Topical Issues Examples Sheet 2

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1. (Location) The XBox One Kinect uses a 'Time-of-flight camera' to sense depth. Describe how this works (research will be required). What issue is there in making such a camera estimate depth over a large distance range (e.g. from 1m to 100m)?

2. (GPS) List at least three error sources for the civilian GPS system and explain:

(a) how they contribute an error to the system (physical mechanism, etc);
(b) the typical error (or range in error) they cause to a pseudorange measurement;
(c) what (if any) mitigation steps can be taken to reduce their effect.

3. (GPS) 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).

4. (GPS) 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?

5. (KF)

(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 how a Kalman Filter can be used to incorporate Zero velocity UPdaTes (ZUPTs) within an Inertial Navigation System. Fully define your state vector, your measurement vector, your H matrix, and explain how the filter is able to correct the position estimates without having a direct measurement of position.

6. (PDR-SLAM)

(a) Explain the principle of loop closure in a SLAM system.
(b) Consider the Particle Filter approach to fusing PDR traces with a floorplan. Explain the changes necessary to incorporate a SLAM scheme to correct the trajectory in an unmapped area of a building.
(c) Can you see any value to running the SLAM scheme when a floorplan is present?

7. (Deep Learning) Give a high level introduction to Deep Belief Networks (DBNs) that would be understandable by a first-year undergraduate studying a technical subject.

8. (Choice Routing) Using an example of your choosing. show how the choice routing algorithm works. Why might it be useful for route guidance for autonomous vehicles?

9. (UWB) Explain what is meant by an 'underlay system' as applied to UWB.

10. (Location) 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.