

MAGREF4PIL

MAGNETIC REFERENCE FOR ACCURATE INDOOR TRACKING

Indoor Positioning Problem

The idea of being able to identify and track the position of a target in an indoor environment is very attractive.

GPS is a good example of the utility of positioning systems. The applications of GPS range from the military to the most ordinary activities like tracking a person's daily jogging. However, GPS is not suitable for indoor tracking as the signal gets attenuated and reflected by buildings' structure.

An accurate indoor positioning can, among others, open a new world for location aware applications and also greatly improve assisted living technology. Nevertheless a reliable and ubiquitous indoor positioning system is yet to be developed.

Smartphone approach

One approach is to make use of smartphone sensors.



Rua Alfredo Allen, 455 4200-135 Porto, Portugal

+351 220 430 300 info@fraunhofer.pt www.fraunhofer.pt In this case of study the focus is on heading correction so only gyroscope and magnetometer are discussed.

The strategy is to integrate gyroscope data over time obtaining an angle update on each rotation movement



Fig1. GPS to IPS transition when entering a shopping centre.

while the magnetometer should work as a compass and provide long term correction.

Limitations

Smartphone sensors are noisy and suffer from bias and drift.

Even though the gyroscope works as intended in short periods of time the integration process leads to a cumulative error that increases over time.

The magnetometer should be able to work as a compass and provide

Features

The application is able to detect the presence of the generated magnetic field and calculate the angle with a variation of 8 degrees that can later be used to improve heading correction.

Antenna Design Outlines

- Size and shape
- Core material
- Power consumption
- Magnitude



Fig2. Application displaying values around 90 degrees for perpendicular crossing.

information for gyroscope data correction in the long run. Unfortunately, the magnetometer senses not only the magnetic field of the earth but also all the environmental interferences.

In the end, heading information lacks the reliability required for a positioning system.

Magnetic reference

Indoor environments are filled with magnetic interferences not only caused by electronic systems but also the building metallic structure itself.

In this particular case the possibility explored was the use of an artificially generated magnetic field that works as a known anomaly that can be a reference for heading correction.

The objective is achieving a heading measurement, relative to the reference, with a smartphone. Then this new data can be compared with the angle yielded by the gyroscope and ultimately serve as a correction factor.

Proof of Concept

Some solenoids were dimensioned with the purpose of using the field outside them as reference.

When crossing the field an Android application detects the artificially generated field imposed by a simple square wave. The higher level is the magnetic field generated by the coils added to the ambient magnetic level whereas the lower level refers only to the ambient magnetic level.

This solution deducts the ambient level influence from the high level isolating only the field generated by the coils which is used to compute the smartphone orientation towards it.

Future Work

The heading calculation still shows considerable variation that could be mitigated by the implementation of signal processing techniques.

Furthermore a more specific signal can be used as a unique signature making this solution more robust to interference or even able to transmit a message.