July 2020

UNIVERSITY OF LINCOLN

Orientation Estimation of Strawberry Fruit

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Presentation Content

- Motivation
- Previous Work
- Work in Progress
- Q & A

Motivation

- 6D-pose estimation of strawberries for picking applications
- Proper path planning with respect to pose
- Ideal handling of fruit to be harvested

Previous Work

- 3D-position: $\sim$ solved problem
- Rotation estimation based on RGB-D data: well researched
- Solutions mostly learning based
- Problems:
  - Rotationally symmetric objects
  - Rotation-annotated training data

Challenges

- Rotational symmetry:
  - Annotation style?
  - Loss function?
- Training Data?
- Rotation Estimator?

Annotation Style

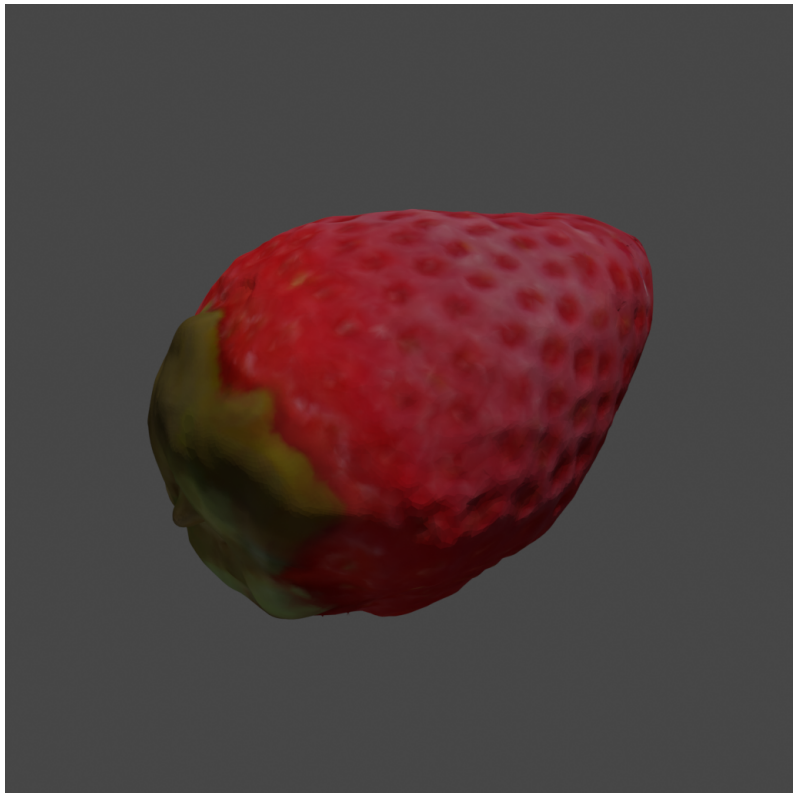


Figure: Rot. configuration: R=300, P=10, Y=30

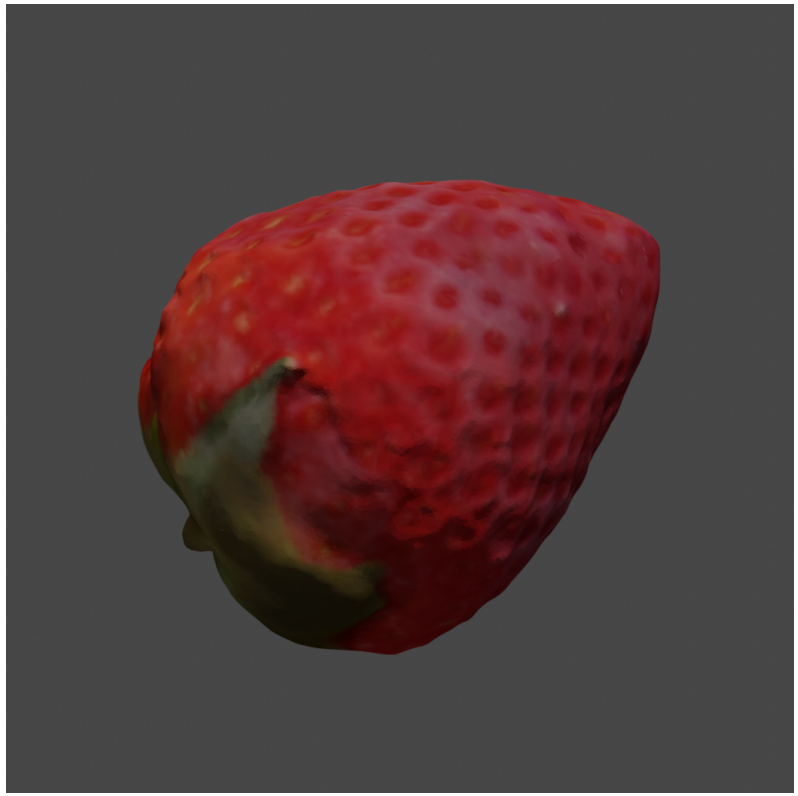


Figure: Rot. configuration: R=50, P=40, Y=170

Annotation Style

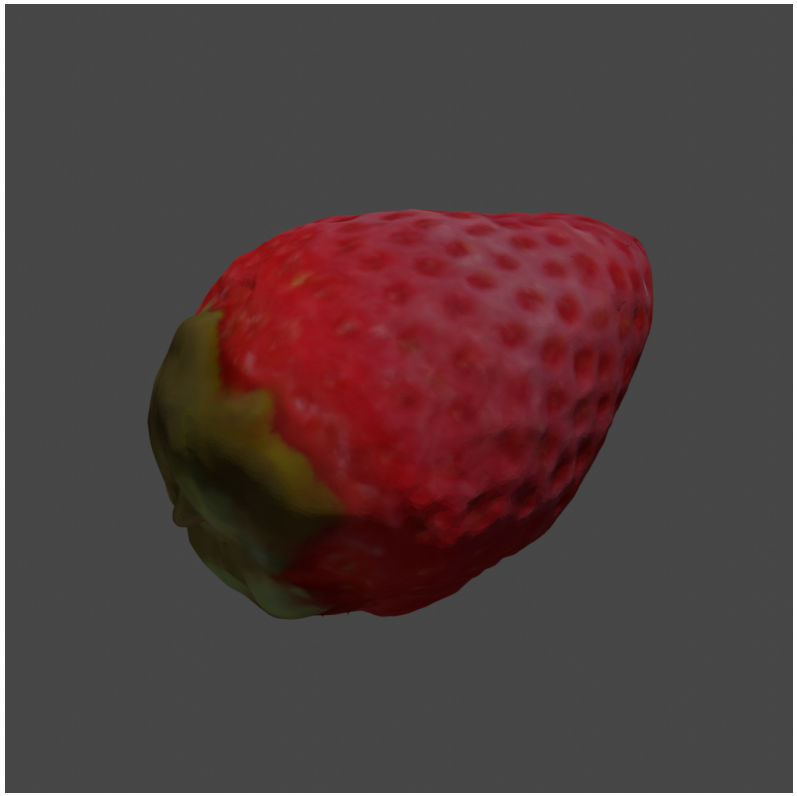


Figure: Rot. configuration: X=0.35, Y=0.82, Z=0.49

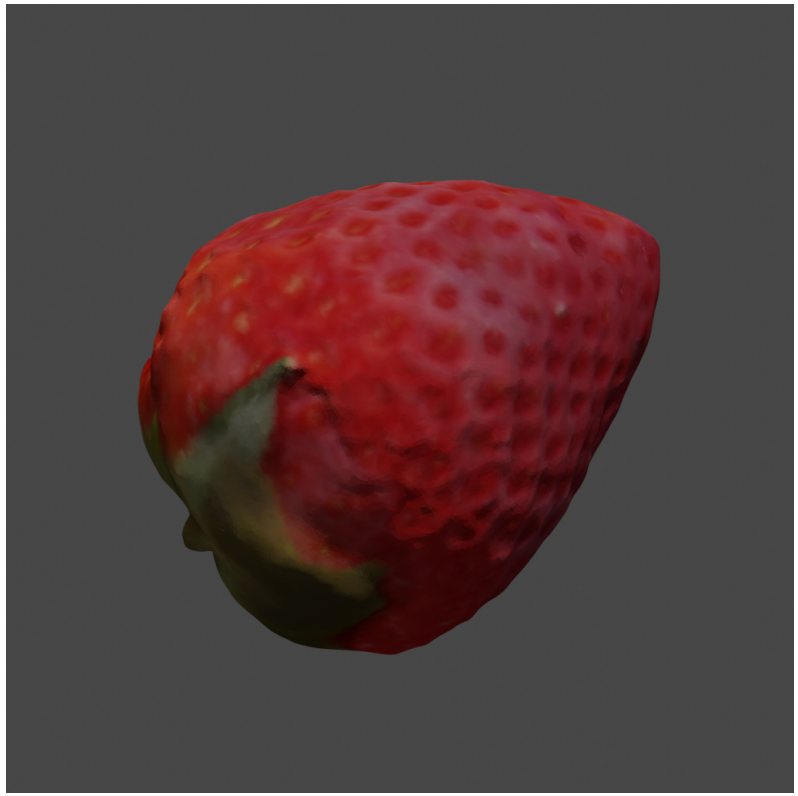
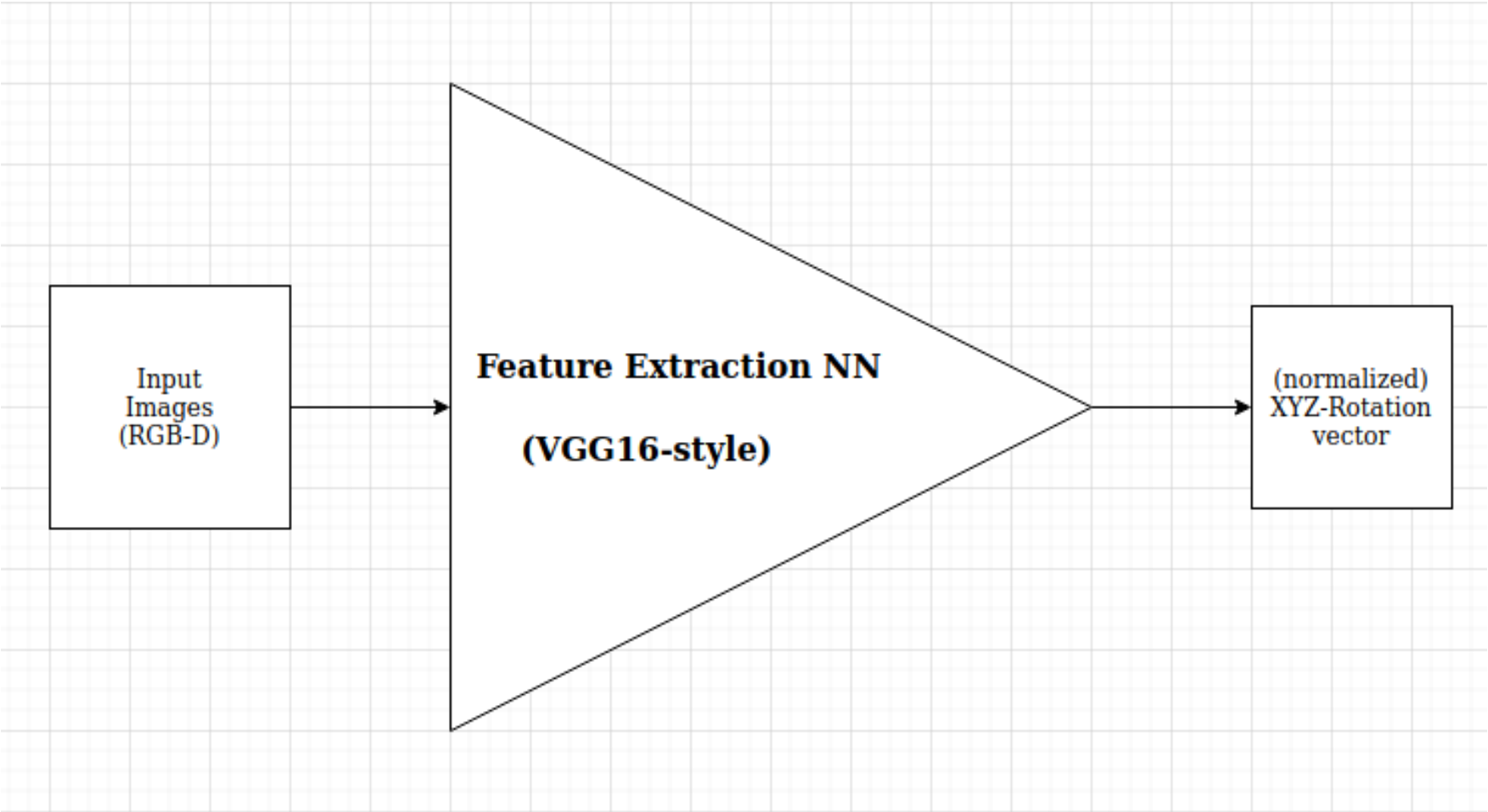


Figure: Rot. configuration: X=0.27, Y=0.79, Z=0.49

Rotation Estimator

- Learning based solution
- RGB-D feature extraction
- XYZ-orientation-vector regression

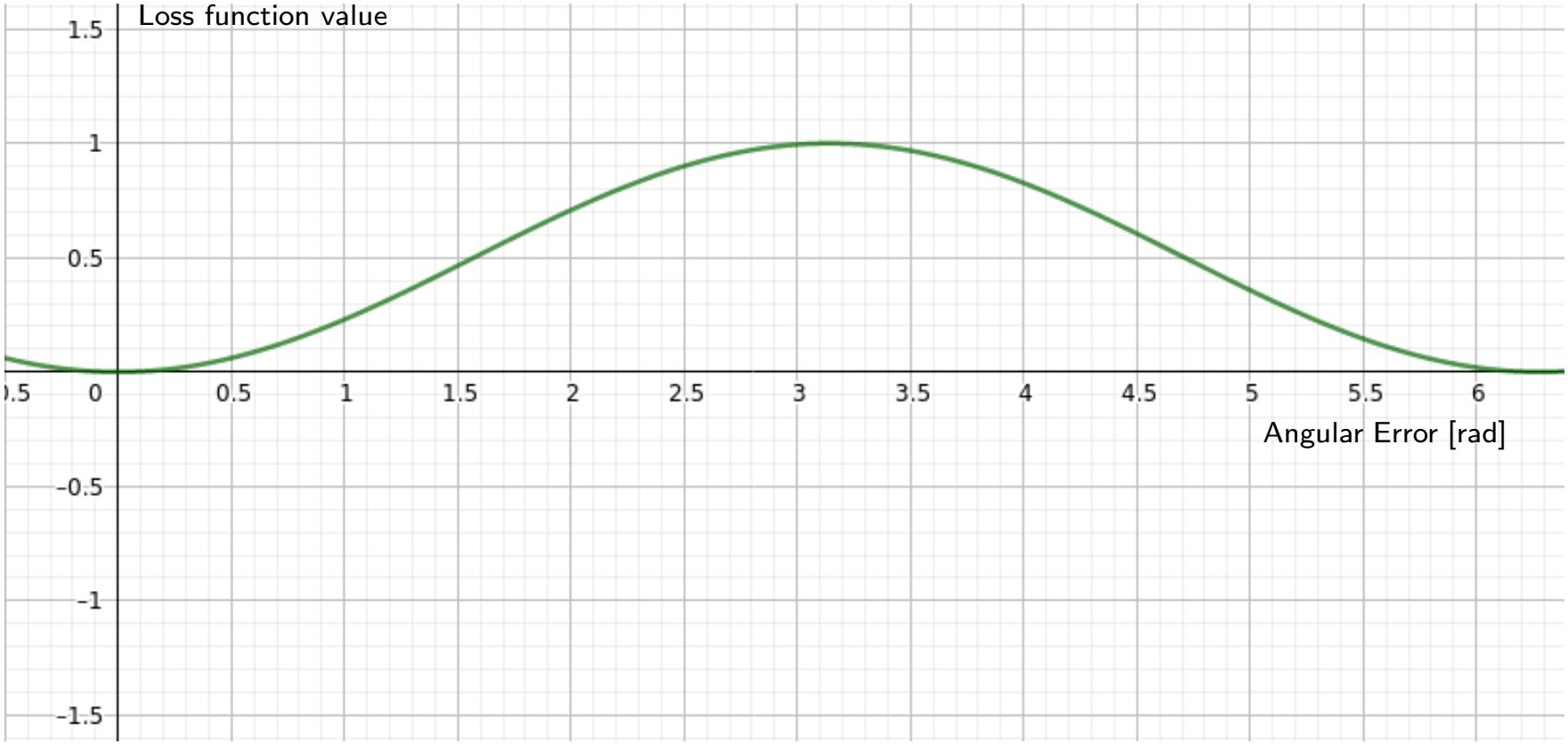
Rotation Estimator



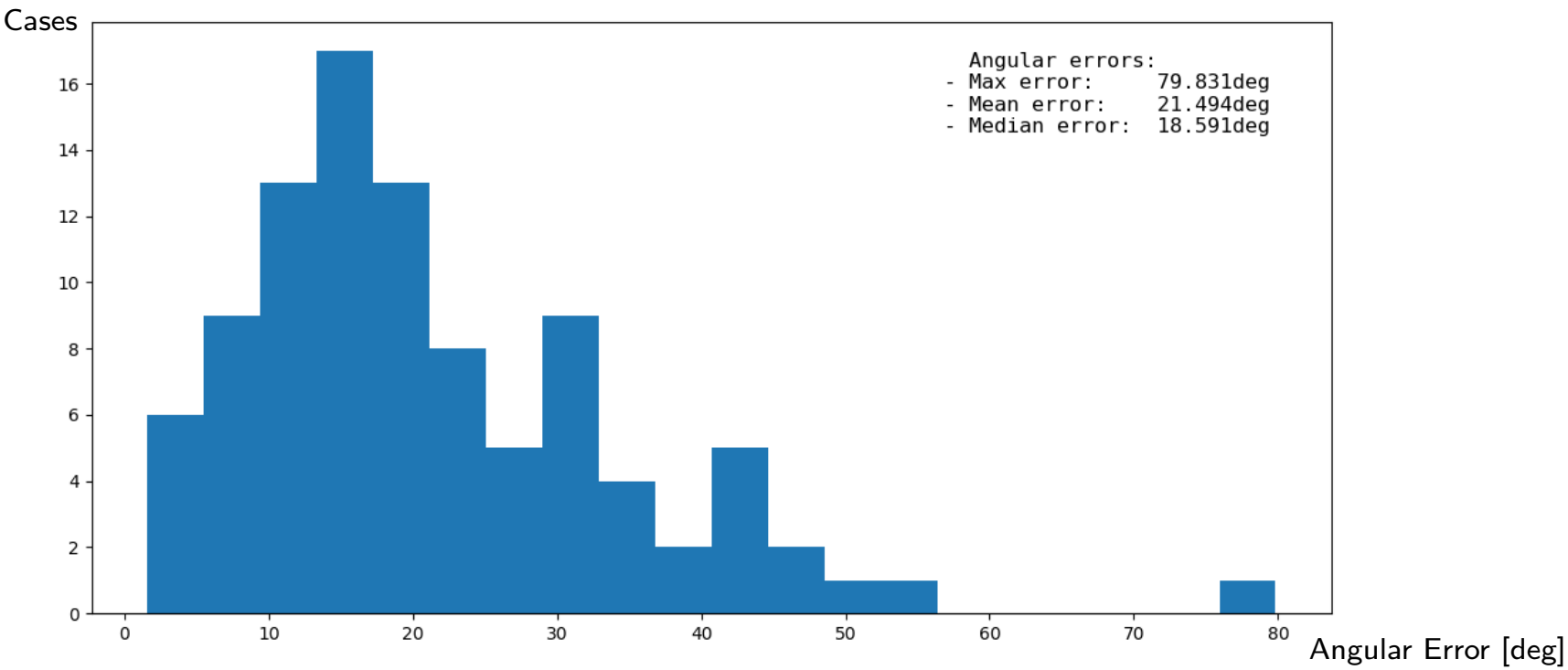
Loss Function

- Loss = modified cosine similarity:
  - Angle ϕ between true and predicted XYZ-vector
  - Scale between 0 and 1: $\frac{1-cos(\phi)}{2}$

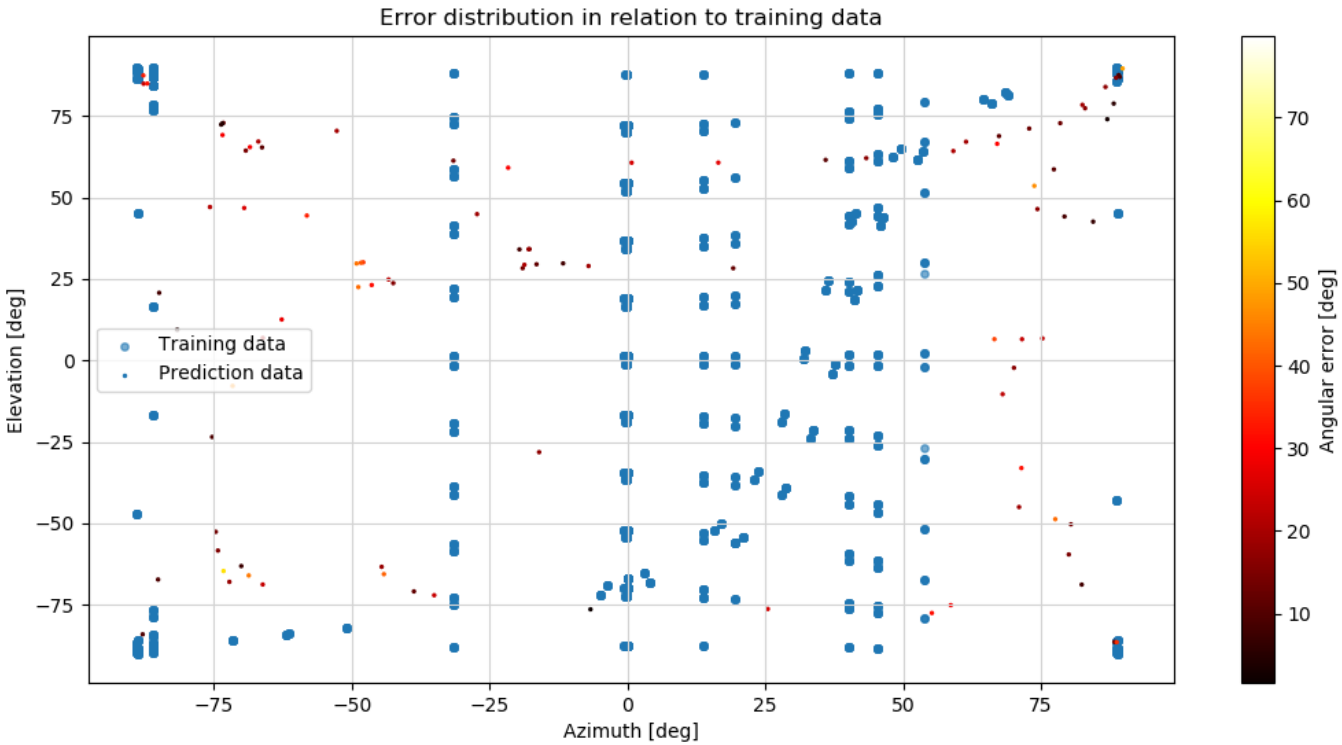
Loss Function



Absolute Performance



Relative Performance



Possible Improvements

- Different feature extractor
- Other rotation representation & loss function
- More diverse training data

Questions?