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A CRIS Data Science Investigation of Scientific Workflows of Agriculture Big Data and its Data Curation Elements

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### Autonomous Indoor Localization via Field Mapping Techniques, with Agricultural Big Data application

**Purdue 2014 BIG Data in Agriculture Symposium “Connecting Vision and Capacity”**

**By Yan Cui, Kartik Ariyur, Benjamin Branch**

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#### Indoor Smartphone Applications

We have shown cell phone geolocation to within 20cm indoors using a magnetic field map, and the magnetometer and inertial sensors available on all smart phones. Our results are from a corridor in the Purdue ME building. Our method is novel and uses the disturbances in the indoor magnetic field vectors—caused by iron in construction, furniture and appliances—as beacons for pin pointing position. Our method is applicable to areas where the magnetic map does not change faster than it can be mapped, i.e., any indoor space where spatial concentrations of ferrous materials remain static such as libraries, offices, or hotels. Our algorithms have clear mathematical properties in that geolocation errors depend only on the resolution of the sensors and the size of magnetic disturbances in the environment.

#### GIS application:

In prior work, funded by Google Inc., we had to manually construct the map by taking a magnetometer to every square foot of the space, something inconvenient for large scale application. We have developed algorithms to automate this map construction, using only data from cell-phone users—various sensor measurements from cell phones including inertial data, magnetic fields, and wireless signal strength from both cell towers and Wi-Fi access points. They need a lot of testing both in single user and multi-user scenarios to understand the efficiency of map building in practice. Our algorithms use a combination of virtual pedometry [1], ranges to wireless transmitters, and magnetic field properties in that geolocation errors depend only on the resolution of the sensors and the size of magnetic disturbances in the environment. Current geolocation algorithms:

- received signal strength (RSS), error 3-5m
- time difference of arrival (TDMA), error 2-3m
- radio frequency identification (RFID), error 3-5m
- our algorithm (Magnetic map), error: 1.5-2m

#### Autonomous Map Construction:

We therefore test various algorithms in realistic scenarios in other area, with voluntary users contributing cell phone data to test the algorithms. The data from individual cell users will consist of sensor data mentioned above along with specific calibration characteristics of individual sensors on their phones so data from various devices can be suitably collected in mass. Our work thus involves the dynamic collection and processing of big data to produce compact map information (in terms of processing and memory needs) available for use to all users through a cell phone application. Purdue is currently processing a patent application that covers the IP in a variety of areas—there are several licensing opportunities in both safety and resource location, besides security.

A general scheme:

1. **m** collection in current estimate interval (stored in intervals)
2. update [m] from new IMU estimation
3. intersect [m] on [p] space to form and update map in intervals

#### References:

