Automated PTZ framing of track cyclists using timing loops

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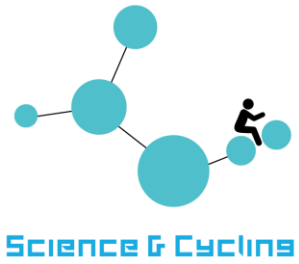


Problem statement

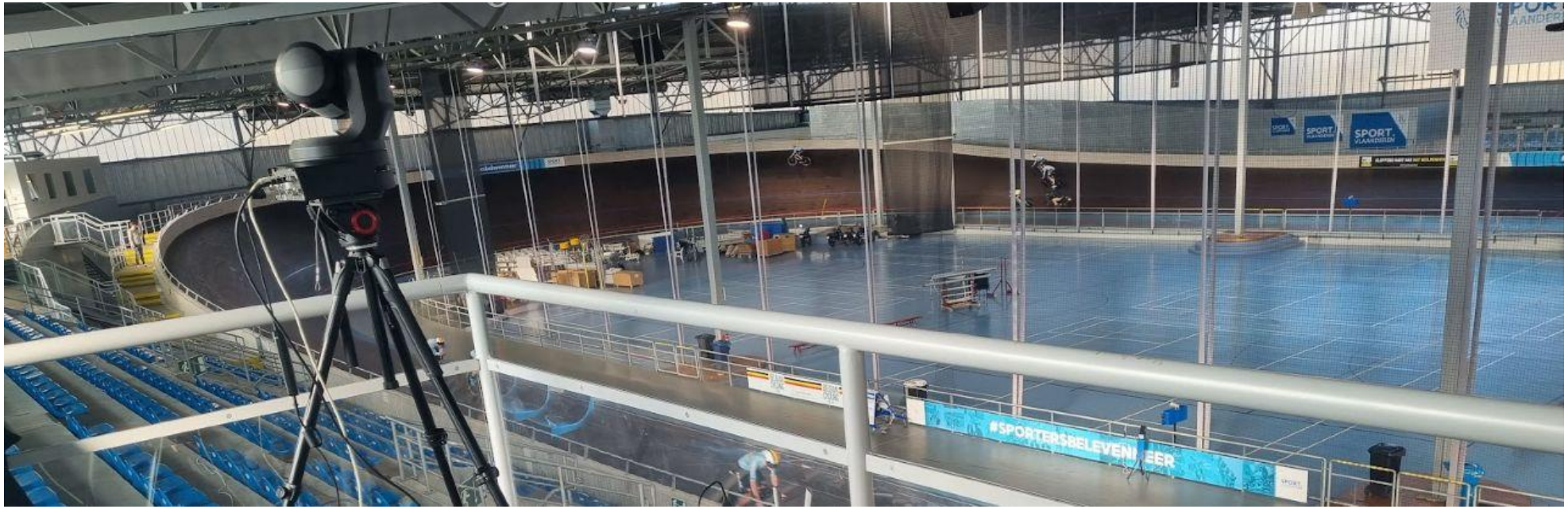
- Manual filming requires:
  - Manpower
  - Concentration
- Yet, videos are a powerful tool for feedback (technique analysis)
- Could we automatically capture video with limited extra effort?

Outline

- Setup
- Challenges & Solutions
- Demo
- Results
- Conclusion

Setup

- PTZ camera
- Indoor cycling track

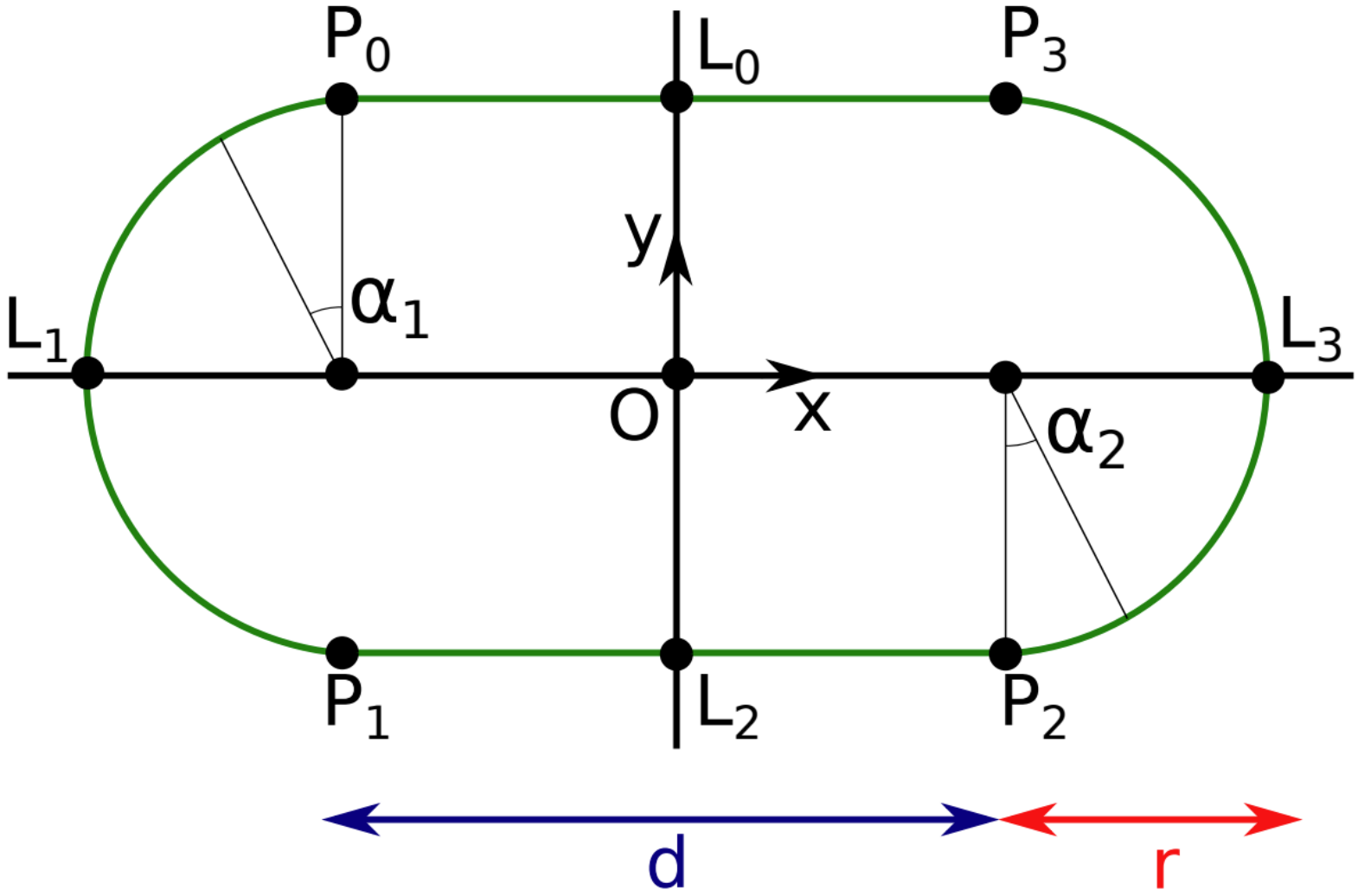


Setup - Camera setup

- Panasonic AW-UE100 or AW-UE150
  - Full HD @ 50 fps (4K possible)
  - Listens to Panasonic HTTP commands
    - Pan/Tilt/Zoom position commands
    - Pan/Tilt/Zoom speed commands (smoother)
  - Pan: horizontal rotation
  - Tilt: vertical rotation
  - Zoom: focal distance change

Setup - Track parameters

- Track length: 250m
- Defined by **d** and **r**
- Counter-clockwise rotation around the track
- L_0, L_1, L_2, L_3: center of corners and straights
- P_0, P_1, P_2, P_3: direction changes



Challenges & Solutions

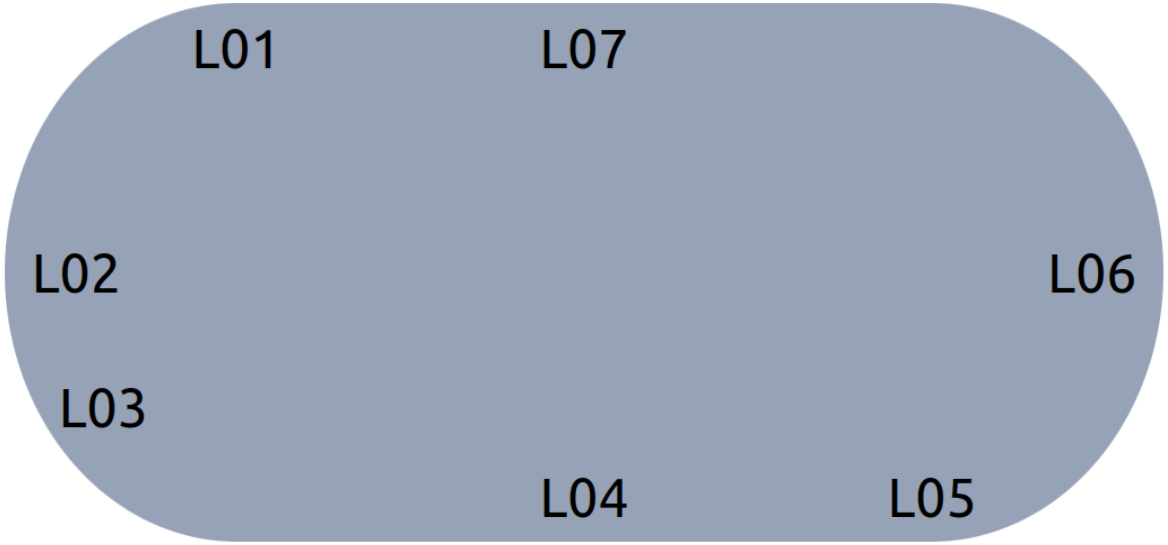
1. The current speed of the riders is required for optimal tracking ($v = \Delta s/\Delta t$)
   - Exact distance between loops should be known (s)
   - Timing loops need be time-synchronized! (t)

Measure the track

- 7 loops around the track @Eddy Merckx Cycling Ghent

GPS time synchronization:

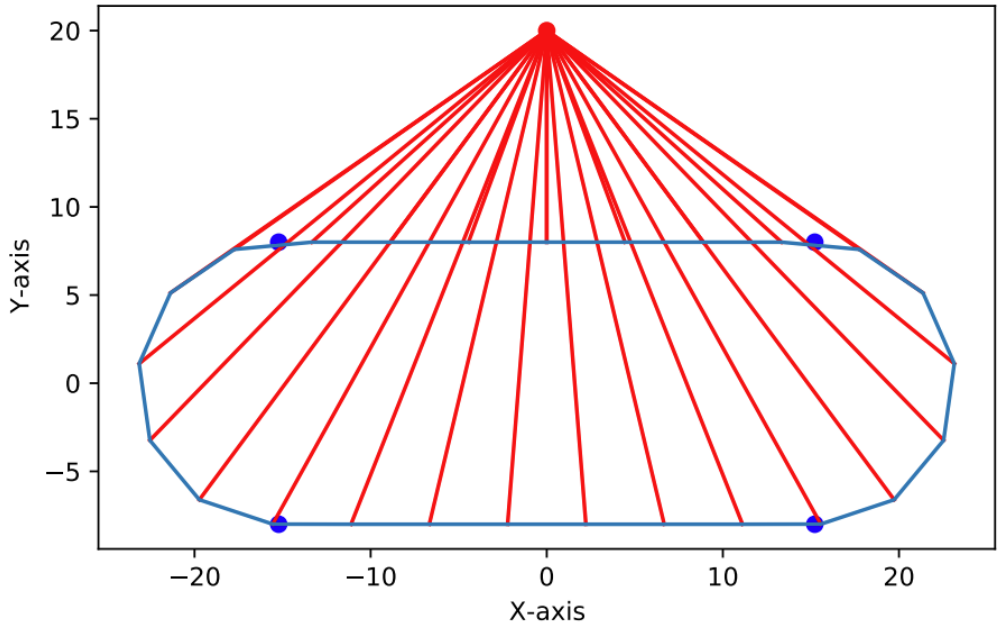
- single clock to all decoders

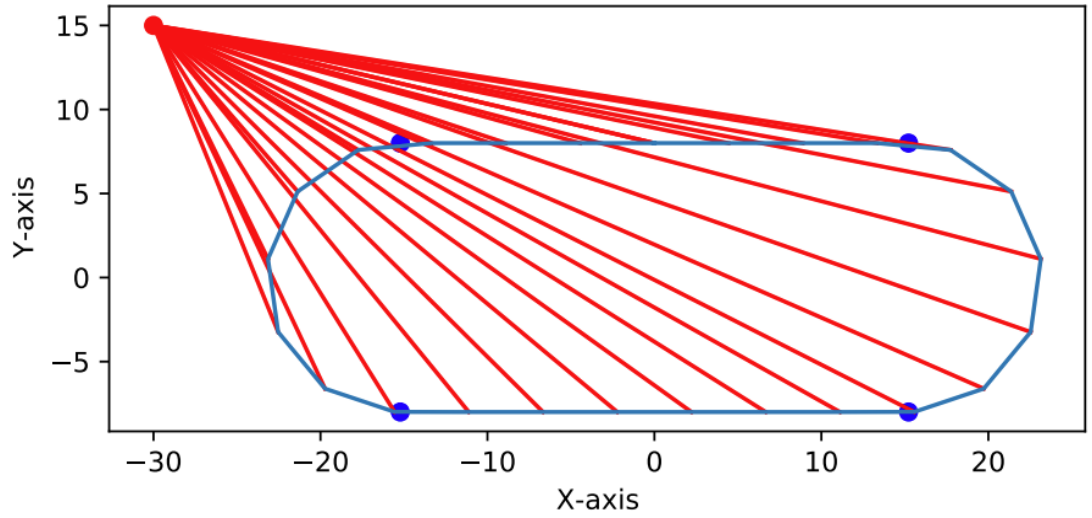


Challenges & Solutions

2. Position and orientation of the camera w.r.t. track need to be known

Practically: using calibration points to assess the quality (projecting track in image)

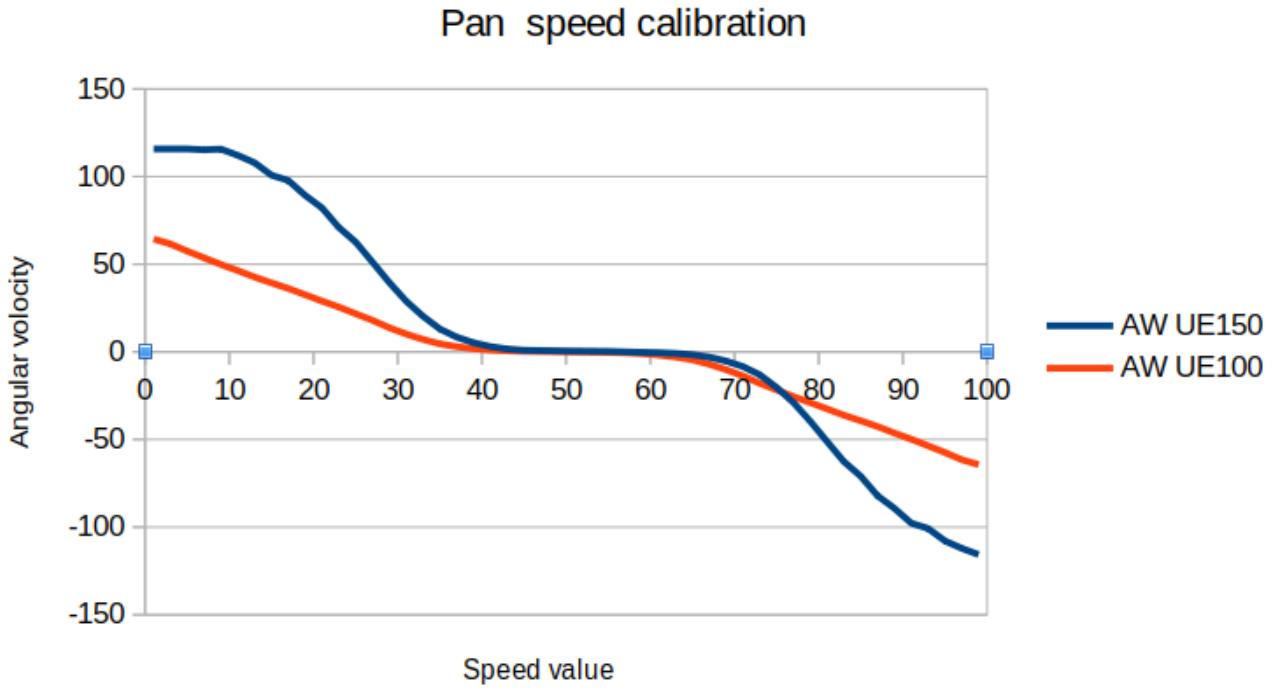




Challenges & Solutions

3. The speed of the camera w.r.t. the commands

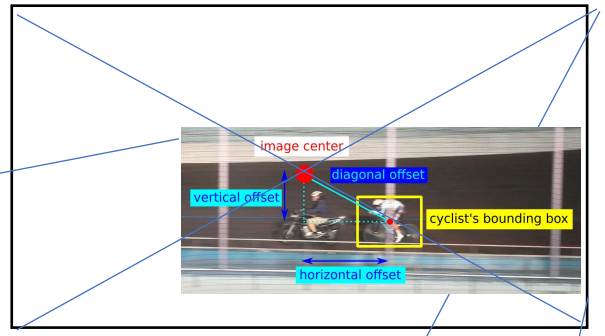
- Speed commands Pan/Tilt/Zoom (range: 0-99) -> camera type specific
- Calculate angle velocity:
  - Angle to cover
  - Time to the next instruction
- Consider reaction time

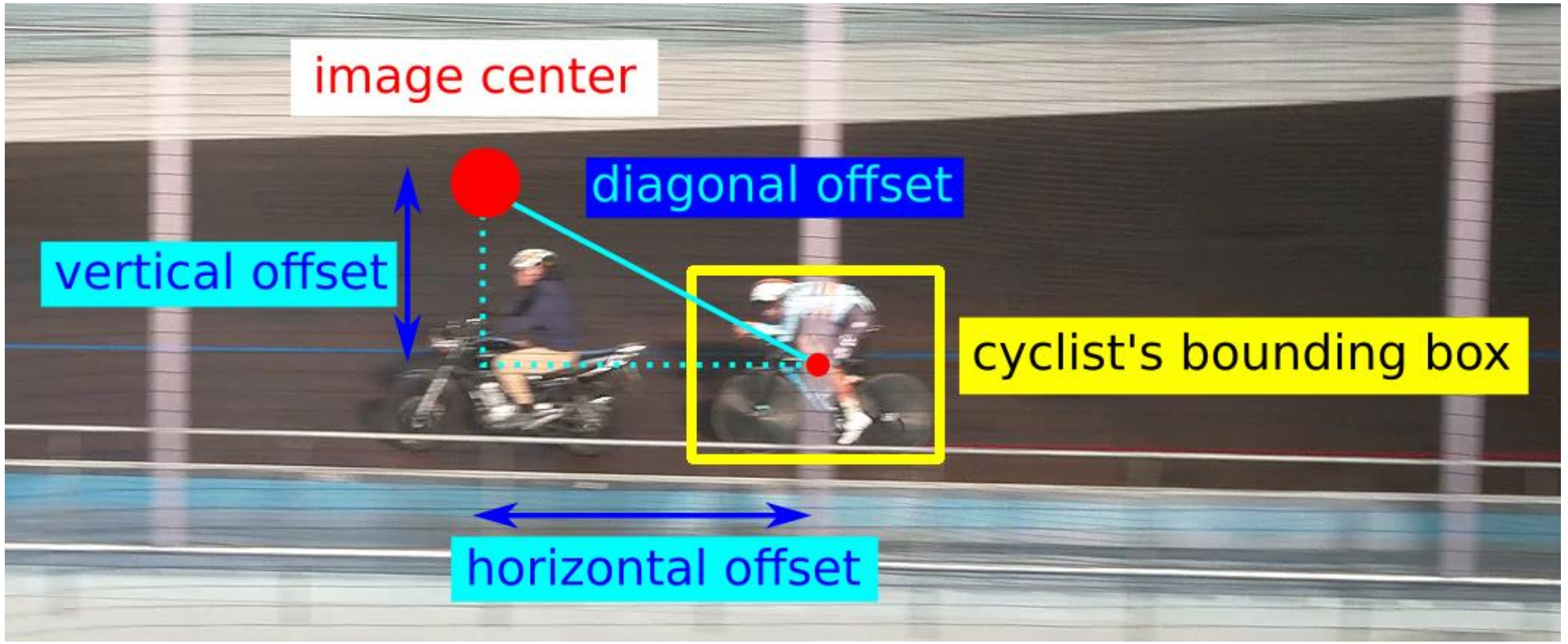



Panasonic PTZ demo
Track Cycling

Results

- Assumption: keep the rider in the center of the image





Results

- FullHD video: 1920x1080px
- Average horizontal offset: 255 px
- Average vertical offset: 237 px
- RMSE of average diagonal offset: 320 px
- The cyclist is successfully tracked
- The cyclist’s bounding box measures 150.3 x 140.6 px
- Position offset is 1.5 times the size of the cyclist in the frame (-> small offset)

Conclusion

- Automated PTZ tracking of track cyclists is possible
- Synchronization and camera calibration are important to solve
- Using speed commands, we obtain smooth filming

Future work

- Optimize the framing of the action
- More accurate camera calibration => allow more up-close footage
- Other sports:
  - Short Track Speed Skating
  - Athletics (400 hurdles)


Hi