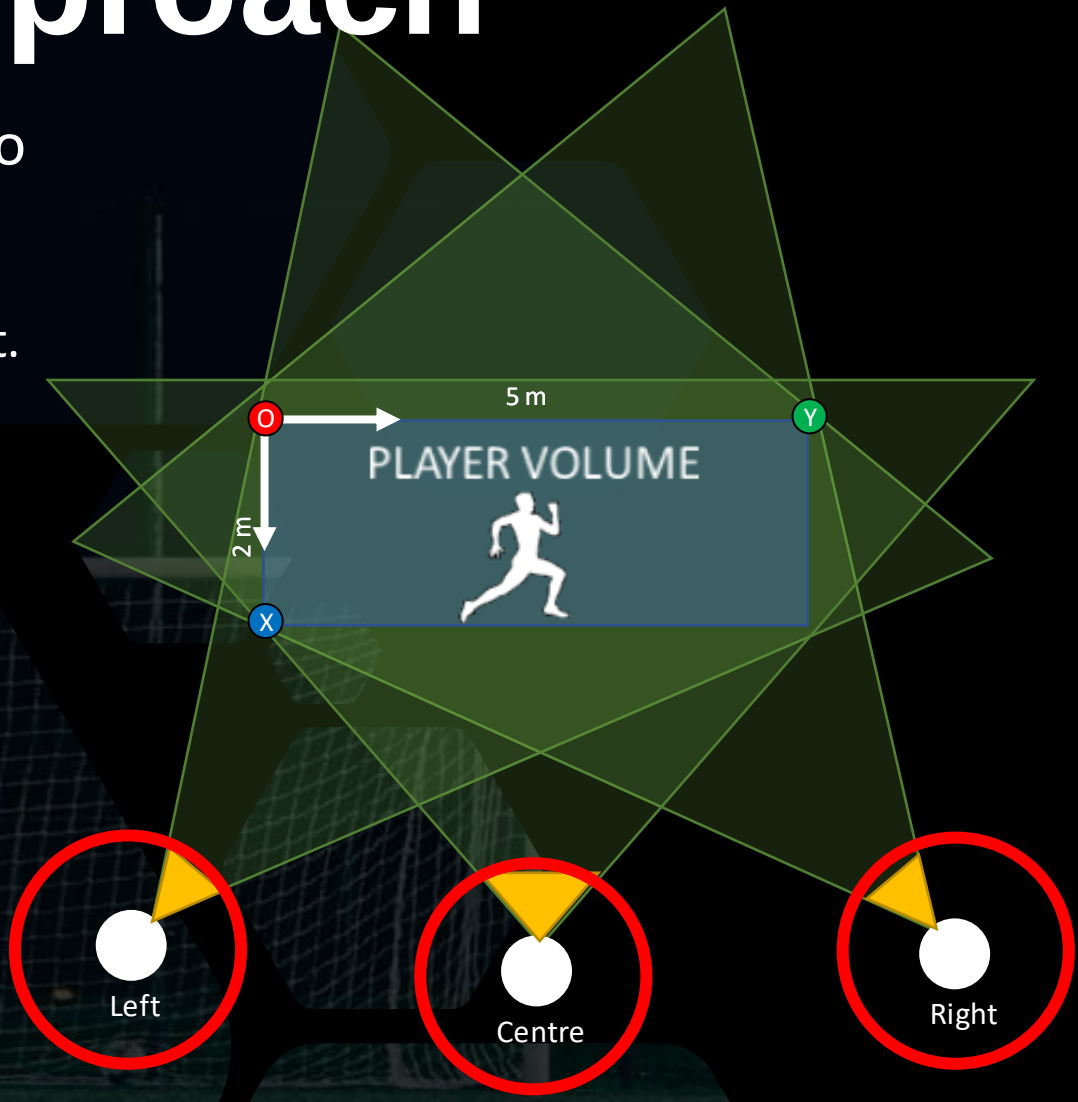
Proposed approach

- Accessible, high-speed video (HSV) approach to determine:
  - Instant of offside event.
  - Position of offside event during dynamic movement.

- Assessments:
  - Number of identifiable events.
  - Three-dimensional body marker accuracy.

- Considerations:
  - Large (20 m^3) player volume, camera pairings (LC, CR and LR).



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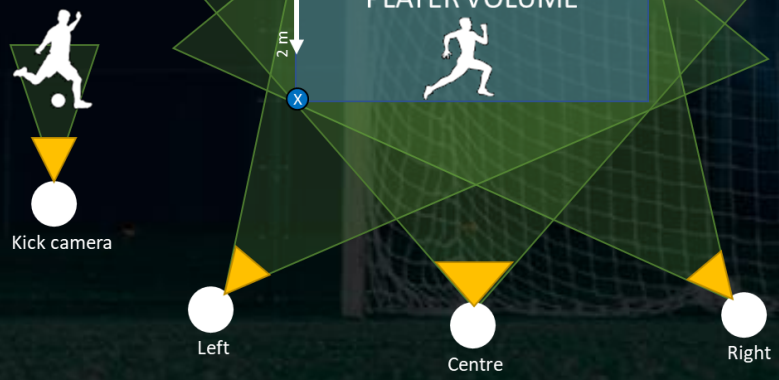
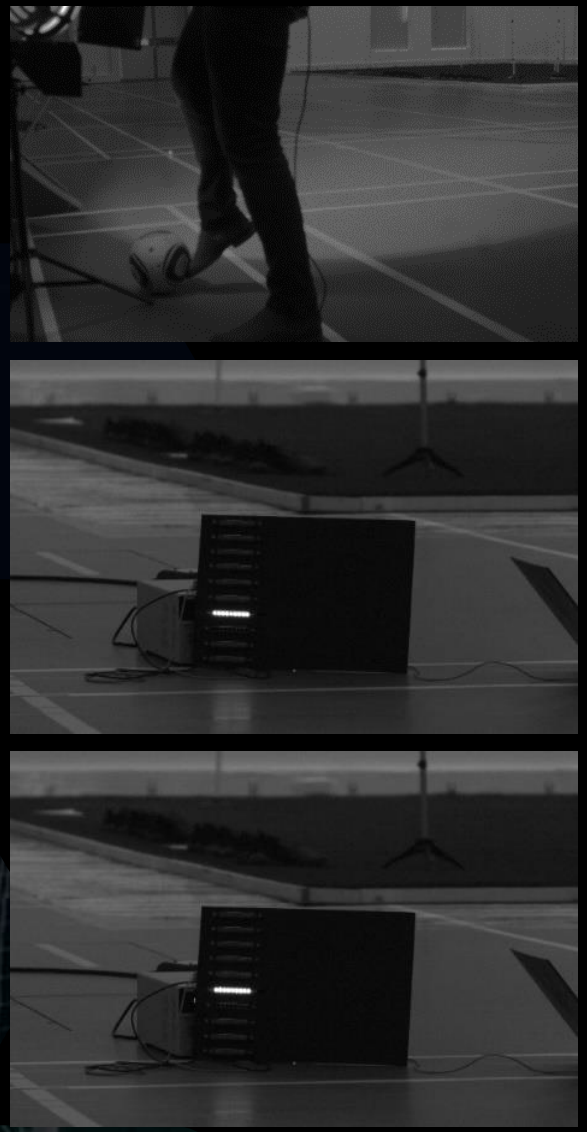
Results

- Instant of offside event:
  - HSV and high-refresh rate LED timing system demonstrates ability to accurately identify offside instant and corresponding broadcast image.
  - Body markers visible in paired images:
    - LC: 77%, CR: 71%, LR: 75%.





Offside event and LEDs illuminating clearly to identify 0.001 s time intervals

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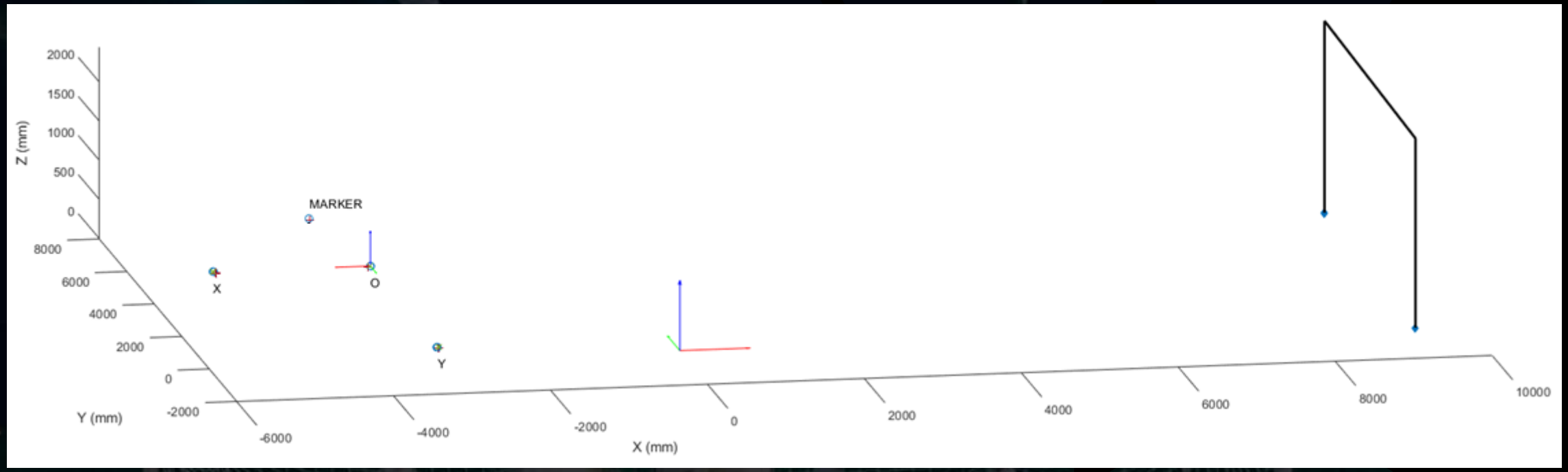
Results

- Three-dimensional position: pitch calibration



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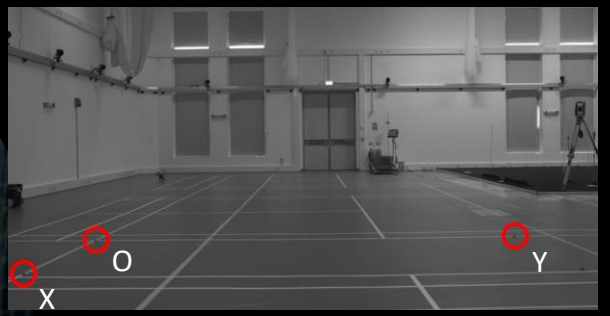
Results

- Three-dimensional position: pitch calibration
  - Accuracy (RMSE) of player volume definition (e.g., O, X and Y locations resp.):
    - TotalStation: 52, 50 and 23 mm.
    - HSV cameras: 45, 84 and 10 mm.

Total Station vs optical motion capture to assess pitch calibration



HSV cameras vs optical motion capture to assess pitch calibration

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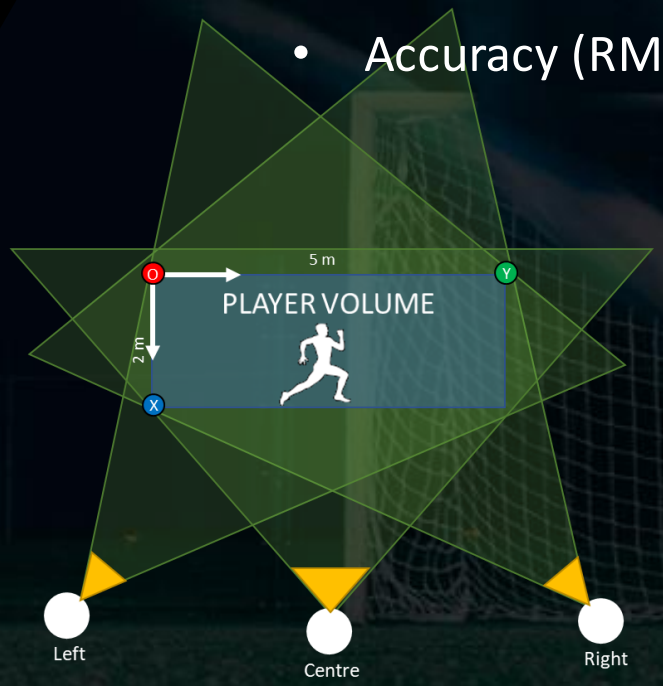
Results

- Three-dimensional position: body markers
  - Reliability (SEM) of body markers in HSV camera coordinate system:
    - LC: 0.23 mm, CR: 0.53 mm, LR: 0.23 mm.
  - Accuracy (RMSE) of body markers transformed to pitch coordinate system (each camera pair):



Marker	LC	CR	LR
Head (mm)	53	109	44
R Shoulder (mm)	45	98	29
L Shoulder (mm)	53	111	39
R Knee (mm)	66	100	45
L Knee (mm)	68	111	45
Mean (mm)	**57**	**106**	**40**

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Interpretation

- Body markers identified with good precision (~40 mm) for majority (75%) of offside events captured.
- Offside measures transformed to goal line were problematic owing to need for accurately defined three-dimensional pitch transformation.
- Transformation error sources included TotalStation surveying and HSV camera definitions of player volume.
- Recommended to include goal line in capture volumes, to avoid data transformation until this aspect of approach is explored further.

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Future applications

- HSV cameras represent a flexible approach to assess semi-automated offside technologies (e.g., accessible, scalable, applicable to pattern clothing).

- Offside measures where goal line not incorporated into capture volume problematic; however, measures incorporating other markings (e.g., 18 yd, 6 yd lines) hold merit.

- Future work should explore use of patterned clothing and include other pitch markings and their orientation (e.g., wide-view of pitch), to minimise errors associated with goal line-based player measurements.

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Thank you

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