

14 Topical Issues (RKH)

Consider an inertial measurement unit that reports its change in distance and heading each second, but is subject to typical sensor errors such as bias and noise. A particle filter is to be used to fuse its output with a building map to estimate the current location of a user within that building.

- (a) Describe the evolution of the spatial distribution of the particles as a user moves through the building to their office. Assume that the initial position is unknown, but that the filter has correctly estimated the user's position before they reach their office. Additionally, the filter continues to run thereafter (during which time they are seated and not travelling). What factors influence the speed of transition between the regimes identified? [9 marks]
- (b) The particle filter is to run on a low power embedded platform that transmits its position results over WiFi. However, it is found to process particles too slowly for real-time tracking.
- (i) Describe the three stages of a particle filter cycle in the context described above. Assuming a multi-core GPU is available, discuss how easily they can be parallelised to increase performance. [5 marks]
- (ii) Describe two further ways to increase performance in such a system. [4 marks]
- (c) The internal structures of many office buildings change over time, as offices merge or split. Assuming the building map is not kept synchronised with these changes, discuss the effects on the positioning system described. [2 marks]