

## Spatial Databases and GIS

### Solutions for Sheet 12

#### Exercise 1 (GPS)

On slides 843 and 844 three different types of errors are described, which may occur when satellites are used for positioning.

1. Which error(s) can be corrected? How?
  - a. *Random errors, current local conditions at the location of the receiver: No.*
  - b. *Clock errors*
    - *Relativistic effects: Yes, they are deterministic and corrected before the signal is send.*
    - *Time error of receiver: Yes, by using at least 4 satellites for the calculation.*
  - c. *Change of speed of propagation of radio waves in the atmosphere*
    - *Ionosphere: yes, as the conditions in the ionosphere are quite stable an atmospheric model could be used.*
    - *Troposphere: no, as the processes there (weather) is too complex to build a reliable model.*
2. What other possibilities exist to improve the positioning and in which cases can they be applied?
  - *DGPS, if the current local conditions of the receiver and the base station are similar.*
  - *Sensor fusion depending on the platform dead reckoning and/or INS can be used.*

#### Exercise 2 (Privacy)

Given is a number of moving objects (people with mobile phones), that want to use a location based service. A centralized trusted party architecture should be used to guarantee k-anonymity.

1. Sketch out an algorithm to provide k-anonymity that is based on a r-tree.
  - Chose  $m = k$  and  $M = k + 1$ .*
  - Build r-tree.*
  - Return the MBR of the leave containing the user as cloaked region.*

2. What advantages/disadvantages does your algorithm have compared to the quadtree spatial cloaking?
- + *Every leaf contains  $k$  or  $k+1$  points.*
  - + *Rectangular regions may be smaller than squares, depending on the distribution of points.*
  - *The distance between the users and the center of the rectangle may be taller than the distance between the users and the center of a square with the same area.*
  - *R-tree is data driven:*
    - + *Regions are often smaller than in space driven structures.*
    - *More difficult to update when objects change position.*