

Radio Navigation and Radar

Time Difference of Arrival Localization

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The objective of this lab activity is to reinforce the understanding of time difference of arrival localization algorithms by implementing them in Matlab and assessing their performance by simulations. Specifically, you will implement the least squares method and the Gauss-Newton method.

As a preparation you shall derive the equations for computing

- the position of the mobile terminal using the least squares method and
- the position update in the iterations of the Gauss-Newton method

from the measured range differences. Differently from the lecture you can not assume anymore that the first fixed point is at the origin.

The places in the program code where you have to make your changes are marked by comments in capital letters like this `% ADD YOUR CODE HERE`. Complete the program code of the functions to compute the position of the mobile terminal in the files `tdoa_least_squares.m` and `tdoa_gaussnewton.m`. The file `tdoa_simulation.m` contains a simulation environment for testing the localization algorithms and for computing the dilution of precision. Choose one out of the three scenarios by uncommenting it.

- Why is the true mobile terminal position not in the center of the scenarios?

- Why is it a good idea to first test your algorithms without any measurement noise?
- Why should one choose a very small measurement noise when computing the dilution of precision?

Determine the dilutions of precision for both the least squares method and the Gauss-Newton method for all four scenarios. Discuss your results by comparing the dilutions of precisions.

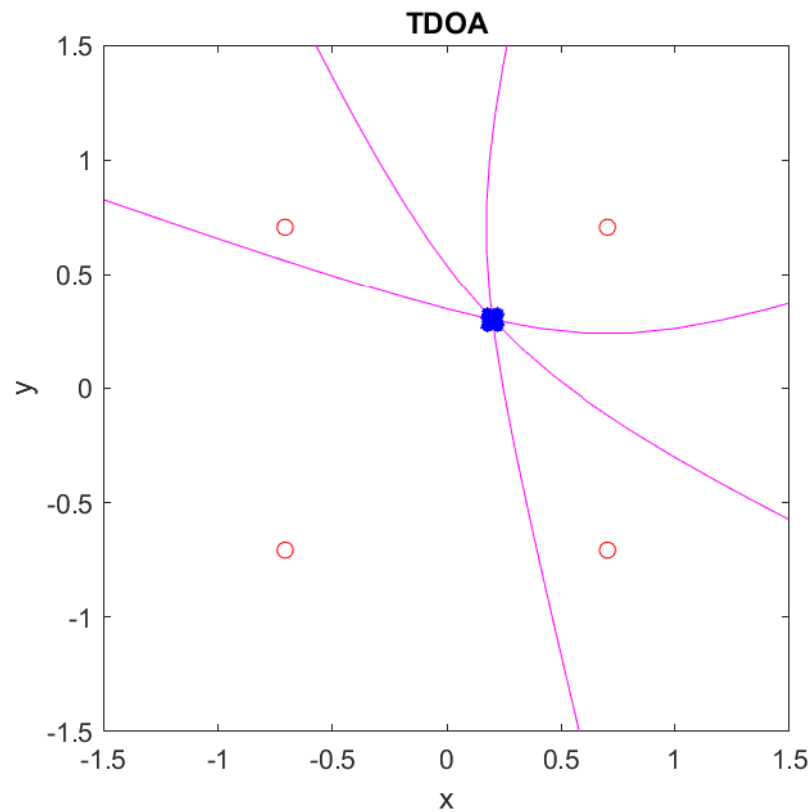


Figure 1: Exemplary simulation results. Fixed point positions in red, Hyperbolas of constant true range difference in magenta, estimated mobile terminal positions in blue.