Geomagnetism-based indoor location estimation method for future smartphone

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ABSTRACT

Geomagnetic field is used for heading detection using an electric compass, because geomagnetic field is static and points towards magnetic-north regardless of position. The magnitude and direction of geomagnetic field, however, differ depending on location in a building. The ferromagnetic substance - e.g. steel reinforcement and H-beam - of a building causes variations of geomagnetic field depending on locations. Variations of geomagnetic field was an undesirable characteristic, which must be overcome for heading estimation. Recently it has been found that geomagnetic field variations can be utilized for indoor location estimation, because geomagnetic field has sufficient variability in buildings.

The geomagnetic field variation, however, is not artificially made for localization, so similar geomagnetic field values exist at many points in a building. The geomagnetic field ambiguity is the primary reason for localization performance degradation. In this paper, to enhance the robustness in local geomagnetic field variation-based localization we propose a geomagnetic field ambiguity elimination method.

Average location estimation error on six different moving routes is improved from 0.52m to 0.26m by the proposed method in indoor gymnasium environment. The first time to fix performance, which is defined as the elapsed time for acquiring the first location information under 1.5m error, is also improved from 4.5sec to 1.5sec.

In this paper, we proposed a novel ambiguity rejection method to enhance the location estimation performance of geomagnetic field-based localization. We enhanced the location estimation error and the first time to fix performances by eliminating the ambiguity of the geomagnetic flux density. We also verified the effectiveness of the proposed method by extensive simulations.

KEYWORDS: localization, geomagnetic field, smart-phone