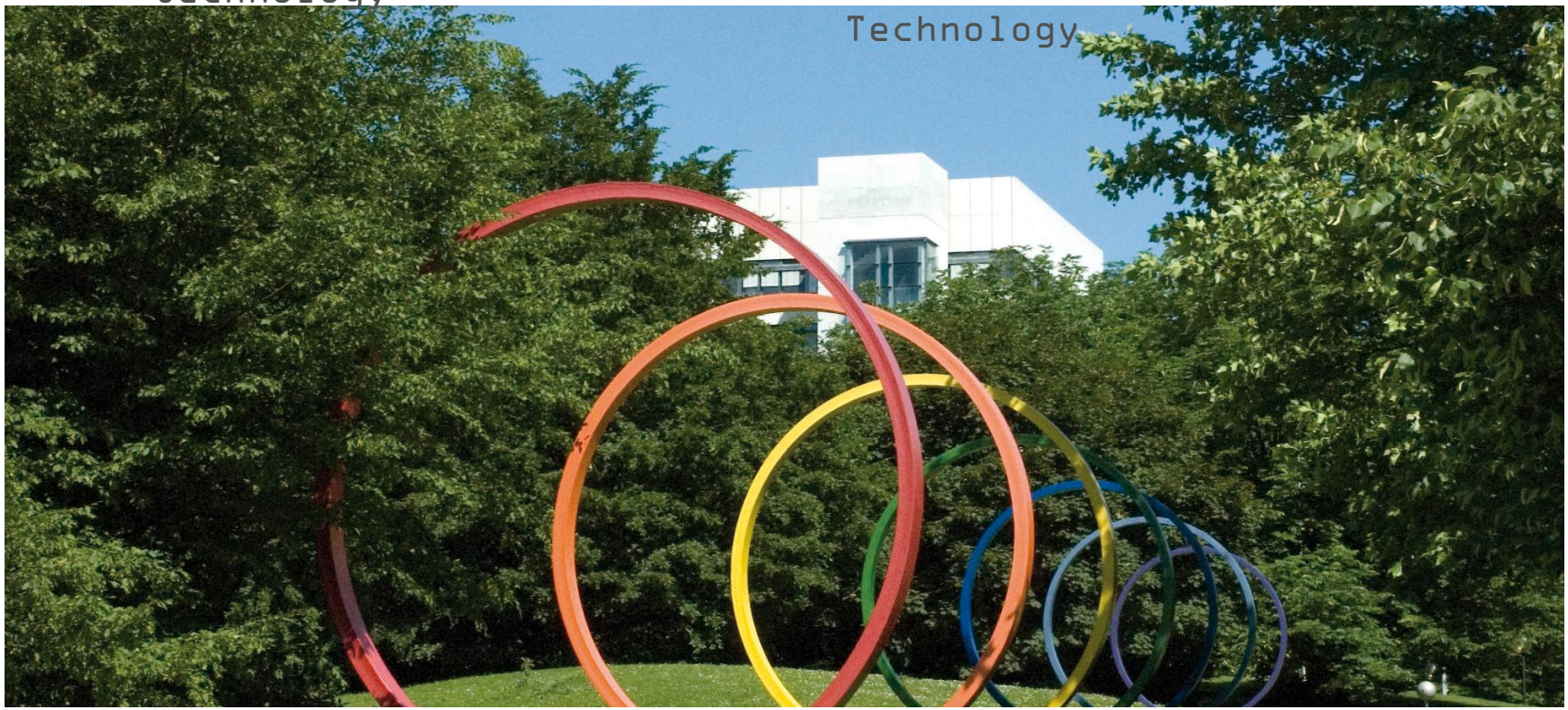
dortmund
university of
technology

Robotics Research
Institute
Section Information
Technology



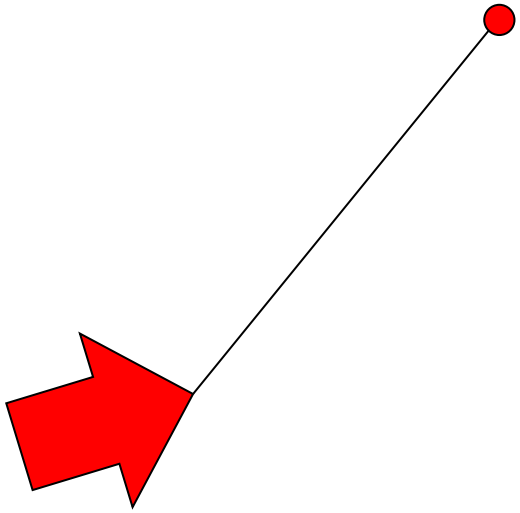
Using Line Observations for Localization

Localization in RoboCup

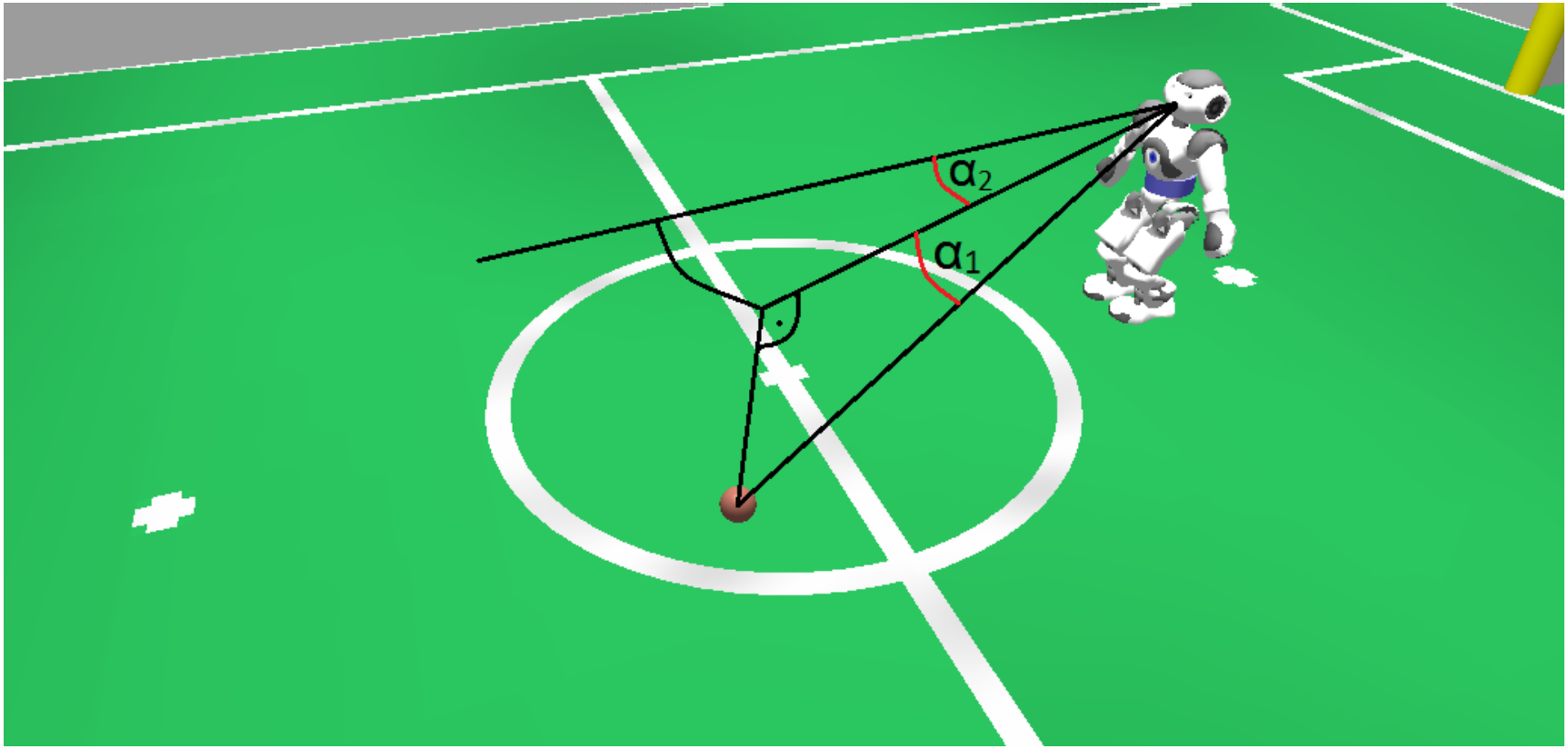
- Particle Filter
  - Very easy to implement
  - Barely any math necessary ;-)

- (Multi-hypotheses) Kalman Filter
  - Faster
  - *Can* be more precise (if done correctly)

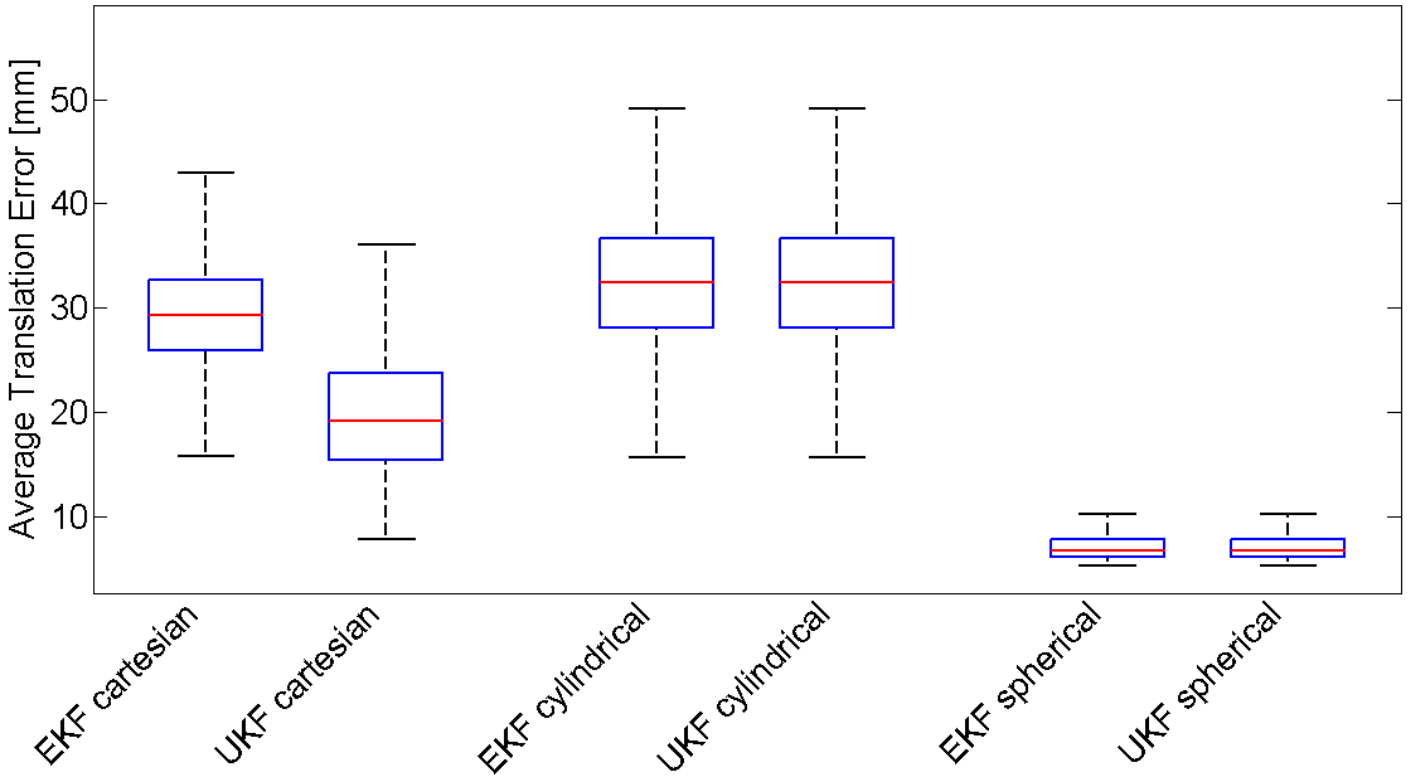
Point Landmarks



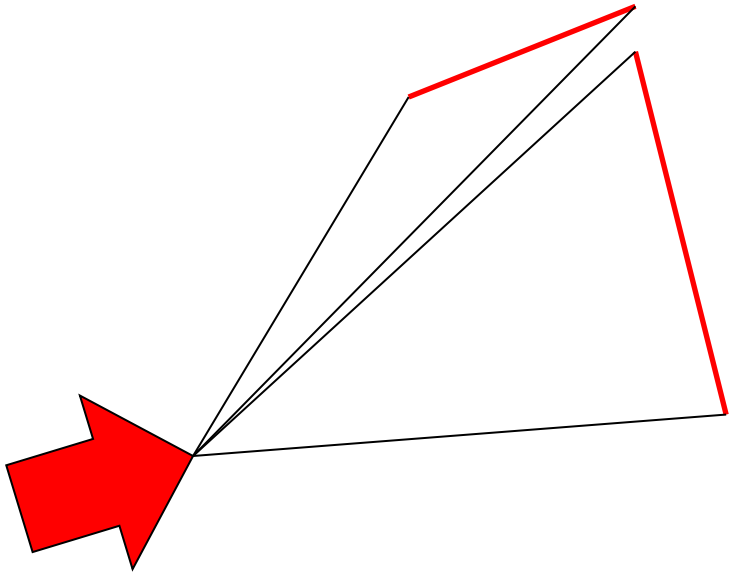
Coordiante System Choices



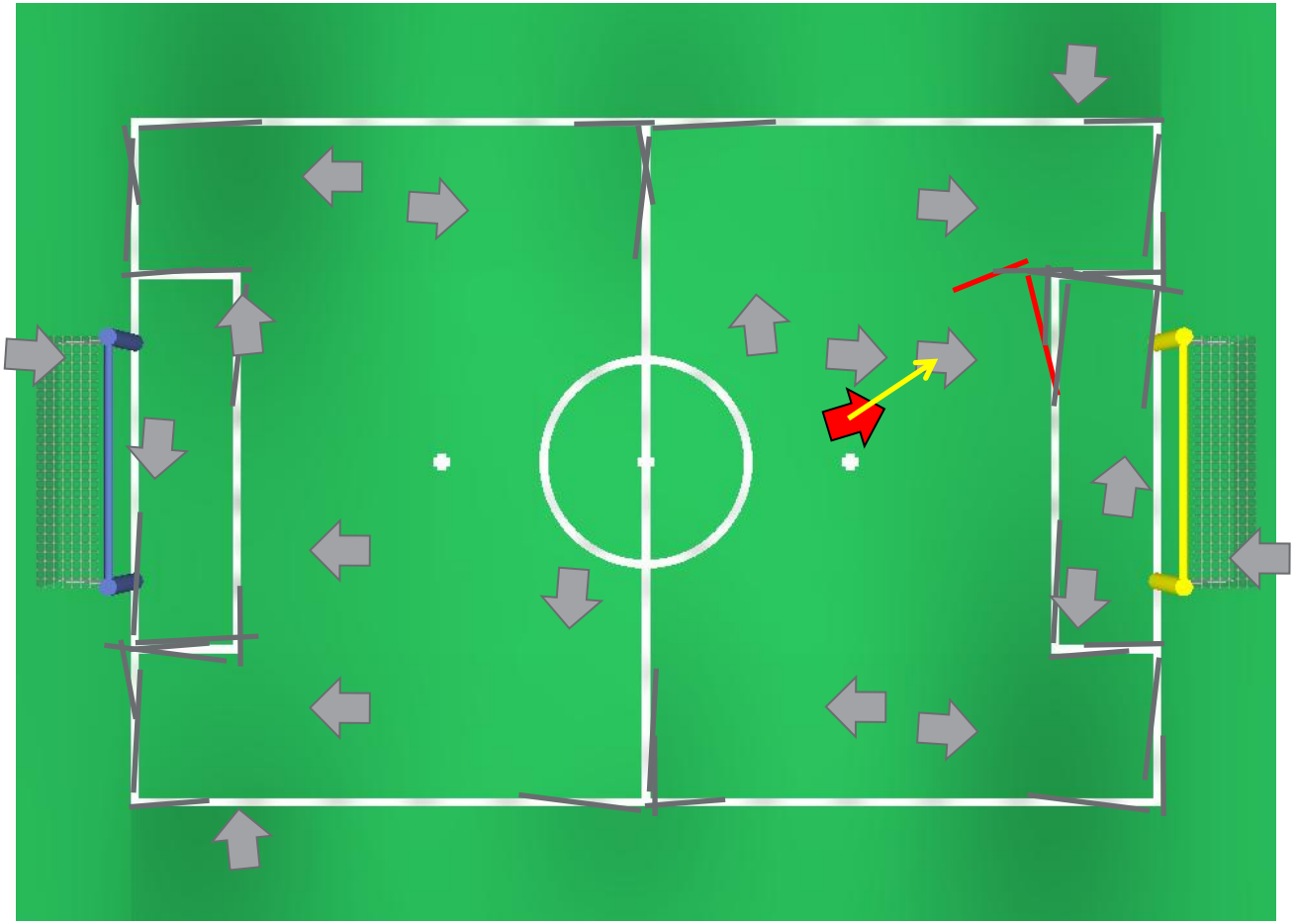
Coordiante System Choices



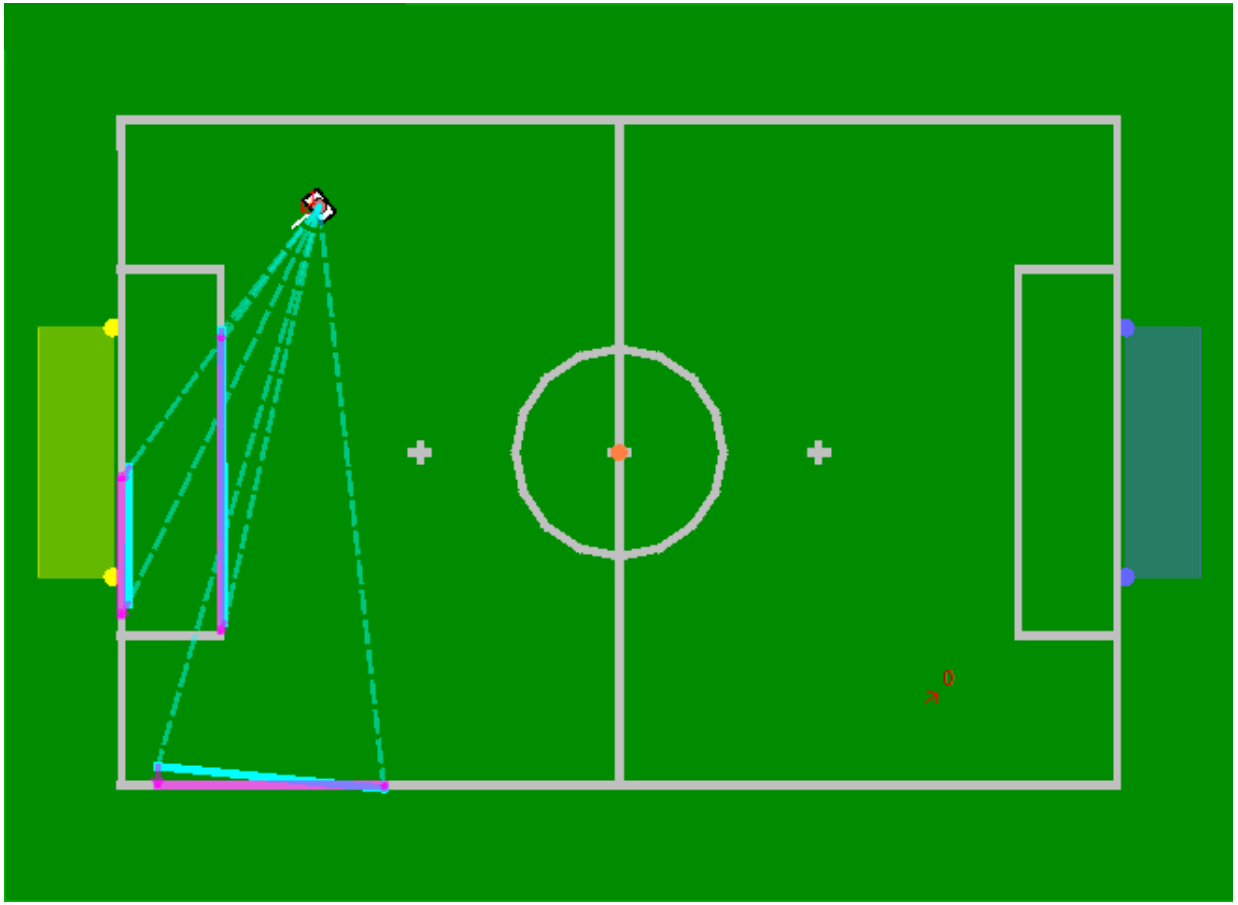
Line Observations



Line Correspondences



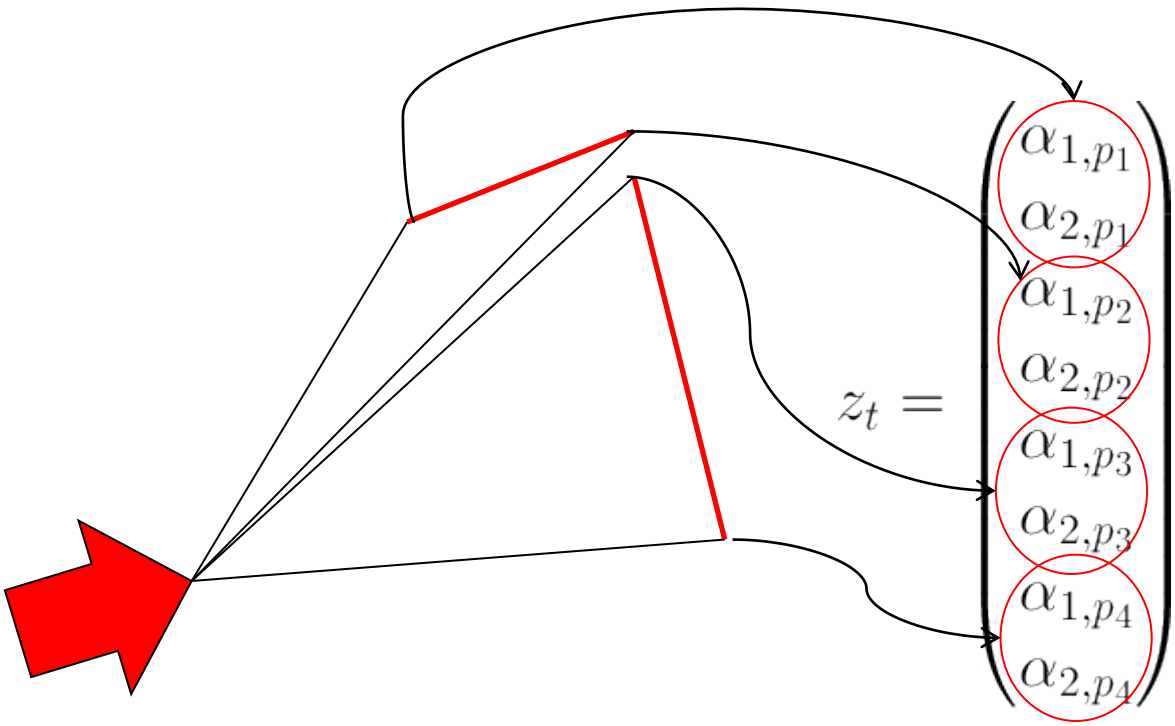
Line Correspondences



Line Correspondences

- Line Matching Algorithm
  - Identify main line direction
  - Divide observations into 2 (perpendicular) classes
  - Try all correspondence combinations (in a clever way, skipping a lot)
  - Output:
    - Perpendicular lines → Set of discrete poses
    - Only parallel lines → Set of continuous pose intervals

Line Observations



Line Observations

$$z_t = \begin{pmatrix} \alpha_{1,p_1} \\ \alpha_{2,p_1} \\ \alpha_{1,p_2} \\ \alpha_{2,p_2} \\ \alpha_{1,p_3} \\ \alpha_{2,p_3} \\ \alpha_{1,p_4} \\ \alpha_{2,p_4} \end{pmatrix}$$

$$z'_t = \begin{pmatrix} \alpha_1 \\ \alpha_2 \end{pmatrix}$$

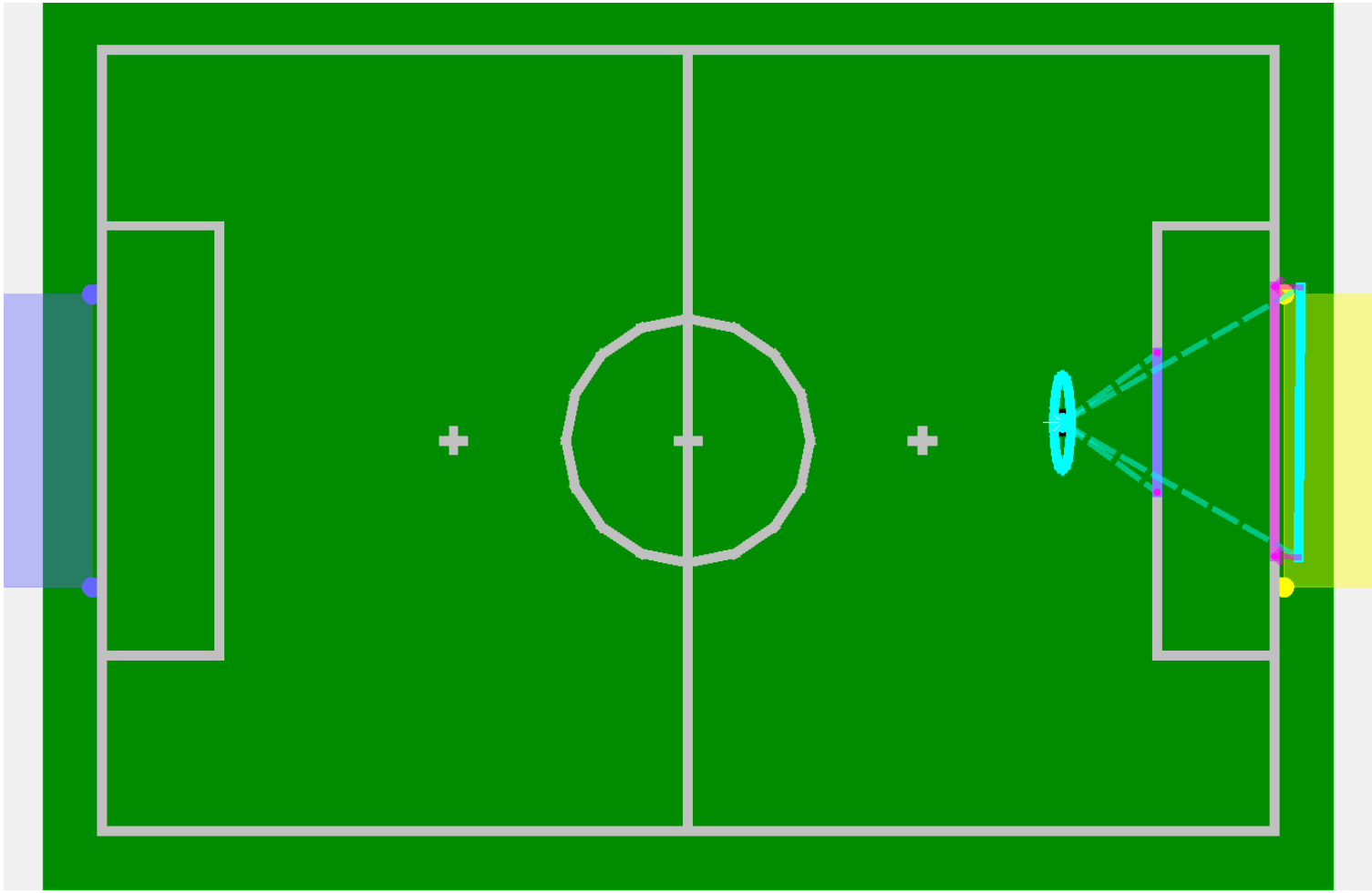
$$R_1 = \begin{pmatrix} \sigma_1 & 0 \\ 0 & \sigma_2 \end{pmatrix}$$

$$R_4 = \begin{pmatrix} R_1 & \gamma R_1 & \gamma R_1 & \gamma R_1 \\ \gamma R_1 & R_1 & \gamma R_1 & \gamma R_1 \\ \gamma R_1 & \gamma R_1 & R_1 & \gamma R_1 \\ \gamma R_1 & \gamma R_1 & \gamma R_1 & R_1 \end{pmatrix} \text{ with } \gamma \approx 0.9$$

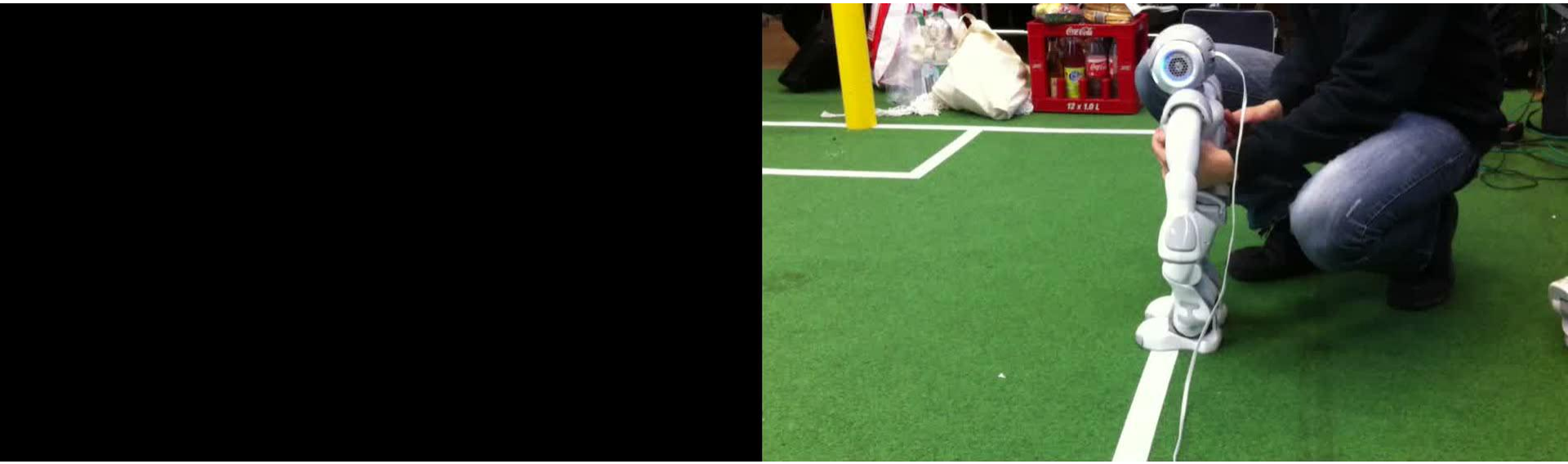
Beware!

- Exceptions to handling line observations using point feature representations
  - Observations of parallel lines only → Underestimate the uncertainty
    - Use different (much more complicated) math
  - Center Circle if you are standing inside it → Hits a singularity!
    - Use Cartesian coordinate system and put "0"s into the rotation column of the measurement Jacobian

Parallel Lines Only



Location in Action



Thank you!