# Effective Indoor Localisation Using Geo-Magnetic Fields

HKUST | Reference: TTC.PA.1015 | Feb. 2017

## Background

Geomagnetic fields can be readily used for indoor localisation, as they have a pervasive spatial presence and high signal stability, and do not require infrastructural support. Much previous work on localisation has combined geomagnetic fields with pedometers (step counters) via particle filters. These approaches, however, are computationally intensive and not accurate enough for use in large open indoor spaces (such as airports or malls), mainly because particles cannot converge properly in environments with a high degree of freedom. They often assume knowledge or explicit user step length input and a meticulously tuned pedometer, which is inconvenient.

## Technology Overview

This invention is a combination of two algorithms that tracks a user's indoor location via geomagnetic field mapping. The first algorithm, Magil, creates a fingerprint map of magnetic field data in a space. The second algorithm, Mapel, calibrates a pedometer based on the data from Magil and uses it to further improve the tracking capability of the overall system.

- Magil uses solely geomagnetism for smartphone-based indoor localisation. We propose a robust localisation scheme that can tolerate noisy or abnormal user behaviours and efficiently yield accurate step counts, walking distances and directions without relying heavily on a meticulously tuned pedometer. No additional network infrastructure required.

- Mapel is a novel graphical model that efficiently fuses geomagnetism with a pedometer for joint indoor localisation based on a conditional random field. It does not require the explicit or accurate input of users' initial positions or step length. It is also computationally more efficient than previous techniques. Mapel's novel self-calibrating algorithm returns the walking distance and step length (stride size) of the user. It starts with a generic step model and collects user data on the fly to train a personalised model.

## Market Analysis

Industry reports predict that the indoor location services industry will achieve compound annual growth of well over 20% for the next several years, as companies race to meet the demand of retail and marketing companies. The field is expected to be worth over US $40 billion by 2022. The demand for better control of autonomous robotics and indoor location based advertising are two factors driving the growth of the market. North America is the leading region so far, but with the rapid adoption of smartphone technologies, the Asia-Pacific region is

poised to become the region with the quickest growth. Some of the leading developers include Apple, Broadcom, Cisco, Google, Microsoft, Qualcomm and Ericsson. [1]

## Benefits

- Improved accuracy and stability using geomagnetism.
- No additional network infrastructure required.
- Easy to deploy.

## Applications

- Navigation in large open areas such as shopping malls or airports
- Navigation for autonomous robots
- Indoor location based advertising
- Fusion with other localisation technologies to mutually overcome weaknesses

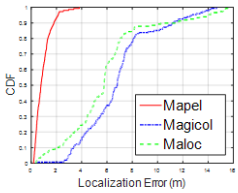
## Patents

- US Patent no.: 16/469,127
- China Patent Pending: -

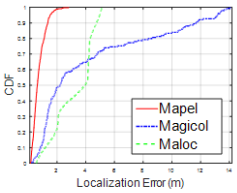
[1] Inventor Evaluation Report – Invention Evaluator Analysis of Effective Indoor Localization Using Geo-Magnetic Field (TTC.PA.1015) (inventionevaluator.com, 2017).

# Figures

## Mapel: Low Localization Error

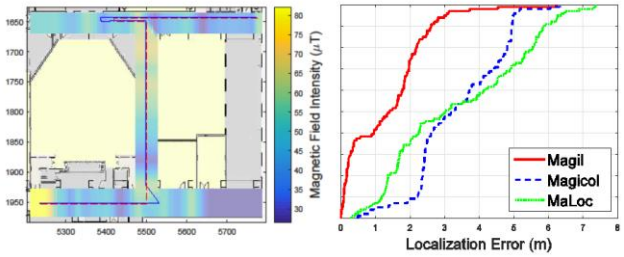



a) Open space




b) Corridor

## Low Localization Error in Corridors




## Low Localization Error in Open Spaces

- Localization results in open spaces: Magil and particle filter based systems