Topical Issues Examples Sheet 2013/14

Dr Robert Harle

1. Discuss the merits and demerits of using long-range passive RFID tags to track people wherever they go.

2. Explain the principle of back scatter coupling

3. Discuss the potential uses of UHF RFID by a supermarket. Include practical and legal considerations in your answer.

4. Describe how the hash-lock and randomised hash-lock schemes work. Discuss their strengths and weaknesses for RFID.

5. List at least three error sources for the civilian GPS system and explain: (i) how they contribute an error to the system (physical mechanism, etc); (ii) the typical error (or range in error) they cause to a pseudorange measurement; and (iii) what (if any) mitigation steps can be taken to reduce their effect.

6. Describe the three segments of GNSS and explain what key information is transferred between each segment. Discuss what could happen to the quality of your GPS receiver position fix if the ground segment was destroyed/disabled (consider the effect on the system after 1 hour, 1 day and 1 month).

7. Explain the key differences between the military and civilian GPS signals. Give the benefits and issues associated with carrier-phase positioning. Under what circumstances could a civilian GPS receiver outperform a military GPS receiver in terms of absolute positioning accuracy?

8. State the radio positioning equation used by GNSS receivers and define each term. Explain why four satellites are required to determine a 3D position fix. There is a small chance that any satellites atomic clock could develop a fault which reduces its performance, resulting in unstable and unpredictable timing errors in the satellite broadcasts. Explain the effect this would have on a positioning solution and propose a scheme, given the availability of 5 satellites, to cross check whether one of the satellites has a broken clock.

9. Propose a scheme that would allow you to jam other people's civilian GPS receivers while still making use of civilian GPS signals for positioning yourself (your jammer and your GPS receiver are both mounted on the roof of the same vehicle).

10. The Bat system is a ToF system where the tag acts as a transmitter.

(a) Explain how sync is obtained
(b) Describe how to invert the system so that the tag is a receiver
(c) Discuss the advantages and disadvantages of this alternative approach.

11. Consider a PDR application that fuses foot-based inertial measurements with a floorplan using particle filters (as per lecture 3).

(a) Distinguish between a strapdown inertial system and a PDR system. Why are PDR systems more successful in tracking over longer time periods?
(b) Distinguish between the localisation and tracking phases of the filter. What are the typical computation requirements of each?

(c) A naive approach to checking whether a particle crosses a wall is to compare the step vector with *every* wall vector in the floorplan. Suggest a more efficient implementation.
(d) Explain why the resample phase is necessary and how you could use it to dynamically reduce or increase the number of particles.

12.

(a) Describe the principles underlying the Kalman Filter. Why is it so commonly used?
(b) What does the H matrix in the Kalman Filter represent?
(c) Explain (at a high level) how a Kalman Filter can be used to incorporate ZUPTs within an Inertial Navigation System.

13. Explain what is meant by an 'underlay system' as applied to UWB.

14. Imagine that you are tasked with designing an iPhone-like device that must be able to position itself at all times (indoors and out). Discuss the solutions you could use and the accuracies you might expect indoors and out.

The following past paper questions are relevant this year.

- ALL Topical issues questions EXCEPT 2011P9Q12
- 2010P9Q1
- 2009P7Q1
- 2009P9Q1
- 2008P7Q2
- 2007P7Q15
- 2006P7Q16
- 2005P7Q16
- 2003P7Q14
- 2003P7Q15
- 2001P7Q14
- 2001P7Q15