Contest Abstract: An Indoor Localization System using Low-frequency Magnetic Fields

Traian E. Abrudan, Ronald Clark, Andrew Markham, and Niki Trigoni
Department of Computer Science, University of Oxford
firstname.lastname@cs.ox.ac.uk

ABSTRACT

We design an implement a localization system that relies on low-frequency magnetic fields. Inertial (and optionally visual) sensors are included to aid the magnetic fingerprinting, and track the locations of the users.

1. INTRODUCTION

Our system relies on magnetic fingerprints that are derived from the 3-by-3 energy transfer matrix corresponding to a pair of triaxial coils. An inertial measurement unit (IMU) that includes accelerometer, magnetometer and gyroscope is also used during the acquisition of the magnetic fingerprints, and for user trajectory estimation. Optionally, visual information may be used to speed-up the fingerprinting process. The location tracking is done by using a Kalman filter.

2. SYSTEM DESCRIPTION AND OPERATION

The proposed system consists of magnetic transmitters (TX) and receivers (RX) (see Figure 1). Both TX and RX are equipped with triaxial coils, which makes the total signal strength invariant w.r.t the relative orientations of TX and RX [1]. The energy transfer matrix is estimated based on a known preamble. RX is also equipped with an IMU that provides acceleration, angular speed, and orientation information. RX is connected to a computer via the USB, where the data are fused in order to track the users' locations.

The system operates in two phases. In the first phase, a "magnetic map" representing the spatial distribution of the magnetic field is constructed. This tedious process is substantially simplified by using the IMU (an optionally a camera). Unlike, for example, the WiFi signal, the magnetic signal exhibits extremely good stability, being completely unaffected by moving people, and a smooth spatial behavior. Therefore, it is very easy to reconstruct, making it suitable for sparse fingerprinting. In the second phase, the magnetic map is used together with the IMU and the floor plan to estimate the location.

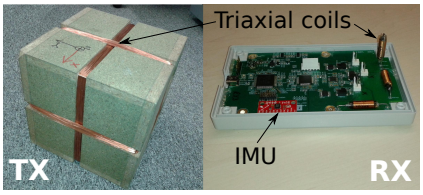

Figure 1: Magnetic TX (left) and RX (right).

3. DEPLOYMENT REQUIREMENTS

The system requires the deployment of several magnetic TXs, depending on the area, and a floor plan.

4. CONCLUSIONS

We propose a robust and accurate localization system that relies on the desirable properties of the low-frequency magnetic field and benefits from an IMU (and optionally a camera) to reconstruct the magnetic map that is used in the online location estimation.

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5. REFERENCES

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