Bachelor end project

Online mounting calibration around the vertical axis of the Kinect sensor

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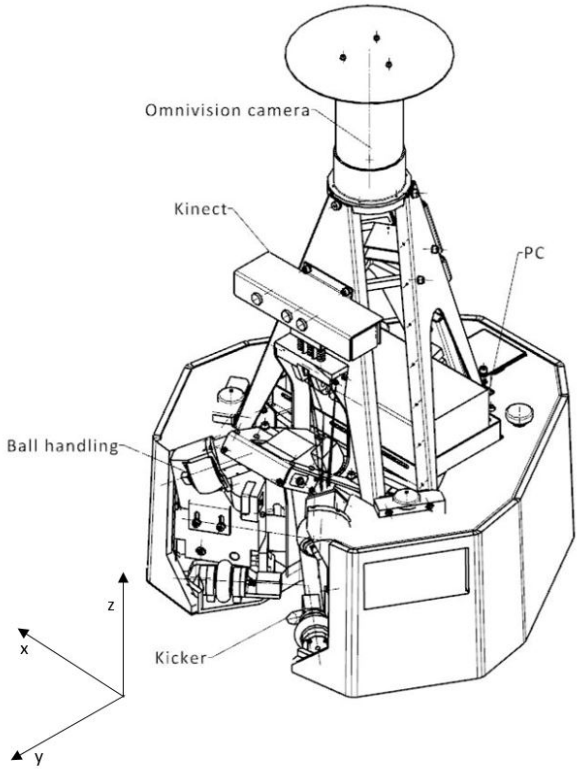
Outline

Goal

Problem sketch

- TURTLE & frame
- Kinect unused
- Online mounting calibration
  - Horizontal axes
  - Vertical axis



Goal

- Develop an online mounting calibration around the vertical axis of the Kinect.

Approach

- Robot coordinate frame
- Kinect coordinate frame
- Omnivision coordinate frame

- Use ball position

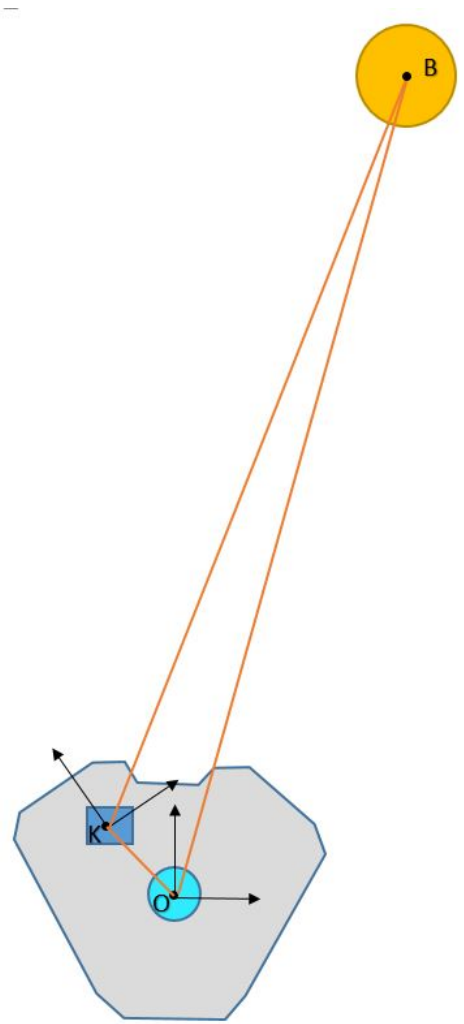
Approach

Challenges - Solutions

Challenge	**Solution**
Delay	Constant θ • RefBox task • Shot/Pass
Offset Kinect and Omnivision	Goniometry
Inaccuracy	Kalman filter
Dislocations due to collisions	Collision detection Filter reset
False-positives	Compare Kinect and Omnivision ball
Ball not in measurement space	Greenfield analysis

Approach

Elaboration: Goniometry



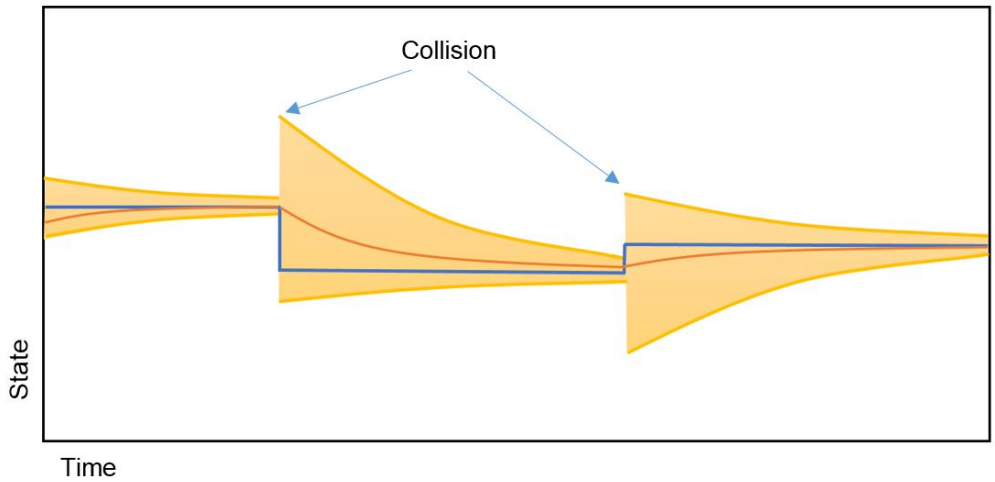
Approach

Elaboration: Kalman filter

- The system:

$$x_k = Ax_{k-1} + w_k$$
$$z_k = Cx_{k-1} + v_k$$

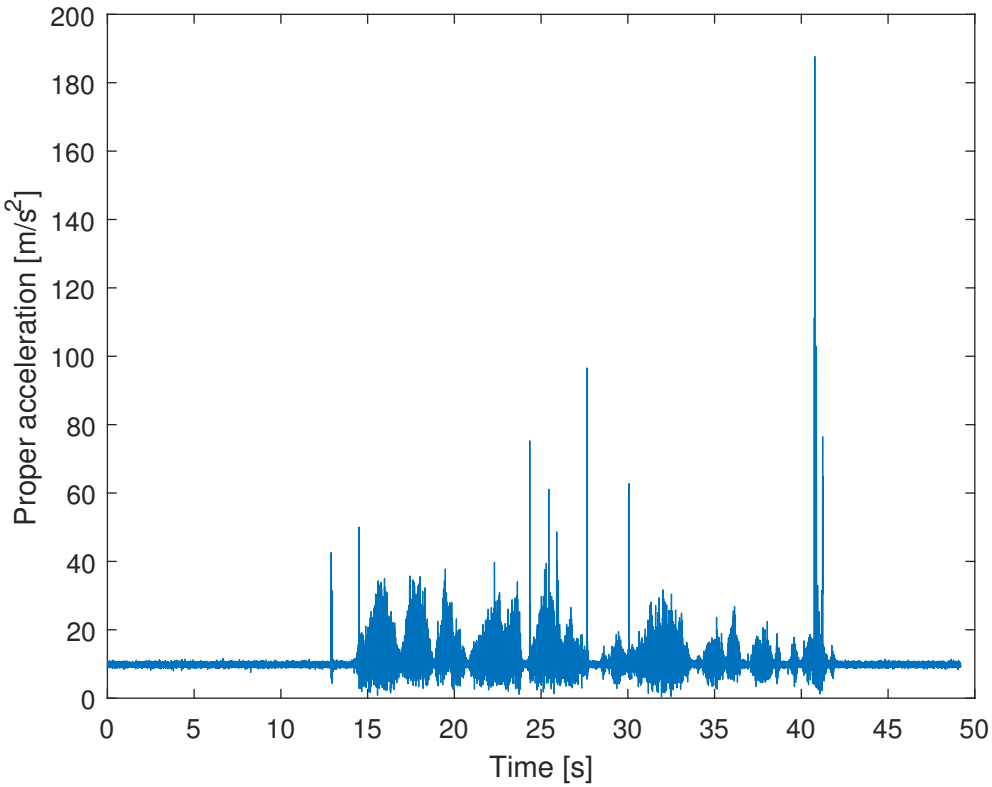
- $x_k = \hat{\theta}_d$, $z_k = \theta_d$, $A = 1$, $C = 1$, $w_k = 0$
- v_k to be determined



Approach

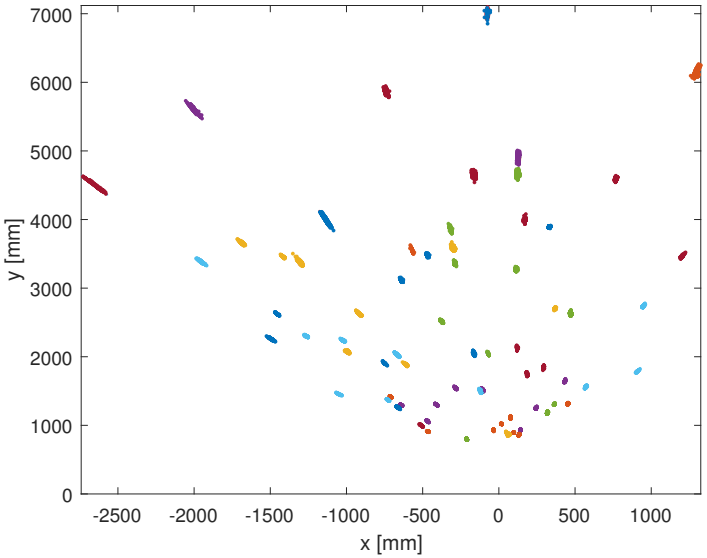
Elaboration: Collision detection

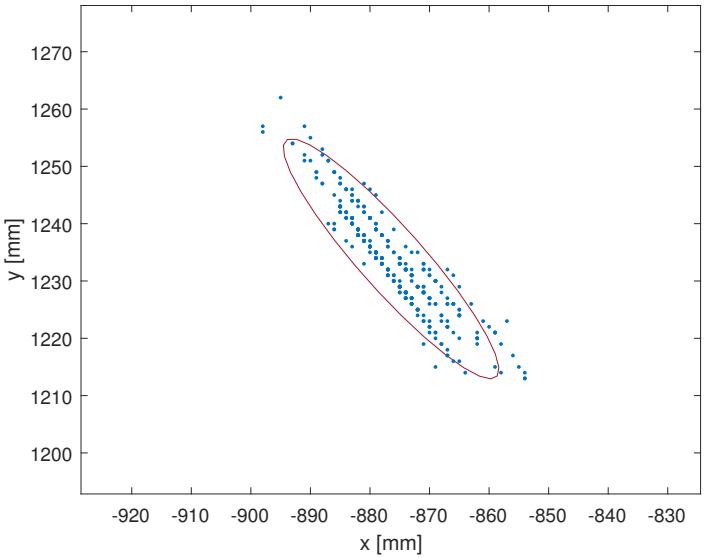
Threshold: 160 m/s^2



Data analysis

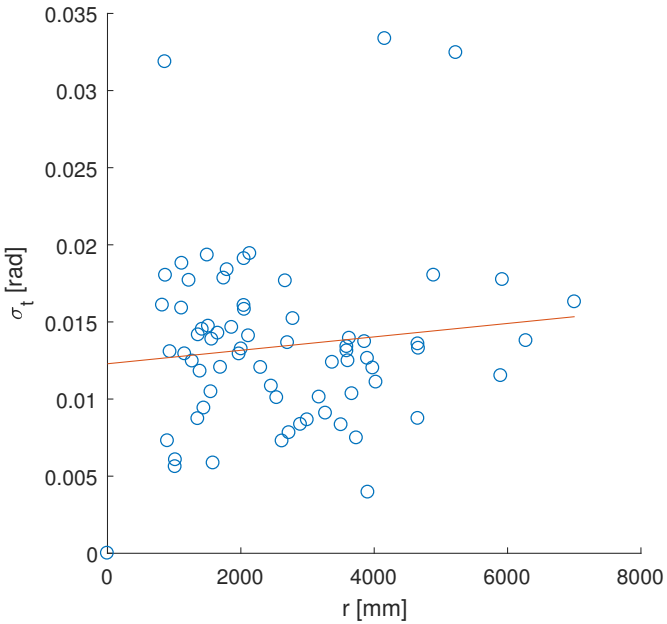
Kinect

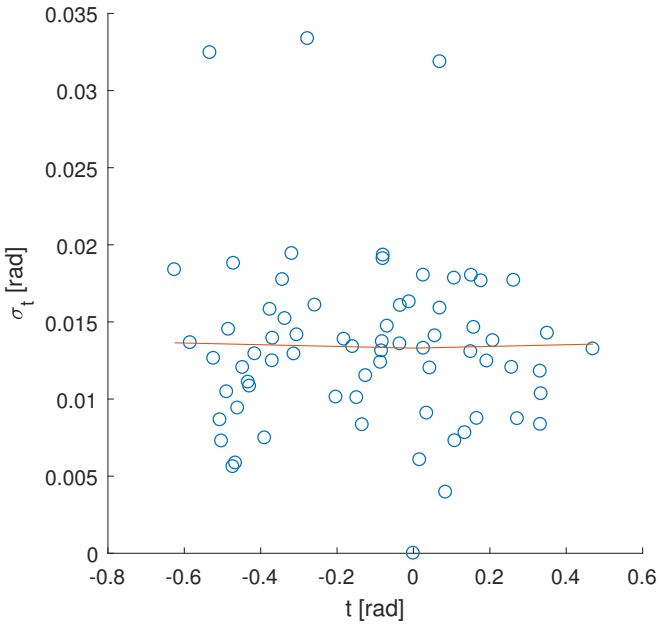




Data analysis

Kinect

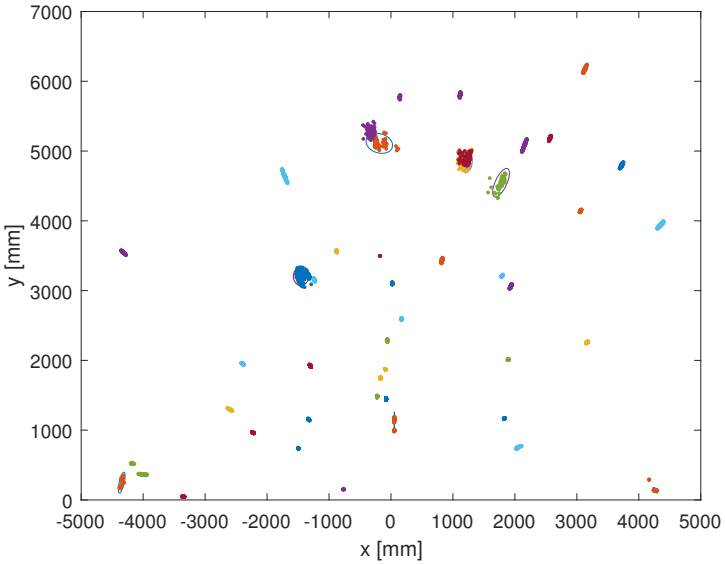


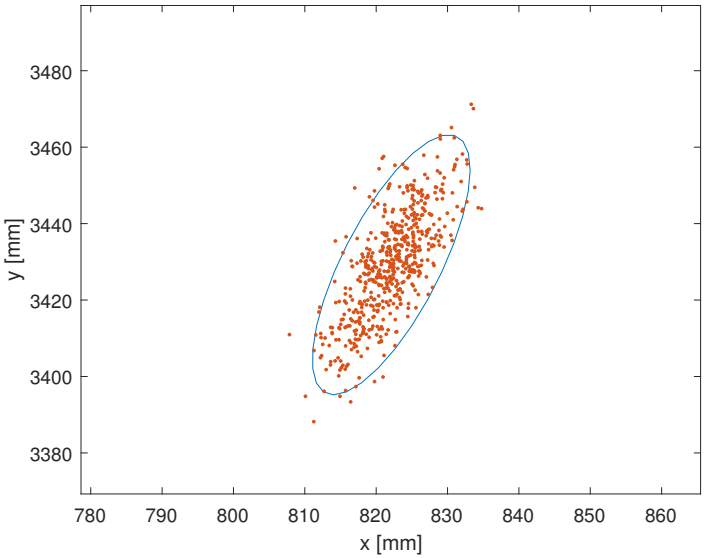


Standard deviation: 0.014
Variance: $2.0 * 10^{-4}$ rad^2

Data analysis

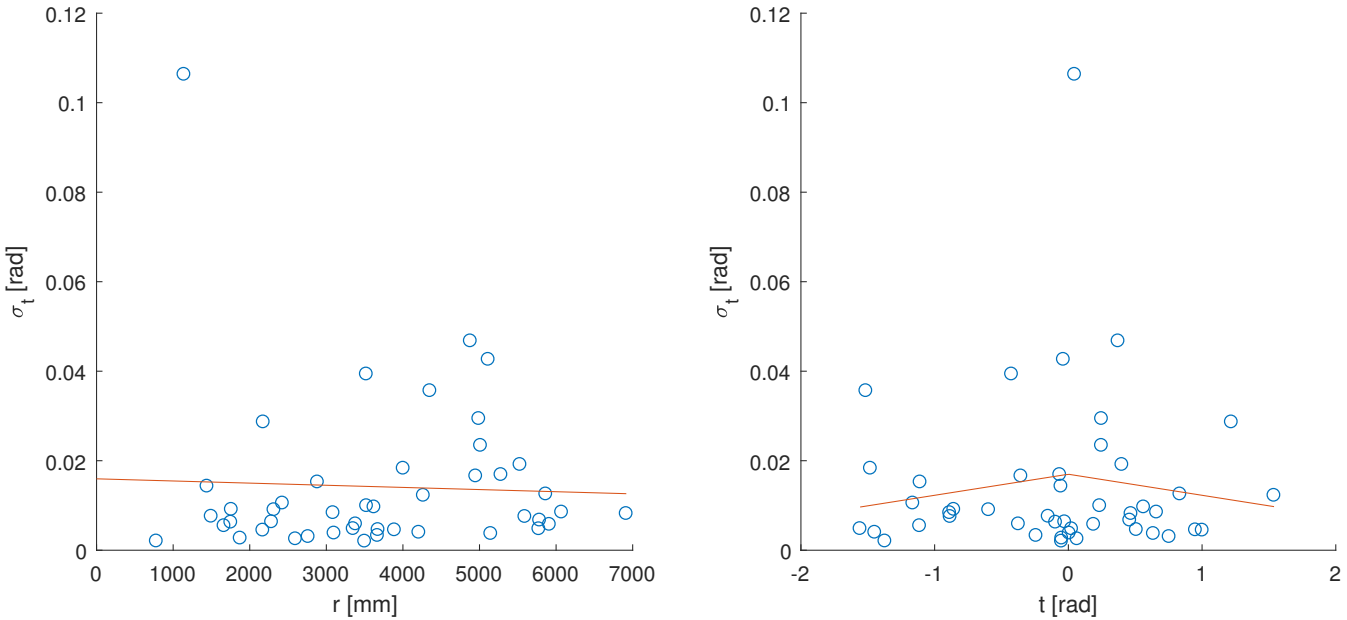
Omnivision





Data analysis

Kinect



Standard deviation: 0.018

Variance: $3.2 * 10^{-4}$ rad^2

Implementation

1. Collision detection
2. RefBox check
3. Ball selection
4. Goniometry to calculate θ_d
5. Kalman filter
6. Correction

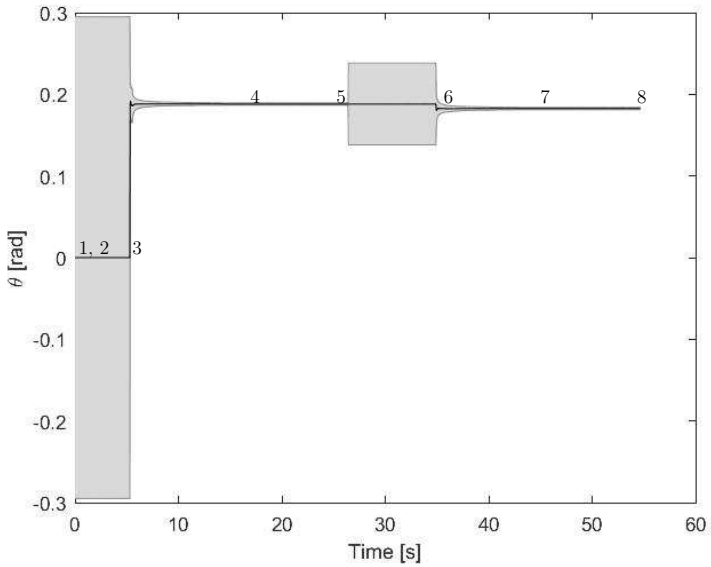
Verification

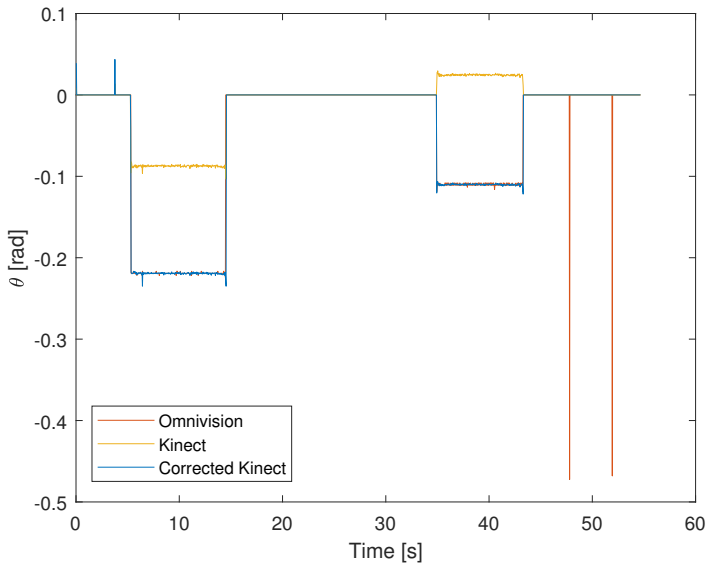
Two cases:

1. Ball laying still with collision
2. Shot/Pass

Verification

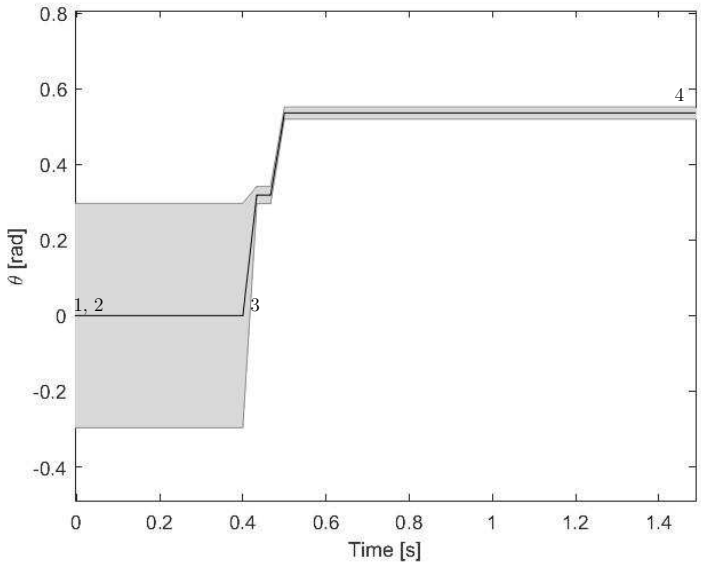
Ball laying still with collision



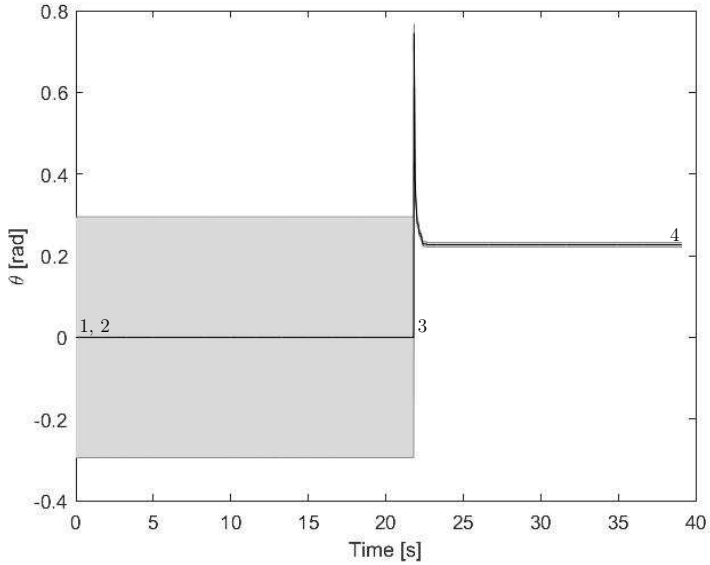


Verification

Shot/Pass



Shot: too little measurements



Pass: still an offset

Conclusions & Recommendations

Conclusions

- Ball laying still: Works
- Shot: Does not work
- Pass: Needs improvement
- Algorithm deals well with collisions
- Greenfield analysis

Recommendations

- Test in game
- Optionally adjust algorithm for Passes to work
- Combine with mounting calibration horizontal axes

Questions?