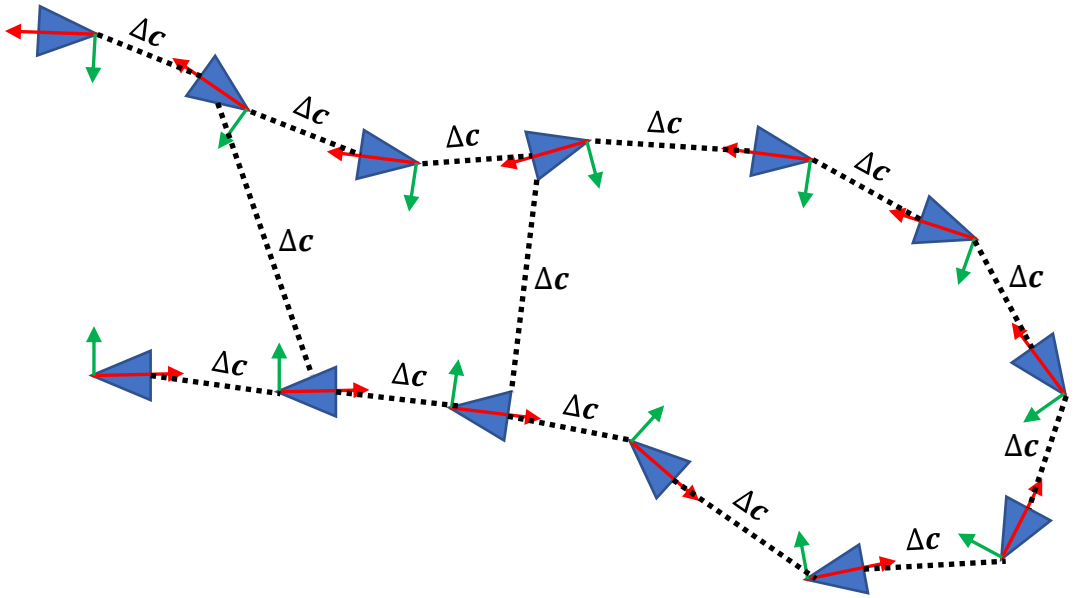
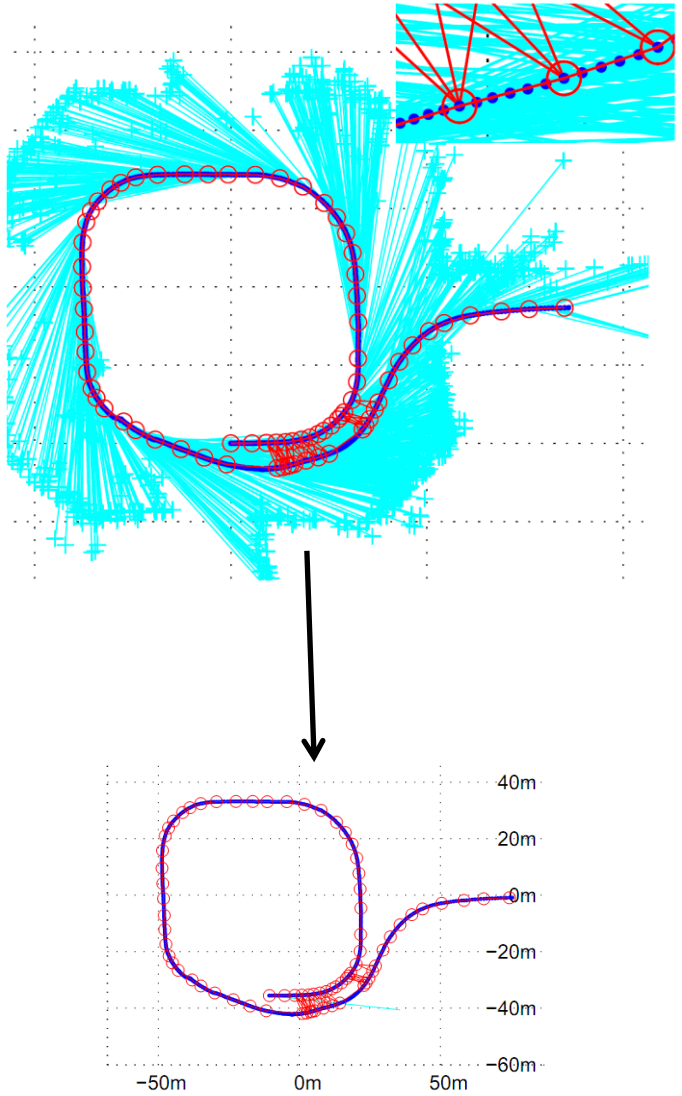
Project – Phase 4

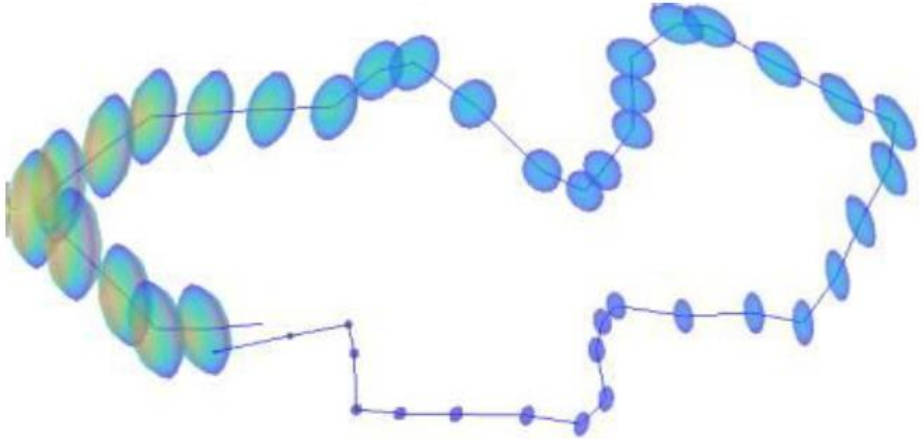
- Pose Graph - Large scale motion estimation



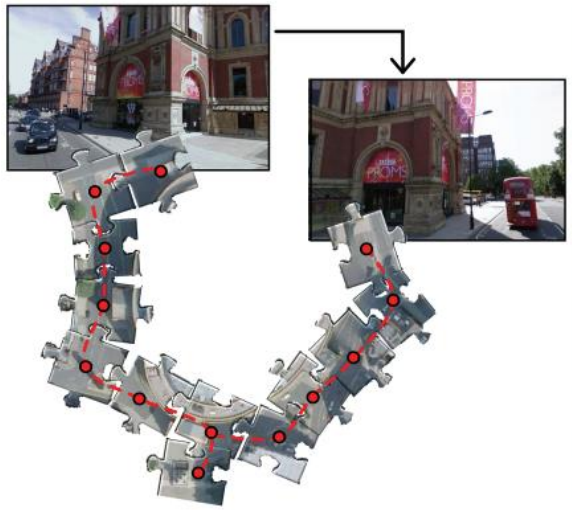


Project – Phase 5

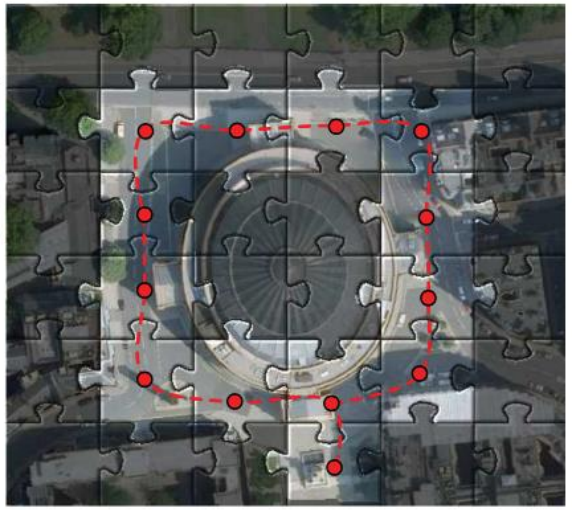
- Loop Closure



(a) Robust local motion estimation



(b) Mapping and loop-closure detection



(c) Global optimisation

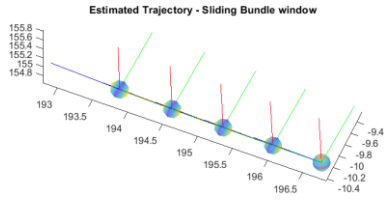
Applying Information Theory to Efficient SLAM – M.Chli

Frame Slam

- RANSAC $p = 0.99$
  - Min / max iteration
- Loop Closure
  - How many are needed?
  - Harder match
  - Can affect keyframes decision

FrameSlam - Visual Odometry

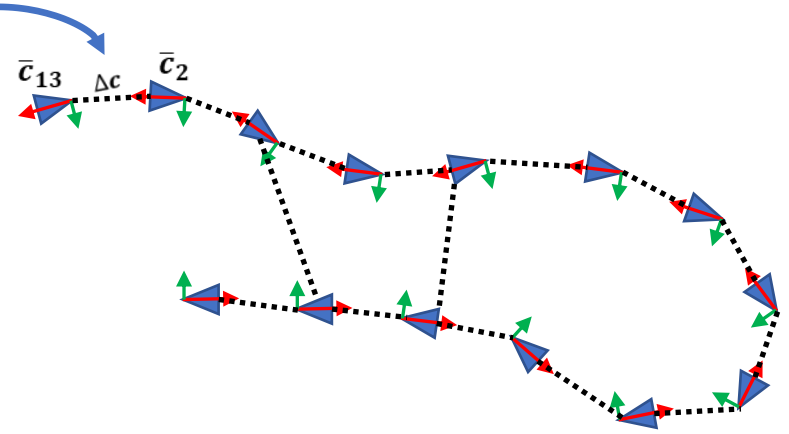
- *Sliding Bundle window* – A local window of the last 12 frames
  - New frame replaces oldest frame
  - Bundle is solved for motion estimation → VO
  - At any time contains at least one keyframe
  - When a new keyframe is introduced, marginalization is performed for a pose graph update



$$\langle c_1, \bar{c}_2, \cdots, c_{11}, c_{12} \rangle \leftarrow \boxed{\bar{c}_{13}}$$

$$\boxed{c_1} \leftarrow \langle \bar{c}_2, c_3, \cdots, c_{12}, \bar{c}_{13} \rangle \longrightarrow \Delta c(\bar{c}_2, \bar{c}_{13})$$

$$\langle \bar{c}_2, c_3, \cdots, c_{12}, \bar{c}_{13} \rangle \leftarrow \boxed{c_{14}}$$



Optimization

- Least Squares
  - Matlab:
    lsqnonlin(f, x0)
  - GTSAM / g20

Accuracy

- Output Covariance vs. Input Covariance
- Covariance vs. projection error

Project Submission

Project Submission

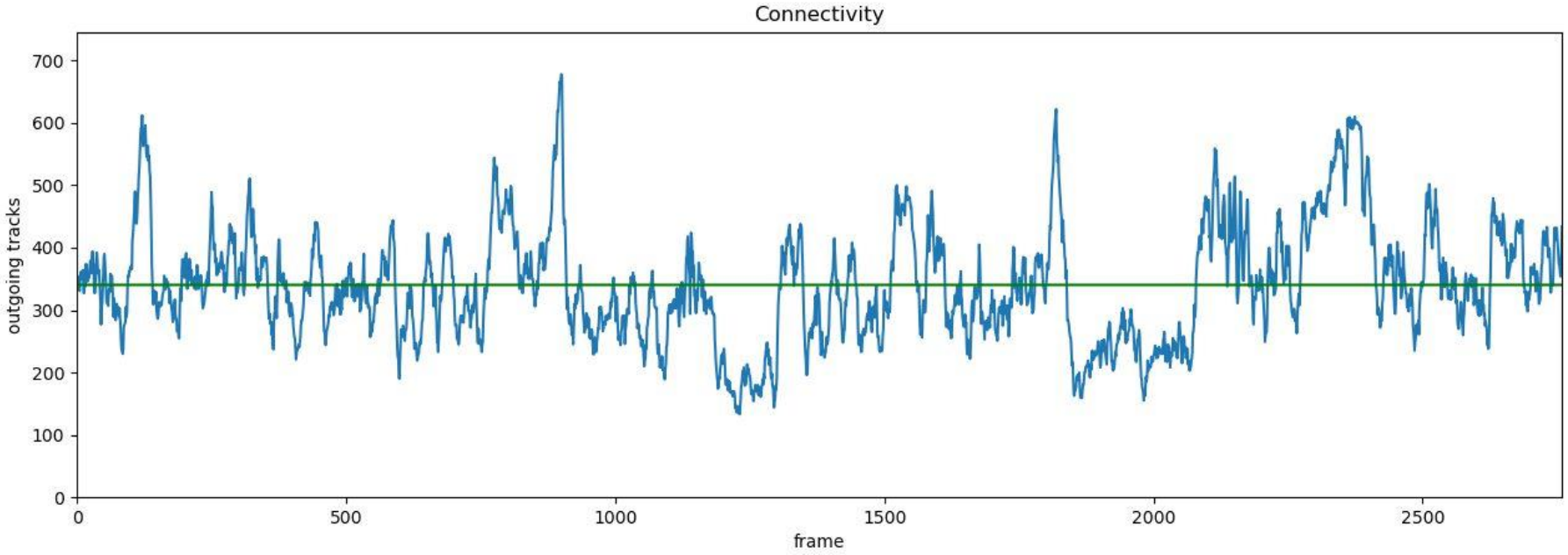
- Overview
- System Stages
  - Describe
  - Reference code
  - Document
- Criticize
- Graphs
  - Use Zoom effectively
  - Overlay when appropriate
  - Analyze for each graph
    - Explain what we see, interesting features, significance

Project Submission

- Total number of tracks
- Number of frames
- Mean track length
- Mean number of frame links

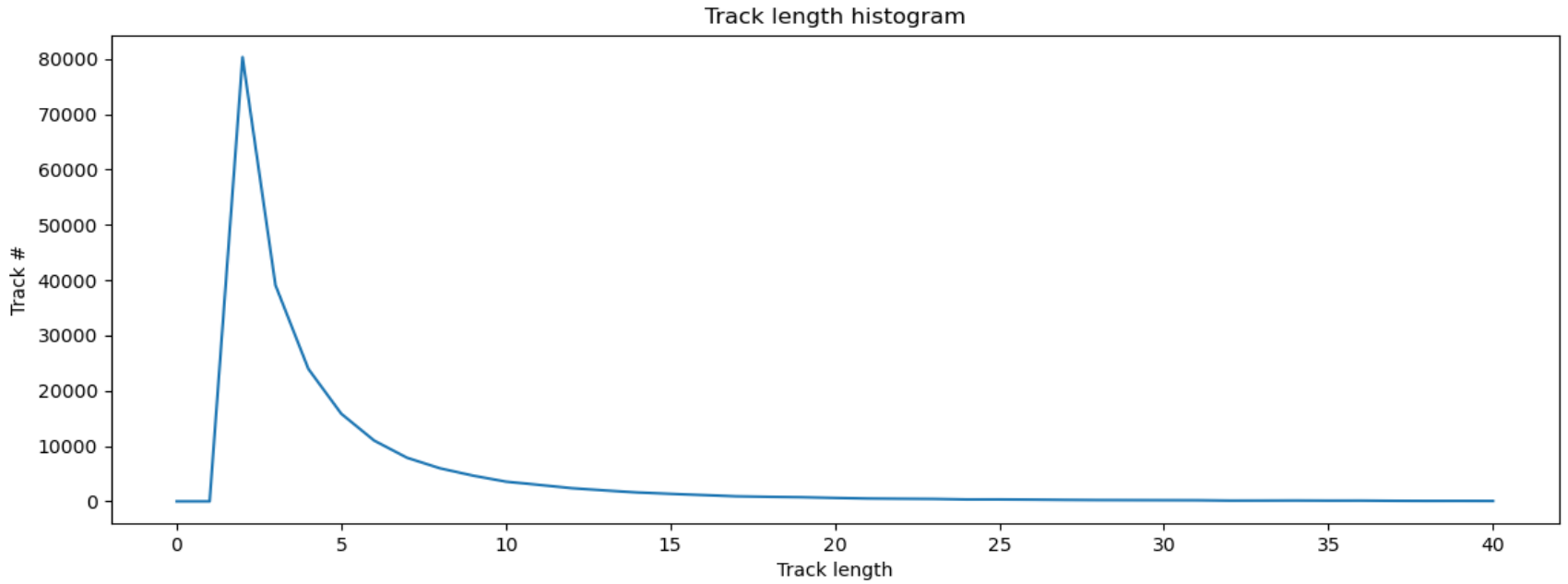
Project Submission

- Connectivity: For each frame the number of tracks **outgoing** to the next frame (the number of tracks on the frame with links also in the next frame)



Project Submission

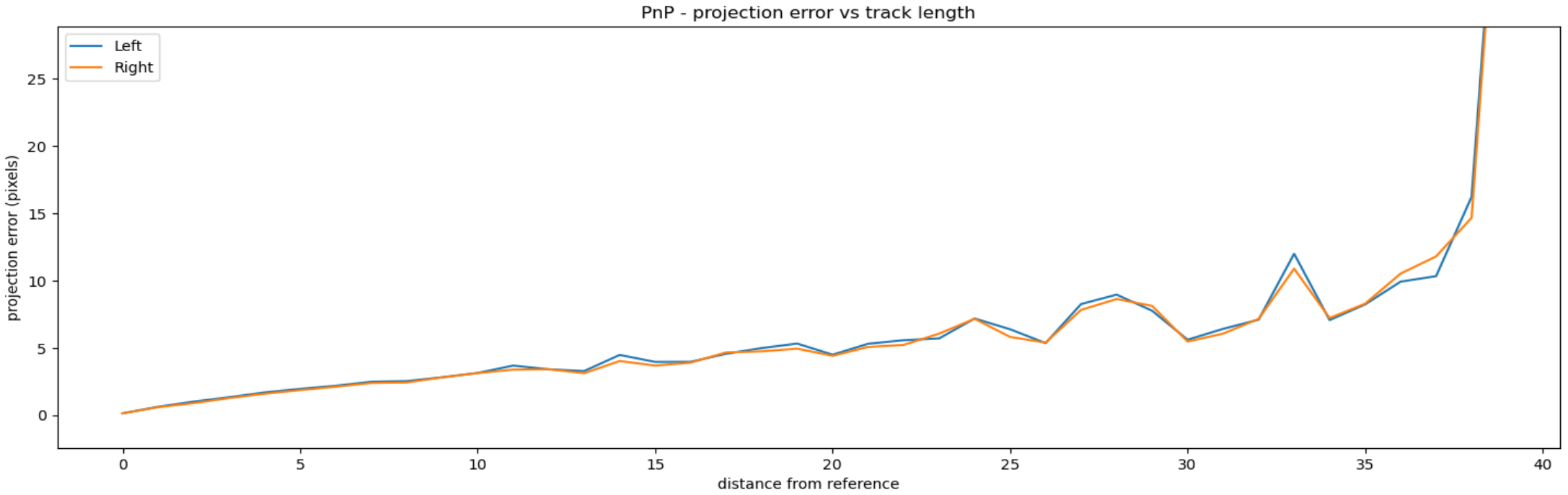
- Track length histogram



- Number of matches per frame
- Percentage of inliers per frame

Project Submission

- Median projection error of the different track links as a function of distance from 1st frame the track appeared on
  - for PnP estimation
  - For Bundle estimation

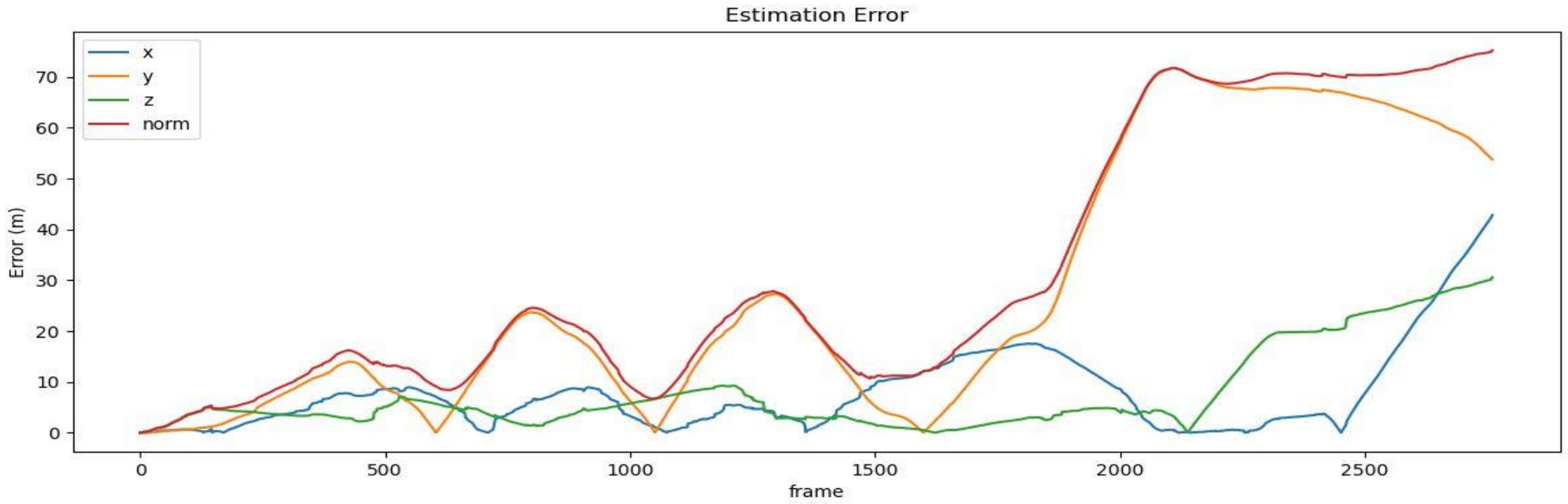


Project Submission

- Median factor error of the different track links as a function of distance from 1st frame the track appeared on
  - for PnP estimation (initial solution)
  - for Bundle estimation (optimization result)

Project Submission

- Absolute PnP estimation error:
  - X axis error, Y axis error, Z axis error, Total error norm
  - Angle error



Project Submission

- Absolute Pose Graph (**without** loop closure) estimation error:
  - X axis error, Y axis error, Z axis error, Total error norm
  - Angle error

- Absolute Pose Graph (**with** loop closure) estimation error:
  - X axis error, Y axis error, Z axis error, Total error norm
  - Angle error

Project Submission

- Relative PnP estimation error:

  The error of the relative pose estimation compared to the round truth relative pose.

  This can be between every two consecutive frames or between every two consecutive keyframes

  - X axis error, Y axis error, Z axis error, Total error norm
  - Angle error

- Relative Bundle estimation error:

  - X axis error, Y axis error, Z axis error, Total error norm
  - Angle error

Project Submission

- Number of matches per successful loop closure frame

- Inlier percentage per successful loop closure frame

Project Submission

- Uncertainty size vs keyframe – pose graph **without** loop closure:
  - Location Uncertainty
  - Angle Uncertainty
- Uncertainty size vs keyframe – pose graph **with** loop closure:
  - Location Uncertainty
  - Angle Uncertainty
- Describe how you represent uncertainty size!