TIADPE
Advanced Pervasive Computing
Absolute positioning by triangulation and trilateration

Practicalities

About:	This note covers a module. A module consists of two consecutive lecture days.
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Revision:	December 1, 2014

Subject

Positioning is fundamental to mobile robotics and location based services and therefore to pervasive computing. Often a mobile and potentially autonomous robot has to position itself before it can carry out meaningful actions. Likewise with location based services, they need a proper positioning before services can be rendered properly. For positioning to happen, sensors must be utilized to acquire positioning data. Positioning methods can be classified into: i) relative positioning and ii) absolute positioning. In this module we will review some common absolute positioning methods based on triangulation and trilateration.

Agenda

Day 1

- L1: Positioning by triangulation
- L2: Positioning by trilateration
- E1: Exercises
- E2: Exercises

Day 2

- E3: Exercises
- E4: Exercises

Readings

1. J. Krumm (ed.), "Ubiquitous Computing Fundamentals", CRC Press, 2010, chapters 3, 4, and 5 (background material)
2. V. Pierlot, M.V. Droogenbroeck, "A New Three Object Triangulation Algorithm for Mobile Robot Positioning", IEEE Transactions on Robotics, Vol. 30, No. 3, June 2014, pp. 566–577

Exercises

Absolute positioning by triangulation and trilateration

†1. Do a Matlab implementation of the triangulation algorithm "Algorithm 1: Final version of the ToTal algorithm", page 572 in reading number 2. You do not have to consider the special cases described in "Algorithm 2" page 573. Run some numerical experiments and plot the results thereof to illustrate how the algorithm works

†2. Device your own trilateration algorithm (or re-implement an existing one) and run some numerical experiments and plot the results thereof to illustrate how the algorithm works. Consider using RSSI as a distance metric so you can take advantage of your exercise solution from the previous module. Note, the RSSI and Tx-Rx distance are not proportional; use the correct relationship.

†3. Write a short note on how the triangulation and trilateration algorithms work; include the Matlab source code and the plots from your numerical experiments. Compare, consider, and describe briefly the positioning accuracy of the two algorithms.

Note on exercises

I will mark with a star ($\star$) those exercises I consider to be most important; if none are marked, they are all equally important. Mandatory hand-ins are marked with a dagger (†). The exercises are to help you fully understand the contents of the course, and master the theories, methods, and techniques presented in the lectures. Also, doing the exercises helps you gain a self confidence that most often shines positively through in an exam situation. When you have done all exercises it is good idea to think critically about the course material covered. Spend a few moments to think about the following:

- Summarize the main topics of this module and reconsider what you learned
- How did you succeed in your learning, and can you improve your learning process?
- How can the teaching-learning process be improved?

Of course, I will be happy to discuss the exercises and the course contents with you; however, before coming to me, it is very important that you engage in a discussion with your fellow students. Most often, the challenges you encounter are also challenges for others. Discussing with your fellow students is a good and social way of learning.