

# Geometric Dilution of Precision (DoP) Based Simulation for Indoor Anchor Deployment

The accuracy of indoor localization solutions is tightly governed by the geometric shape made by the anchors in relation to the area where the indoor localization solution is deployed. This is a web tool that will allow you to experiment with various anchor placements in a rectangular room of your choice and demonstrate how the location accuracy of a client is expected to vary in the indoor space purely because of the geometric dilution of precision (DoP). Of course, other parameters such as furniture in the room, absorption by walls, reflections by metallic surface, etc. does impact accuracy, but this website ignore those issues and only concentrates on the DoP. Furthermore, there are multiple ways to perform localization. We will only focus on time-difference of arrival (TDoA) techniques for localization. The solution to localization is an intersection of hyperbolas and since every measurement has errors, the localization accuracy in a space is non-trivial to calculate.

You may give us information about anchor coordinates, room size, distance between sample points, sigma, maximum error shown, choice of initial seed, and your choice of DoP method. Below is one example of inputs (all of your inputs should be in millimeters, and the output contour map is in meters):

Anchor Locations: 1500,1500;1500,2500;2500,1500;2500,2500

The bottom left corner of your room is the origin. This means your initiator is at (1500,1500), and three responders at (1500,2500), (2500,1500), (2500,2500) respectively.

Room Size: 4000\*4000

width\*height. This is a 4meter\*4meter room.

Sample Distance: 200

distance between each location sample used for accuracy calculation. Sample taken every 0.2meter. Thus,  $20*20 = 400$  sample points in our case.

Sigma: 50

sigma of Gaussian noises added to TDoA (Mu is set as 0).

Maximum error shown: 10000

maximum error shown in our map. All errors larger than this are rounded down to this maximum value.

Initial Seed: custom

This is an initial guess of target location. Our solver starts from this initial seed, and converges to the target location.

If custom is chosen, you need to specify your initial seed location in the following Custom Seed parameter. If origin or roomCenter is chosen, then the initial seed will be the bottom left corner of your room or the center of your room respectively, and the input for Custom Seed will be overlooked.

Custom Seed: 20,20

If you choose custom in Initial Seed, specify your initial seed here. Otherwise, just put random location like 0,0. Cannot leave it empty.

DoP: all

“All” means the calculation will run 100 times with different Gaussian noises added to TDoA and return the median error value for each sample point.

“Best” means the best anchor combination will be selected based on our DoP value and used for calculation.

Count: 50

50 counts means each sample point is calculated with random Gaussian noises for 50 times, and the plot shows the median error of those 50 results for each sample.

Want to get a feel with our website using some input examples? Simply choose one of our 4 inputs and click apply! You do not need to input anything for the example to run.

Here are the inputs for each example:

Small Square:

```
anchorLoc = "150,150;150,250;250,150;250,250";
roomSize = "400*400"
sampleDistance = "200"
sigma = "50"
maxErrShown = "10000"
iniSeed = "roomCenter"
customSeed = "20,20"
dop = "all"
Count = "50"
```

Small Rectangular:

```
anchorLoc = "100,200;300,200;100,600;300,600"
roomSize = "400*800"
sampleDistance = "200"
sigma = "50"
maxErrShown = "10000"
iniSeed = "roomCenter"
customSeed = "20,20"
dop = "all"
Count = "50"
```

Large Square:

```
anchorLoc = "1500,1500;1500,2500;2500,1500;2500,2500"
roomSize = "4000*4000"
sampleDistance = "200"
sigma = "50"
maxErrShown = "10000"
iniSeed = "roomCenter"
customSeed = "20,20"
dop = "all"
Count = "20"
```

Large Rectangular:

```
anchorLoc = "1000,2000;3000,2000;1000,6000;3000,6000"
roomSize = "4000*8000"
sampleDistance = "200"
sigma = "50"
maxErrShown = "10000"
iniSeed = "roomCenter"
customSeed = "20,20"
dop = "best"
Count = "20"
```

Hope you find our website helpful. If you have questions, please send an email to Zixin Yin ([zyin81@gatech.edu](mailto:zyin81@gatech.edu)). If you find this work useful, please cite it as:  
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