

MINI PROJECT

LOCATION ESTIMATOR WITH COMPASS ONLY

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1. INTRODUCTION

1 INTRODUCTION

Problem Statement

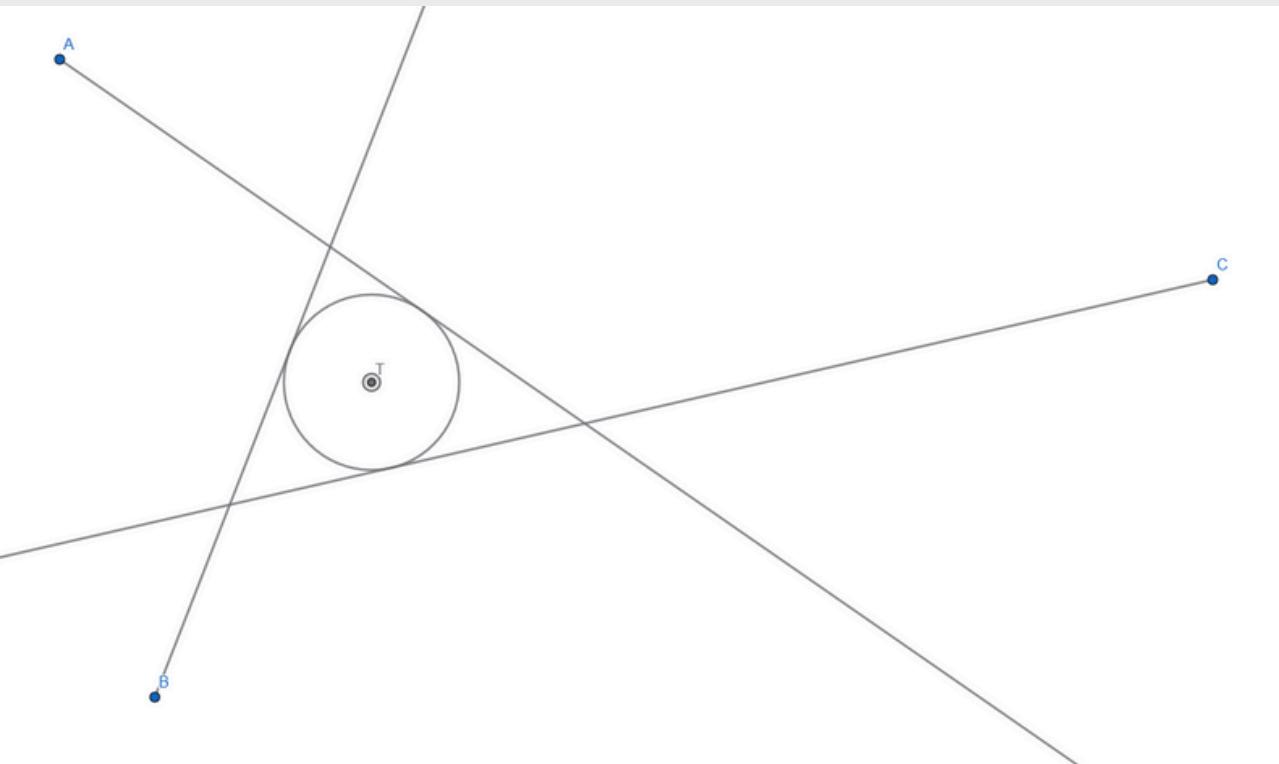
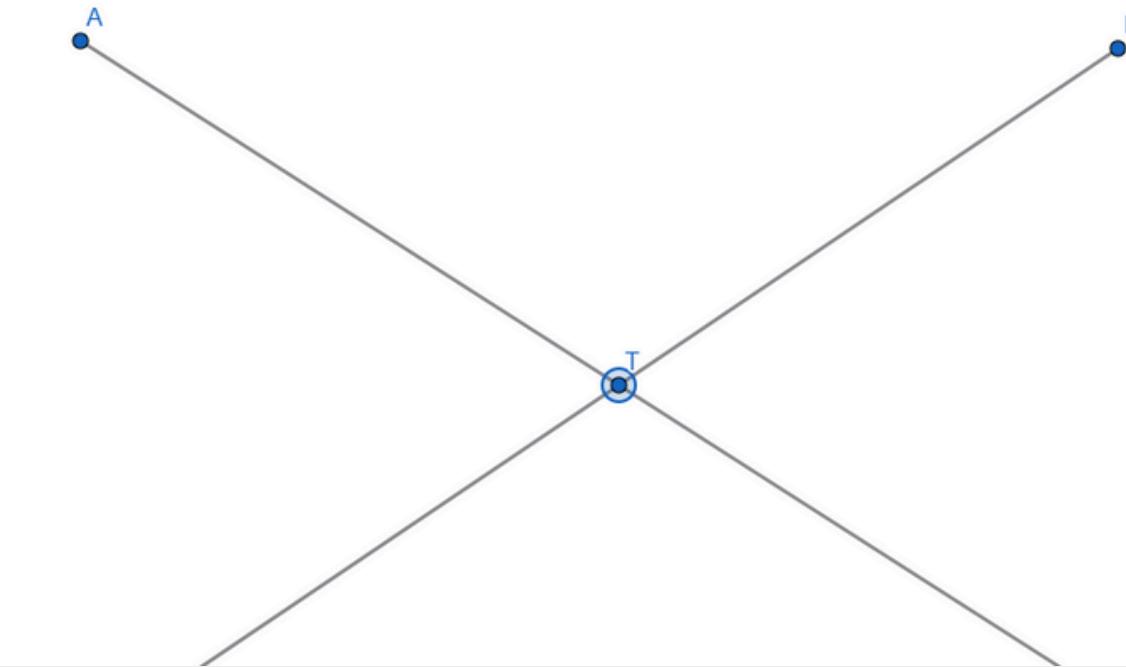
- Location Estimating is a common practical problem in both civil and military fields.
- This problem is solved with high accuracy with GNSS (Global Navigation Satellite System).
- In some extreme cases, GNSS is not available and a compass is the only equipment.



1 INTRODUCTION

Current Approach

- The well-known classical approach for this situation is geometrical approach.
- This approach have 2 limits:
 - + Limited anchors (2 or 3).
 - + Not considering noises and bias (from both anchors and bearings).



2. METHODS

2METHODS

Least Error Estimator

- An expansion of classical geometric approach
- Allows an arbitrary number of anchors
- Inherited drawbacks: Not considers noises and bias

- Loss: sum of L2 distant from a point to 5 lines (defined by position of anchors and bearings)

$$\mathcal{L}(T) = \sum_{i \in \text{anchors}} d(T, l_i)$$



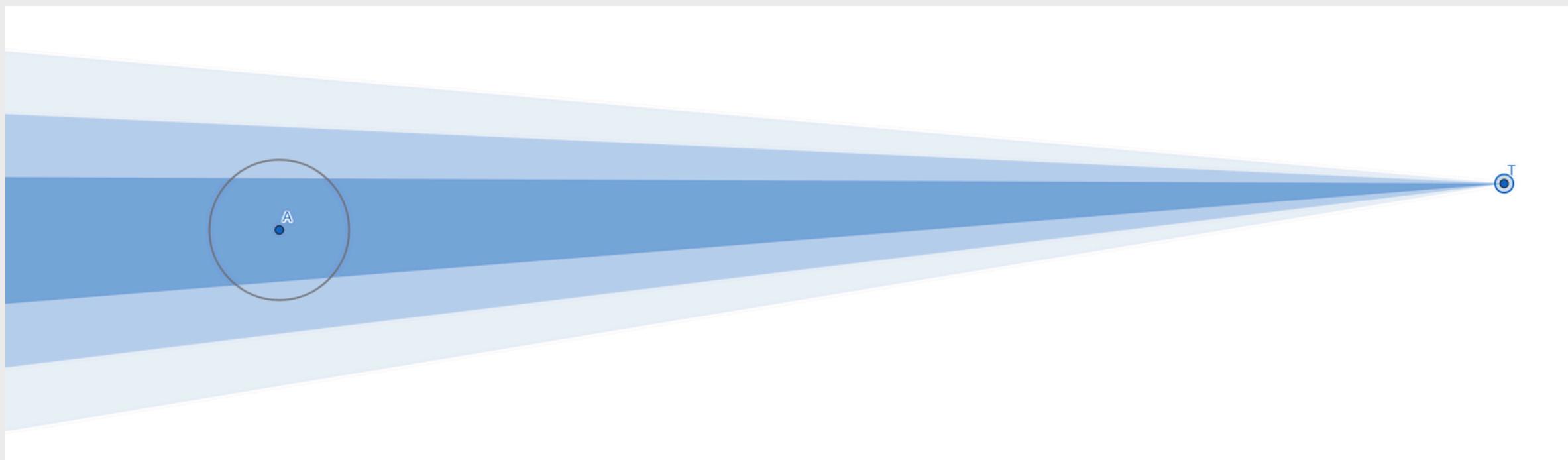
2METHODS

Maximum Likelihood Estimator

- Allows an arbitrary number of anchors.
- Considers:
 - + Noise of anchors
 - + Noise and Bias of bearing measurements

- Loss: sum of log likelihood of the measurements given parameters.

$$\mathcal{L}(T) = \sum_{i \in \text{anchors}} -\log \left(L(\phi_i | x_T, y_T, b) \right)$$

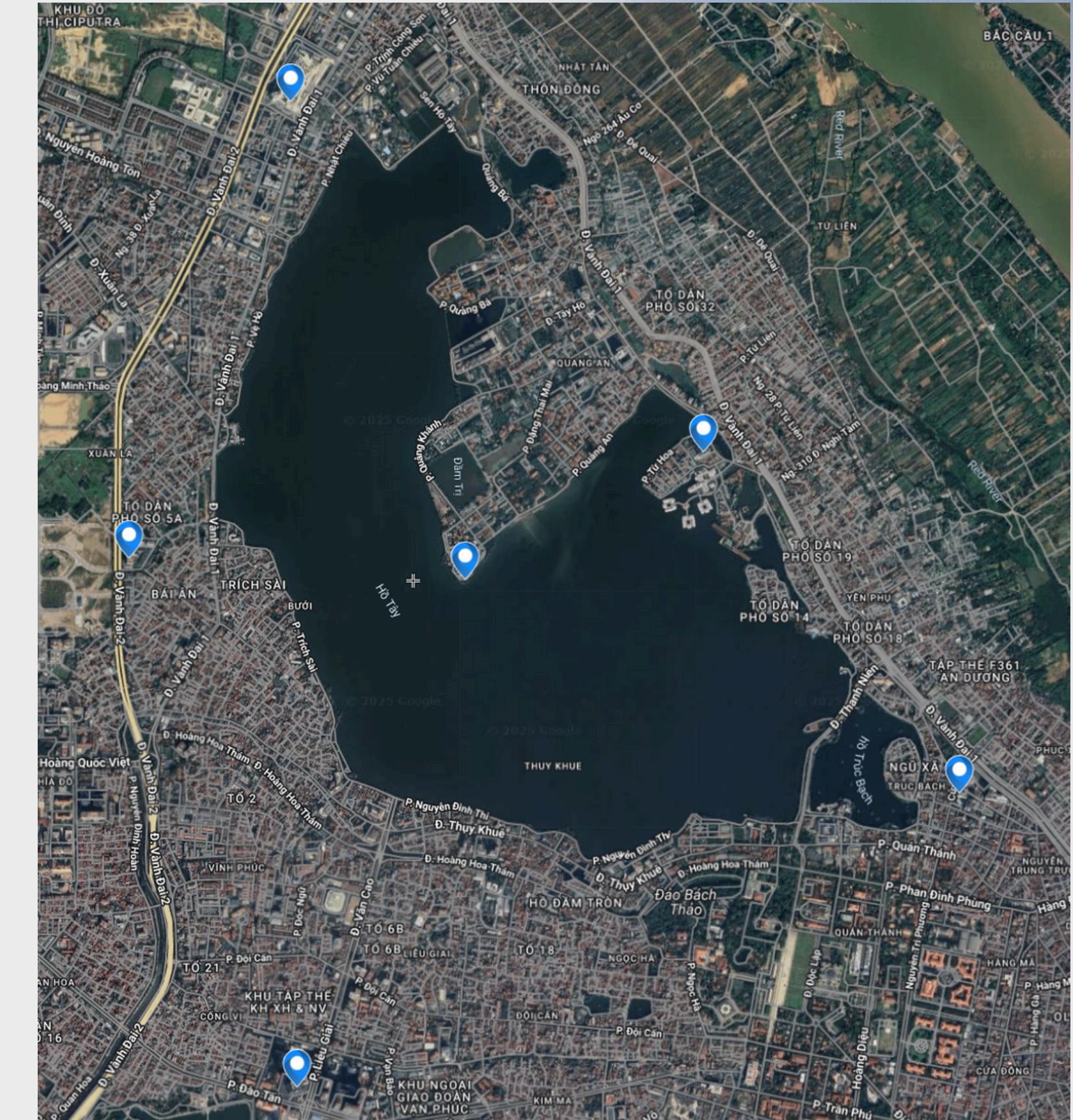


3. RESULTS

3. RESULT

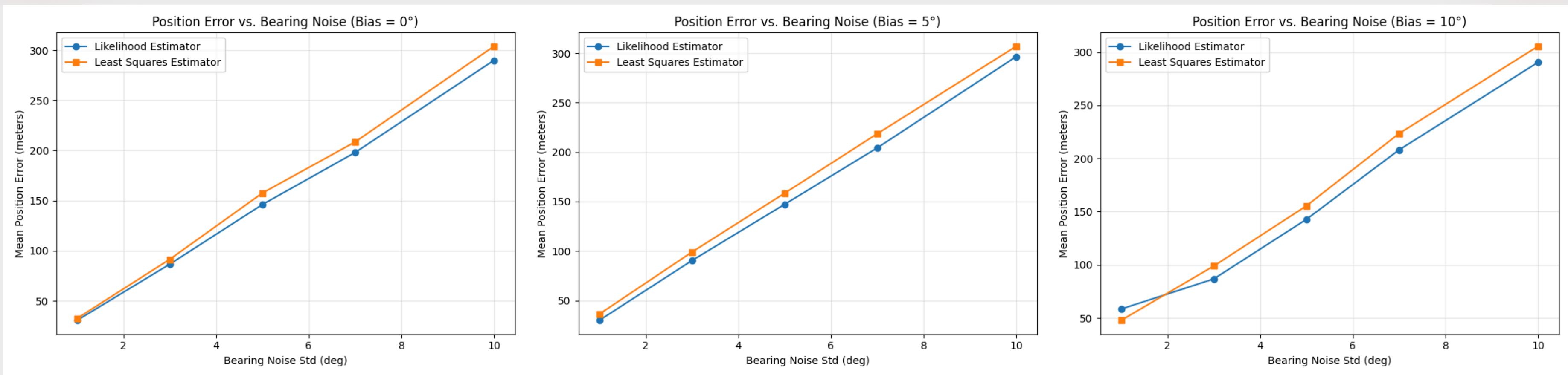
Example Used For Simulation

- We choose one location in Hồ Tây as our example.
- The 5 anchors are:
 - + Sheraton Hanoi Hotel
 - + EVN Twin Tower
 - + Lotte Hotel Hanoi
 - + Moon Tower
 - + Lotte World Aquarium Hanoi



3. RESULT

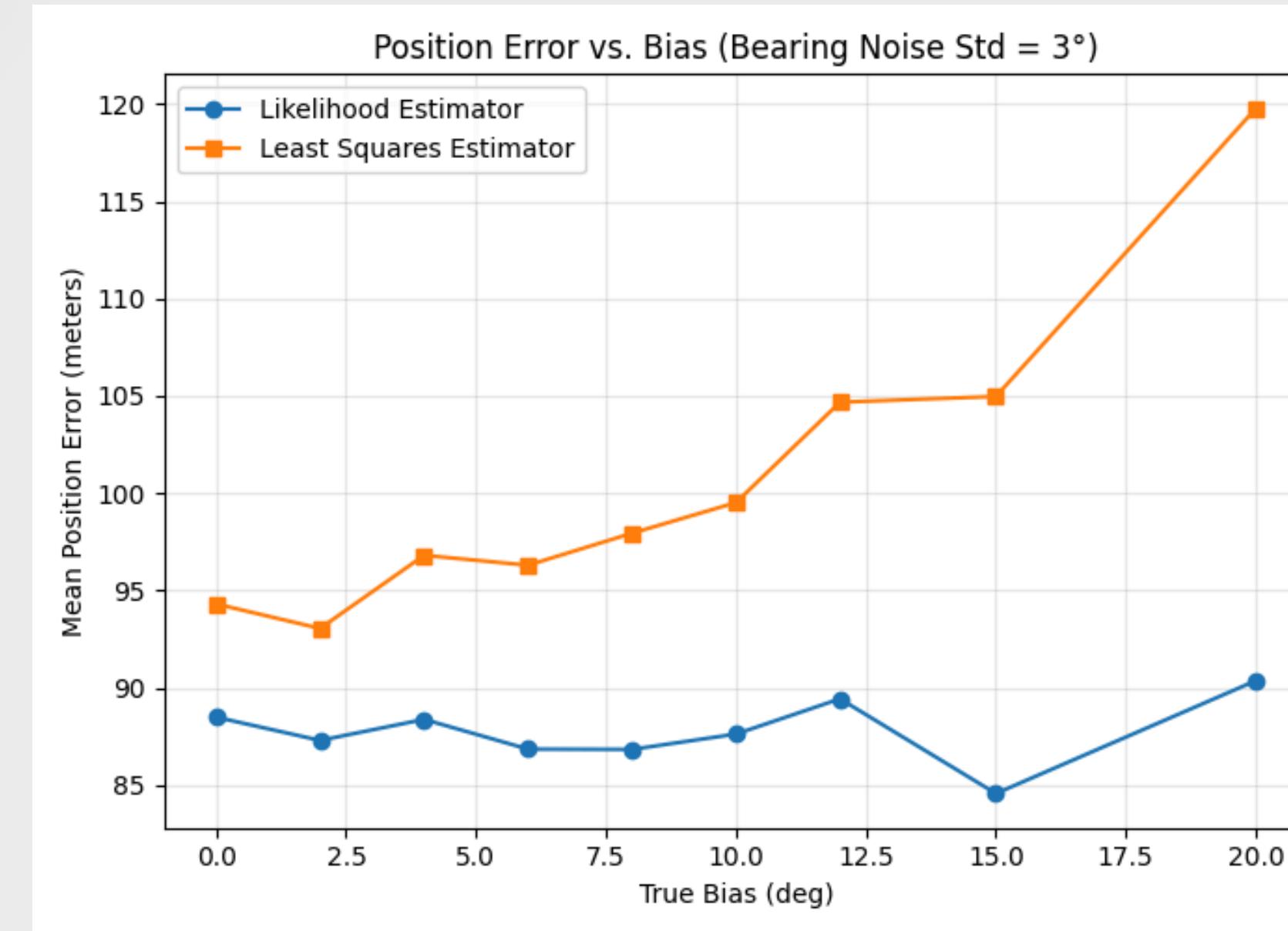
Results



- In most cases, the Likelihood Estimator have lower Mean Position Error.
- In realistic case (3° of standard deviation in bearing noise), the Mean Position Error is under 100m.

3. RESULT

Results



- Likelihood Estimator is more robust when bias increases.
- In realistic case (3° of standard deviation in bearing noise), the Mean Position Error is under 90m.

4. CONCLUSION

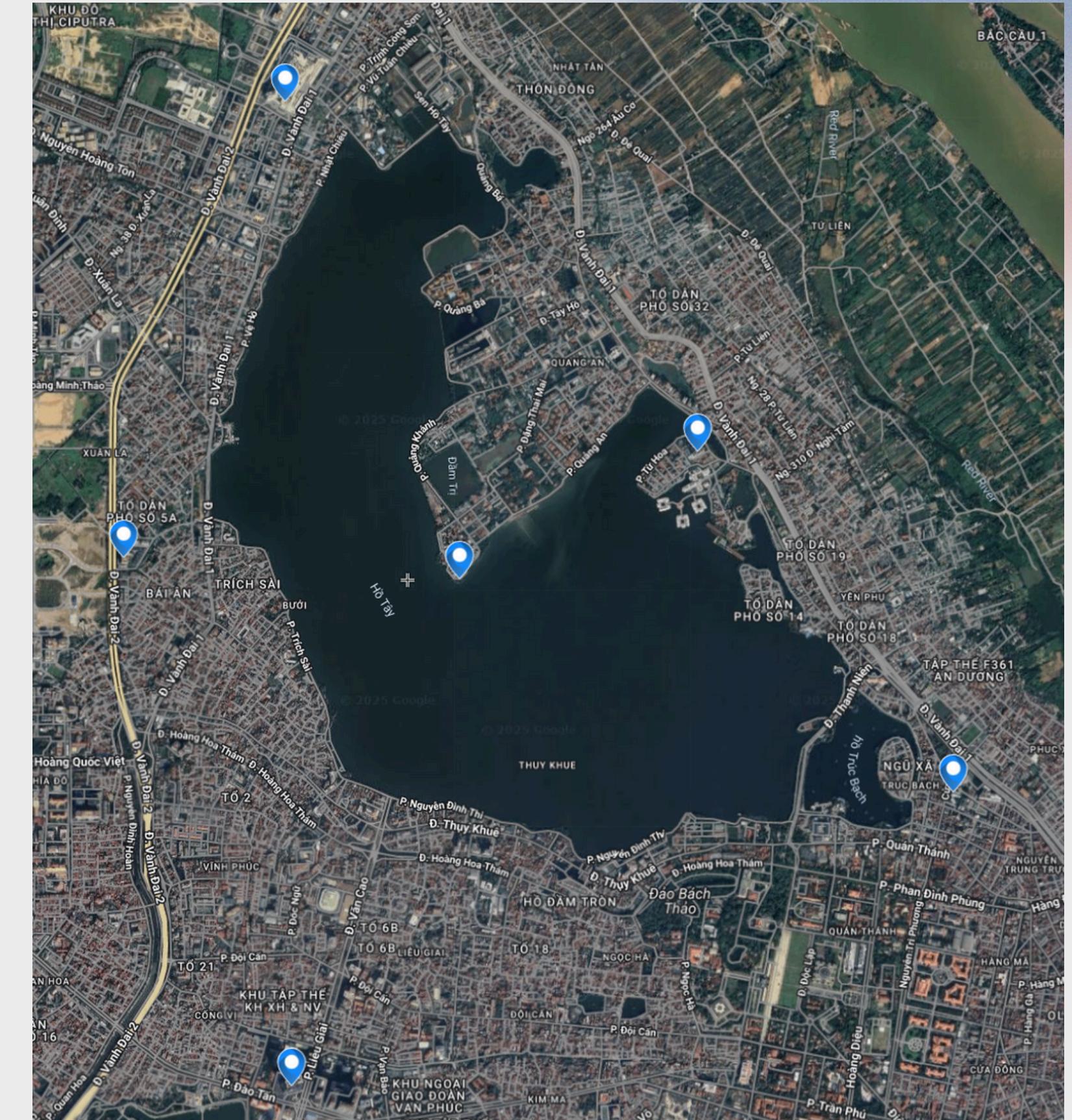
4. CONCLUSION

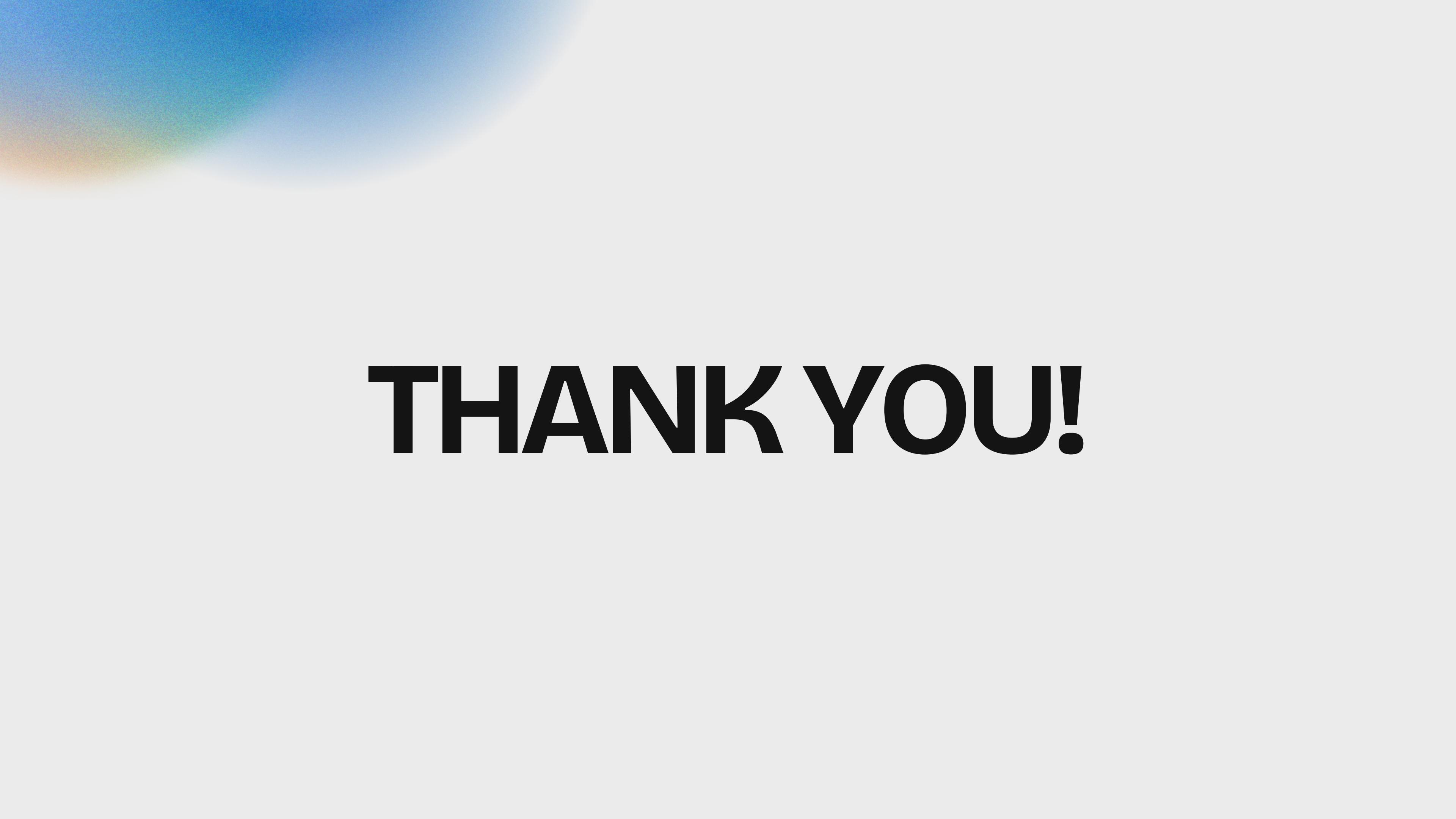
Conclusion

- With minimal equipment, the methods allows location estimation with not too bad accuracy.

Future Works

- We are working on a deeplearning models for MLE methods that might surpass current hand-crafted estimators.





THANK YOU!