2012 International Conference on Indoor Positioning and Indoor Navigation, 13-15th November 2012

Scalable Indoor Pedestrian Localisation using Inertial Sensing and Parallel Particle Filters

Agata Brajdic
Computer Laboratory
University of Cambridge
Cambridge, UK
ab818@cam.ac.uk

Robert Harle
Computer Laboratory
University of Cambridge
Cambridge, UK
rkh23@cam.ac.uk

ABSTRACT

Although many solutions for indoor pedestrian localisation have been proposed, still no dominant technology exists – indeed, only few have made it out of the laboratory, mainly due to extensive infrastructure requirements that hinder ubiquitous deployment. An exciting technique that gained attention recently is dead-reckoning based on human gait locomotion. This approach determines relative changes in position of the pedestrian using inertial sensors only. It is becoming especially interesting in the context of mobile computing since modern mobile phones come equipped with accelerometer and gyroscope.

However, even state-of-the-art inertial sensors suffer from a significant accumulation of drift over time. Correcting this drift is a complex problem and poses a major barrier to ubiquitous application of inertial technology. The only method known to date that enables localisation using only relative inertial data are particle filters. Particle filters are numerical approximations to Bayesian filters where a number of particles (each essentially an independent hypothesis about the location) are continuously updated with inertial data. When augmented with the building map providing environmental constraints, particle filters are known to successfully reduce the drift and enable precise localisation. However, the difficulty with this approach is that it requires a large particle set for sufficiently accurate localisation, hindering location system scalability.

In this paper we present a particle filters based location system that can, using only commodity hardware, localise between 5 and 32 pedestrians in real-time, compared to at most one using previously reported approaches. Our system achieves scalability by exploiting the latent parallelism in the particle filter and adapting it for execution on commodity Graphical Processing Units (GPUs). We describe architecture of the parallel localisation filter and show how to handle multiple such filters using a novel paging scheme and an adaptable particle number. We provide extensive evaluation of our location system and compare it with the approach from prior work.

KEYWORDS: Inertial tracking, Particle filters, Localisation, Parallel processing.