Finding Satellite Direction from Time Difference of Arrival Data using Resnet

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Intro:

- Find satellite direction with TDoA
- Train Resnet101 to find 2D TDoA solution
- Draw a line from (0,0) to CNN (X,Y) output for direction

Methods:

- Generated dataset with random noise
- Images are hyperbolas created from TDoA data
- Tried ensemble of nets and 10k, 25k, and 100k images

Results:

- Elevation error decreases
- Azimuth error constant

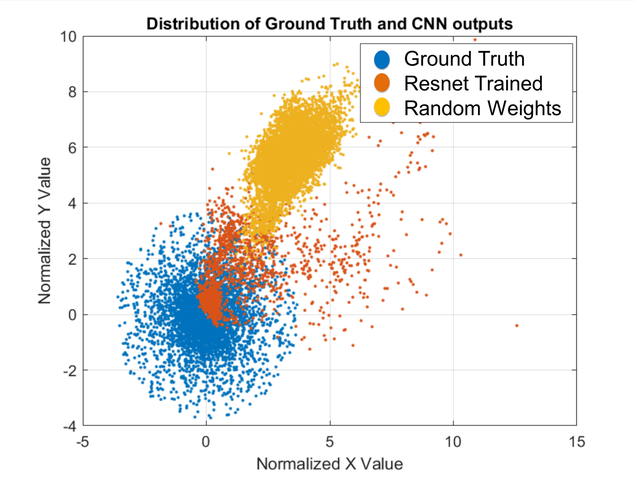
Future Direction:

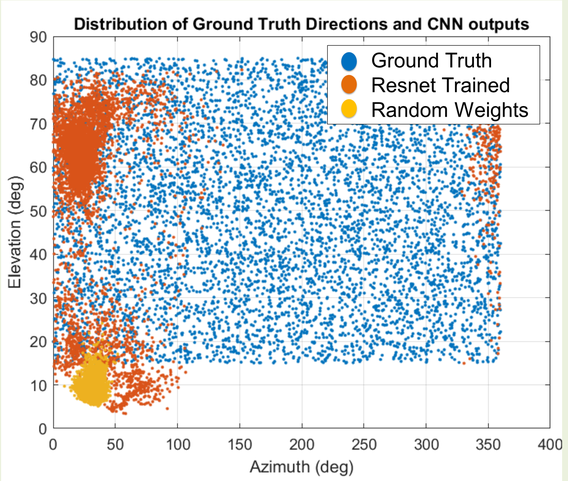
- Quadrant classification then regression
- Increase loss if output has incorrect sign for X or Y

Abbreviations: TDoA (Time Difference of Arrival)

Our goal is to reduce TDoA solution's sensitivity to noise.

Resnet failed to learn –X and –Y values causing azimuth error to decrease only marginally from training. Bar-codes representing TDoA data and adding more images does not change error significantly.

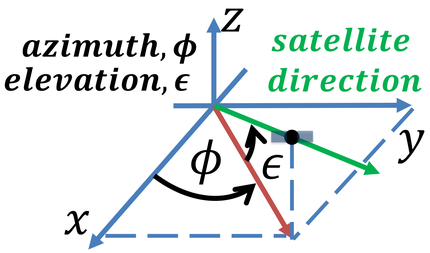


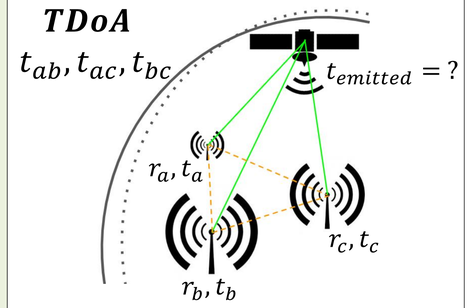


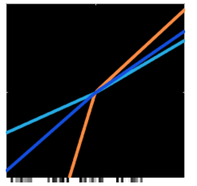
Resnet fails for negative X or Y values. → Resnet struggles with azimuth angles between 100-330 degrees

	Error	Classic TDoA	Random Weights	No Bar-code, 10k	Bar-code, 10k	Bar-code, 100k images
No input noise (deg)	Azimuth	1	89.5	88.3	88.4	87.9
	Elevation	1	43.5	19.0	18.9	18.2
Max input noise (deg)	Azimuth	19.9	90.2	87.8	88.1	88.7
	Elevation	7.3	44.1	19.3	19.3	18.0

Supplementary Figures

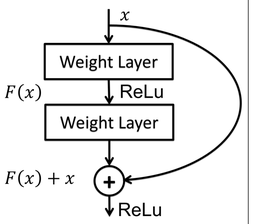






Sample image with the bar-code

Residual neural network



Training for 100,000 images. Best RSME 0.08