TIADPE
Advanced Pervasive Computing
Relative Positioning

Practicalities

About:	This note covers a module. A module consists of two consecutive lecture days.
Lecturer:	Christian Fischer Pedersen, office E-311, cfp@eng.au.dk
Revision:	December 8, 2014

Subject

In navigation, mobile robotics, and location based services, dead (meaning deduced) reckoning is the process of determining one's current position via a previously determined absolute position. The current position is determined by advancing the absolute position based on known or estimated speeds over elapsed time and course. Dead reckoning was originally devised for navigational purposes to counter a very important problem: finding one's position so it was possible to determine routes – including the way home – when out of sight of land. As dead reckoning is based on an extrapolation from an absolute position, dead reckoning is a relative positioning method. Dead reckoning is an umbrella term that covers several practical implementations that vary according to application needs.

Agenda

Day 1

- L1: Relative positioning by dead reckoning
- E1: Exercises
- E2: Exercises
- E3: Exercises

Day 2

- E4: Exercises
- E5: Exercises

Readings

1. J. Krumm (ed.), "Ubiquitous Computing Fundamentals", CRC Press, 2010, chapter 7
2. Mathworks, "Mapping Toolbox: Navigation", R2014b documentation, 2014, pp. 1–20

Exercises

Relative positioning by dead reckoning

Note: Matlab specifics are typeset with `typewriter` font.

†1. Create a map with paths and dead reckoning points

- Start point: Dept. of Engineering, Finlandsgade 22 (`wmmarker`)
- End point: Railway station, Banegårdspladsen 1 (`wmmarker`)
- Create suitable waypoints from start point to end point

- Plot the straight line path from start point to end point on a map (`wmline`)
- Plot the path along the waypoints from start point to end point (`wmline`)
- Compute the distance in meters along both paths (`distance`). Find the distance difference
- You plan to walk at noon from Dept. of Eng. to the railway station along the waypoints. Compute the dead reckoning (DR) points (`dreckon`)
- Mark (`wmmarker`) the DR points and associate a note (`FeatureName`) with the DR timestamps

†2. Re-implement the `dreckon` function. Adhere to the following requirements:

- Speed entries are given in m/s rather than knots
- Allow for slight symmetric variations, v_l, in the speed per leg, s_l, entries, i.e. $s_l \pm v_l$
- Consequently, variations, d_i, should be determined for the DR points $(x_i \pm dx_i, y_i \pm dy_i)$
- Compute a scaling factor, f_i, per DR point to reflect the size of the position variation. With the scaling factor, use `IconScale` to scale the `Icon` used by `wmmarker` to illustrate graphically the variation
- The variations in the DRs lead to a range of possible paths; the best case path, coincide with the normal `drecon` path, and the worst case path ends at point which is offset the most from the target end point, i.e. the railway station. Compute the worst case offset in meters.
- Explain how your modified `drecon` works. Include source code

†3. Combination of absolute and relative positioning

- Explain how it would make sense in a positioning system to combine your absolute positioning method (ToTal triangulation) with your relative positioning method (modified dreckon)

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.