



# IPIN 2022

TWELFTH INTERNATIONAL CONFERENCE ON

**INDOOR POSITIONING  
AND INDOOR NAVIGATION**



# AI-based 5G Positioning

Chang Su



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Chinese Academy of Sciences



# Team members



中国科学院软件研究所  
Institute of Software, Chinese Academy of Sciences

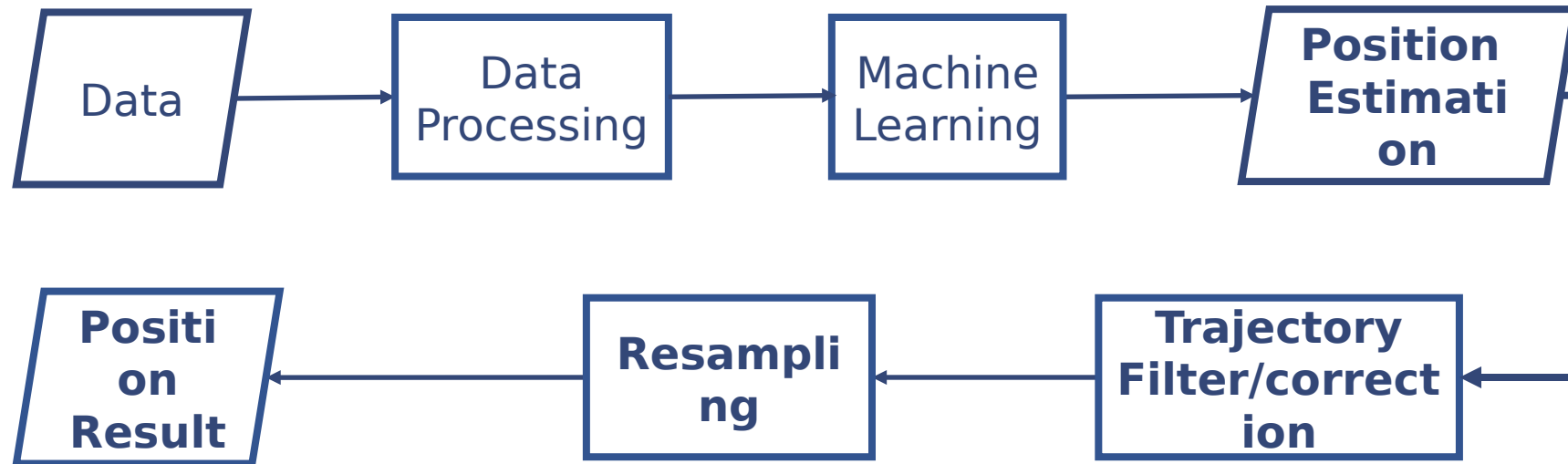
## Team: Mobile

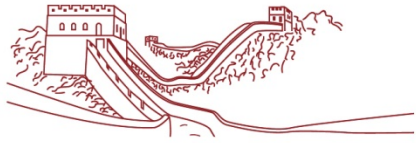
**Members: Chang Su, Beihong Jin,  
Zhi Wang, Siheng Li, Yuqi Su**





# Algorithm Pipeline





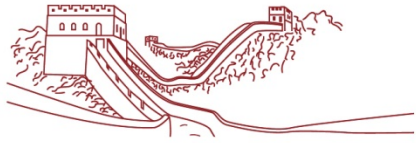
# Description of Data



Time Stramp(s)	TOA 0 (ns)	TOA 1 (ns)	TOA 2 (ns)	TOA 3 (ns)	Rsrp 0 (dBm)	Rsrp 1 (dBm)	Rsrp 2 (dBm)	Rsrp 3 (dBm)	X (m)	Y (m)
0	122	140	234	223	-51.95	-54	-56.2	-56.6		
0.12	117	136	230	218	-51.7	-53.95	-56.05	-56.7		
0.2	117	135	231	217	-51.4	-54	-55.95	-56.7		
0.28	125	143	238	226	-51.25	-53.95	-55.85	-56.8		
0.4	125	142	238	225	-51.3	-53.8	-55.8	-56.6	3.25	17.97

TOA: 
$$T_{srs}^{bs,ue} = T_{tx}^{ue} + T_{air}^{bs,ue} + T_{rx}^{bs}$$





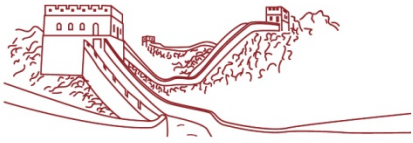
# Description of Data



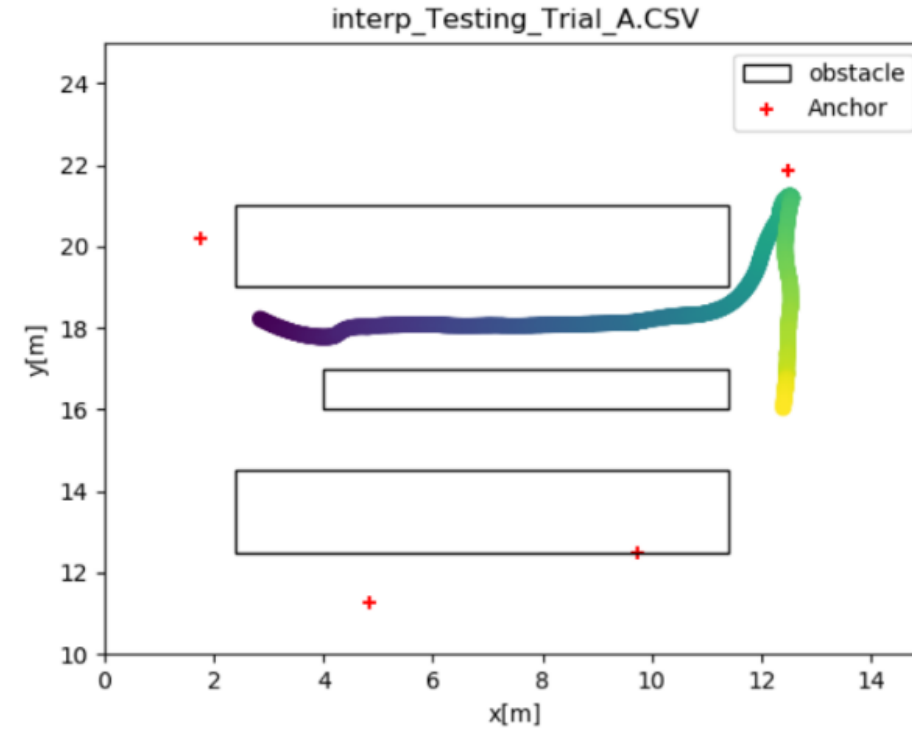
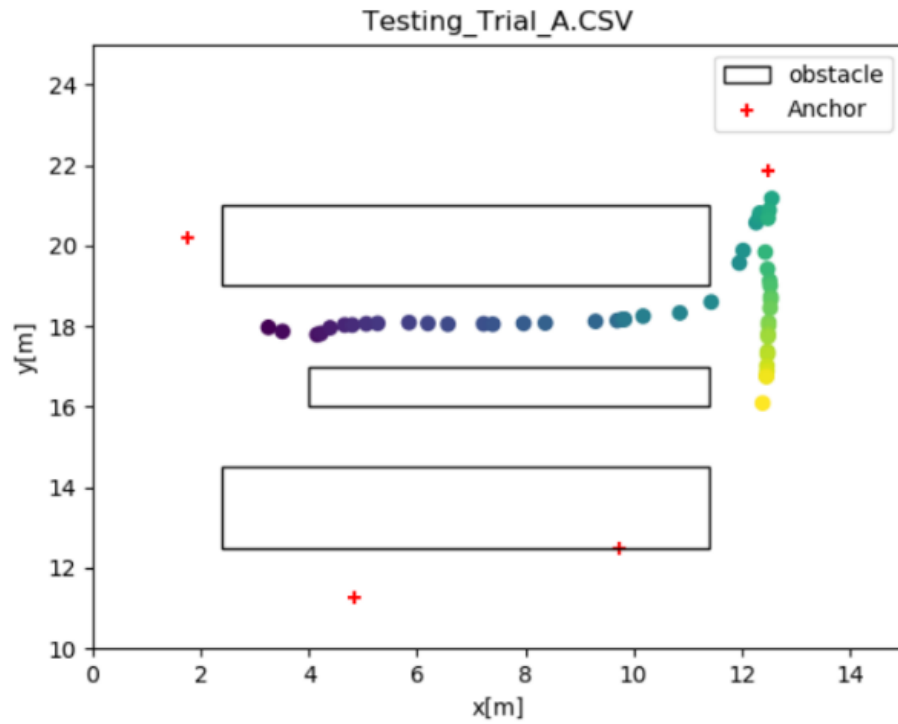
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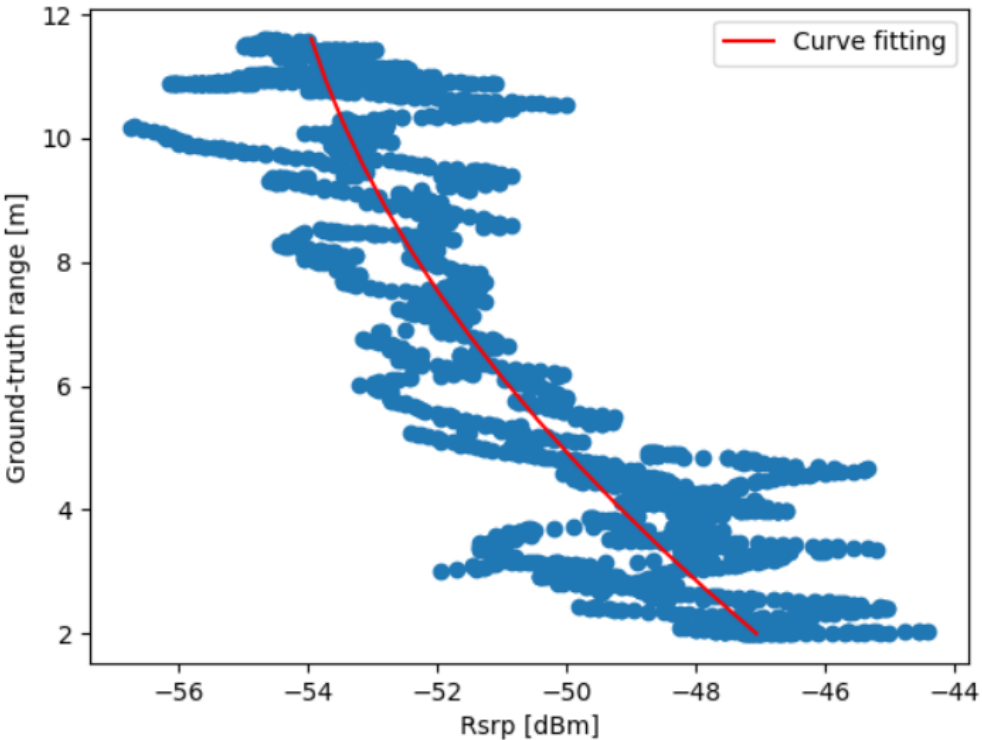
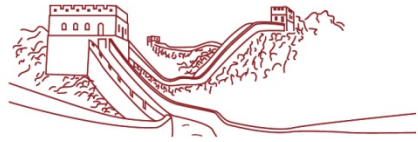




# Obtaining more labeled data



# Data augment



Relationship between rsrp received by TRP 0 and true range

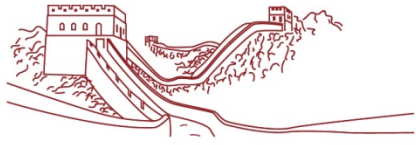
Fitted Function:

(1)

We simulated 100,000 data as the training set  
Examples of simulated data

Rsrp 0	Rsrp 1	Rsrp 2	Rsrp 3	X	Y
-50.25	-55.55	-53.57	-54.99	4.43	22.74
-45.57	-52.32	-52.25	-53.03	1.88	20.3
-53.95	-49.36	-54.51	-45.71	10.5	11.62





# Machine Learning



We introduced the **Catboost** model which takes the Rsrp and the difference between Rsrp as the input and output estimated coordinates directly

If we receive Rsrp as 1, 2, 3, 4 and the position of the UE (target) is x, y

Then the input is:

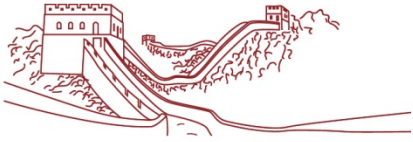
[ 1, 2, 3, 4, (1-2), (1-3), (1-4), (2-3), (2-4), (3-4)]

The label is :

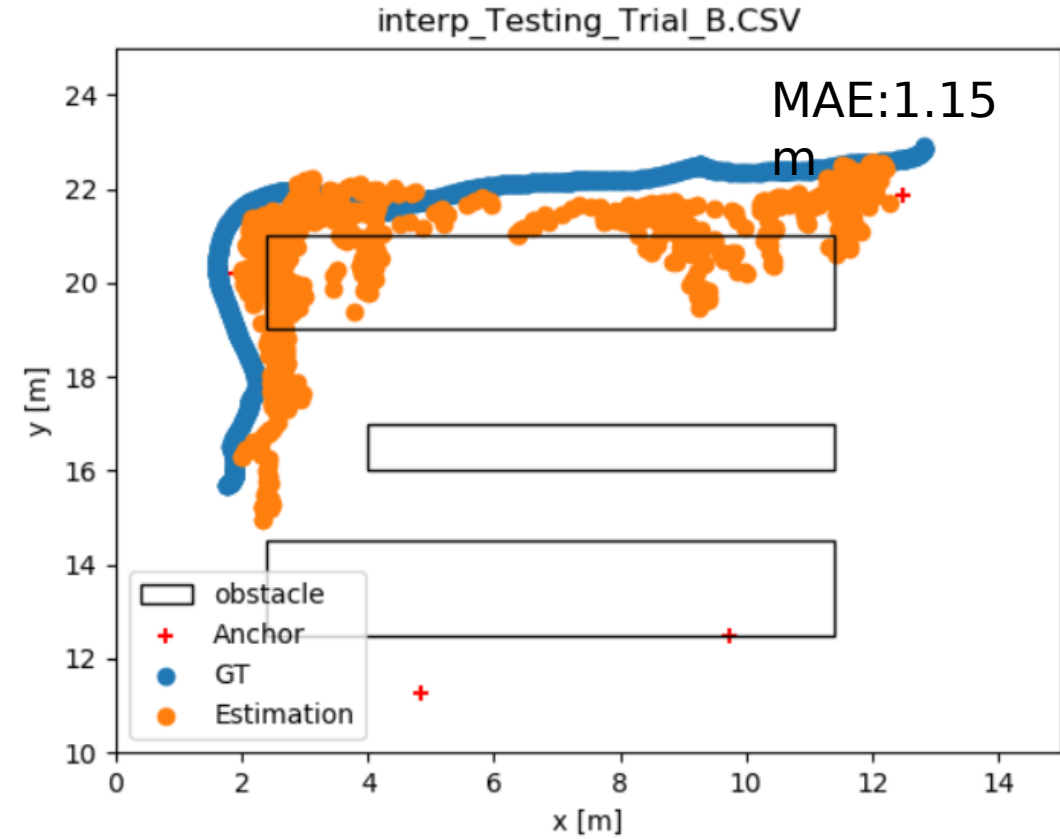
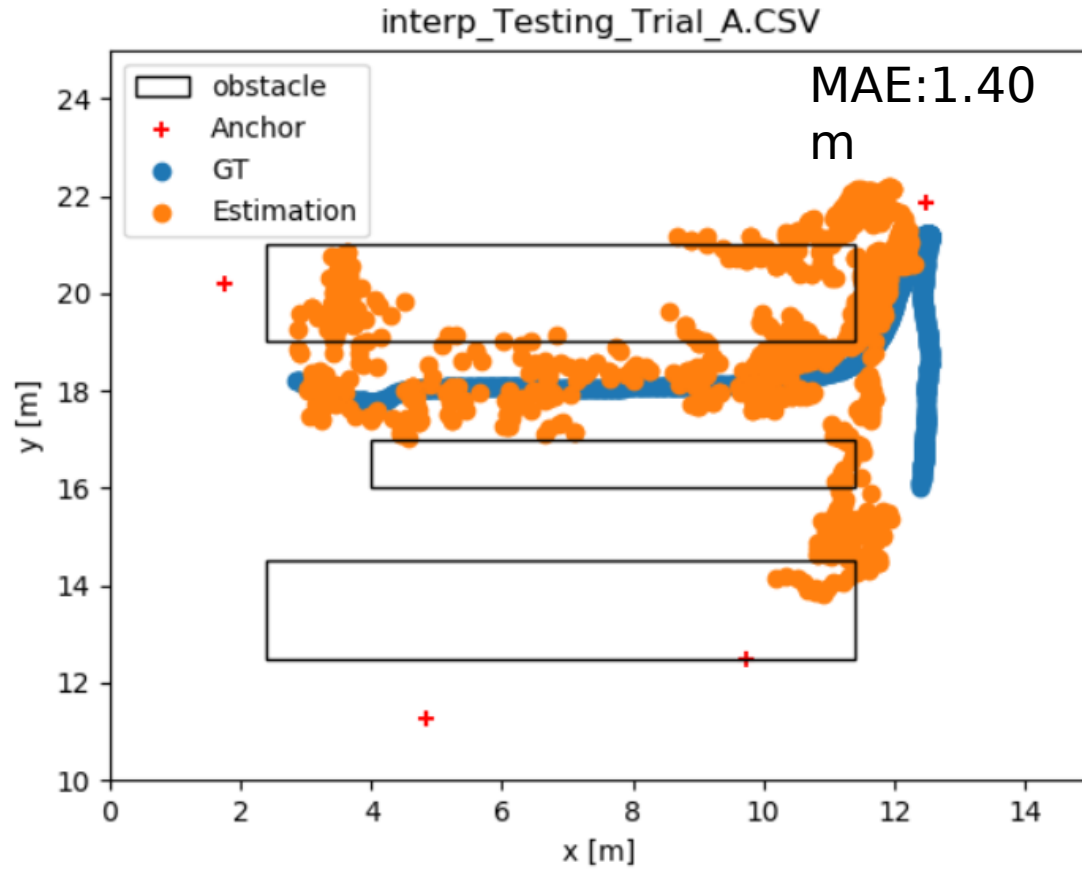
[x, y]

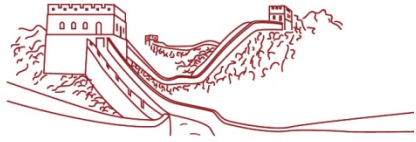






# Machine Learning



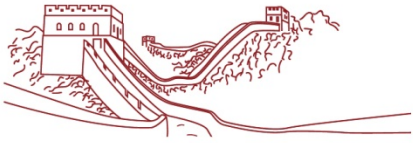


# Trajectory Filter/correction



1. People cannot pass through obstacles
2. The position of a person will not change greatly in a short period of time
3. When we obtain relatively accurate position estimates, we can further obtain more position information by correcting TOA

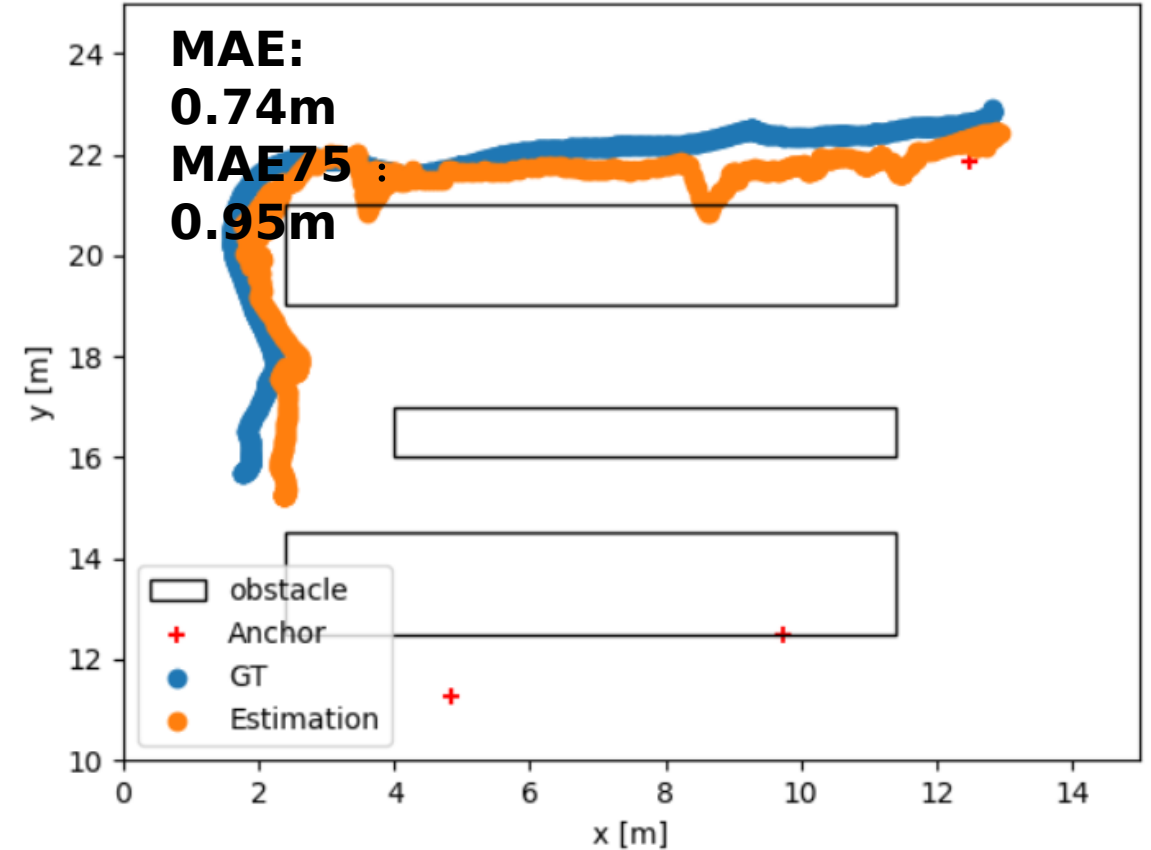
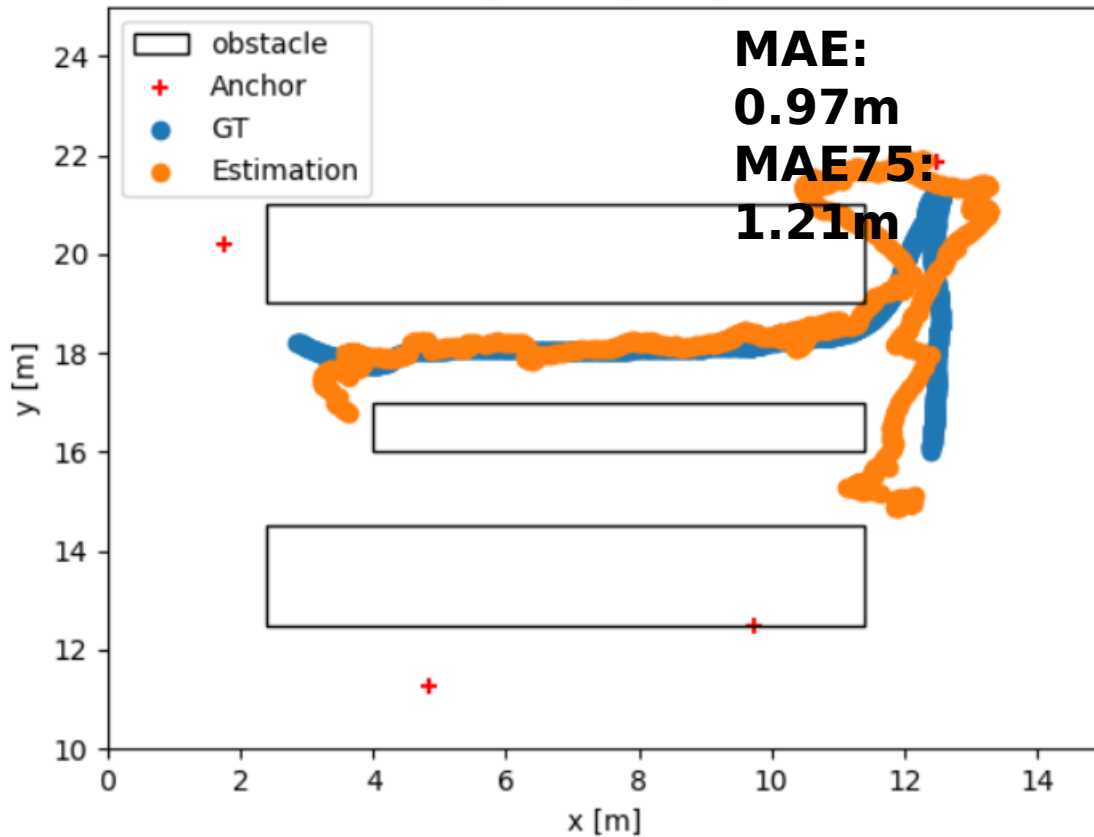


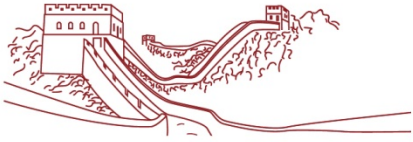


# Trajectory Filter/correction

interp\_Testing\_Trial\_A.CSV

interp\_Testing\_Trial\_B.CSV

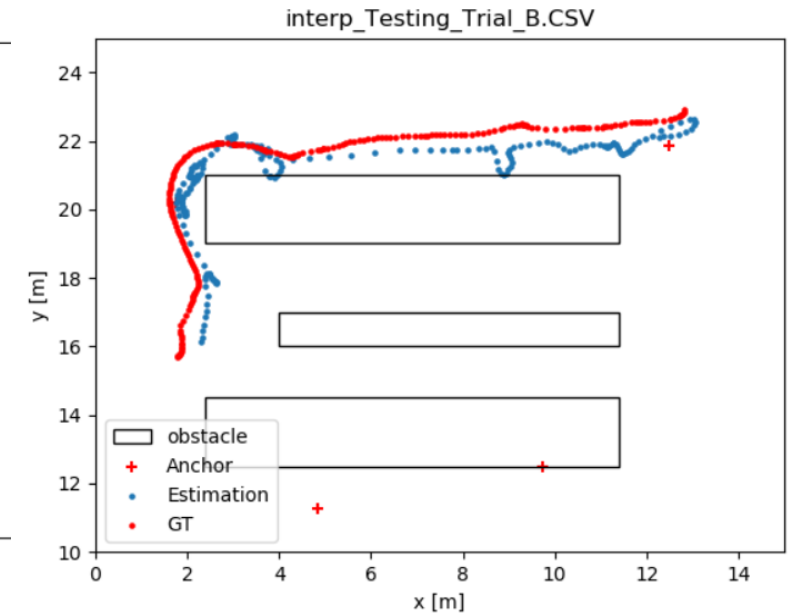
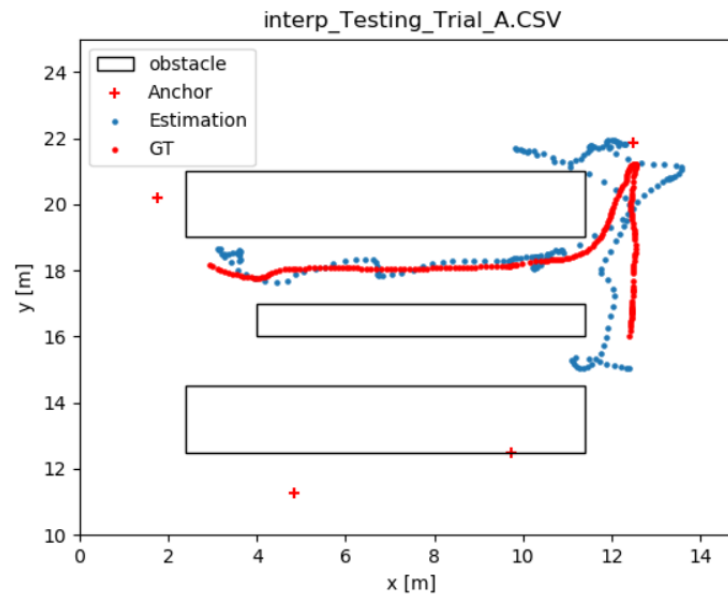




# Resampling



Finally, when testing the scoring data in real-time, we will collect the previous position estimations with corresponding time and perform fitting and resampling every 0.5 seconds to obtain the submitted results





THANK YOU FOR YOUR ATTENTION !

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