Radio Navigation and Radar

Time of Arrival Localization

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The objective of this lab activity is to reinforce the understanding of time 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 ranges. 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 `toa_leastsquares.m` and `toa_gaussnewton.m`. The file `toa_simulation.m` contains a simulation environment for testing the localization algorithms and for computing the dilution of precision. Choose one out of the four scenarios by uncommenting it.

- What are the characteristics of the four given 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.

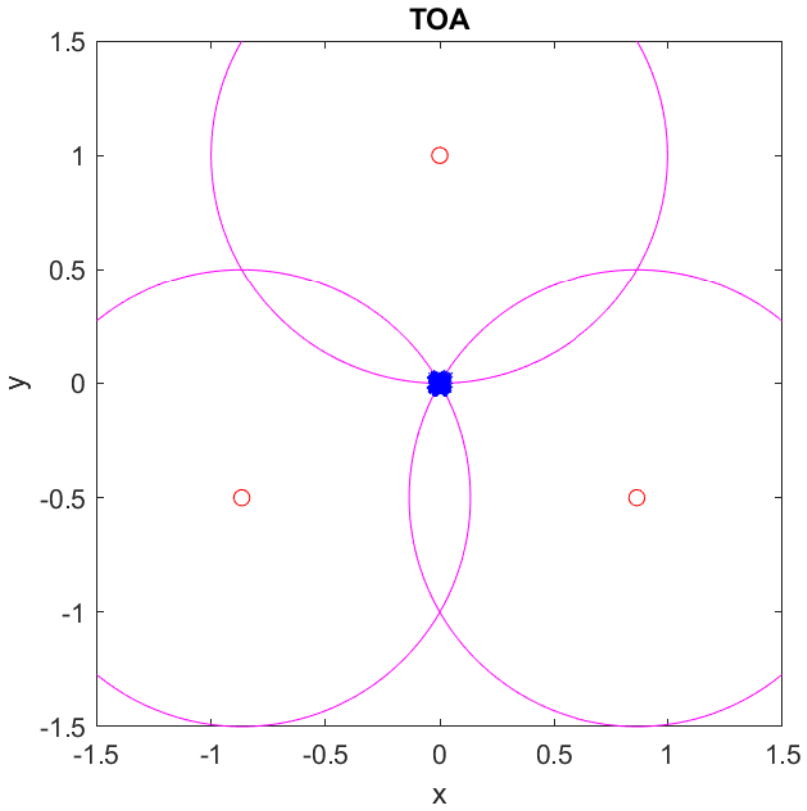

Figure 1: Exemplary simulation results. Fixed point positions in red, circles of constant true range in magenta, estimated mobile terminal positions in blue.