МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ

ІНСТИТУТ АЕРОНАВІГАЦІЇ

АЕРОКОСМІЧНИЙ ІНСТИТУТ

ІНСТИТУТ ІНФОРМАЦІЙНО-ДІАГНОСТИЧНИХ СИСТЕМ

Тези доповідей

Київ
6-8 квітня
2016

Magnetic field data processing with personal electronic device

Olena Mironyuk
IAN NAU
Kyiv, Ukraine
mironyuk.lenochka@mail.ru

Ivan Ostroumov
IAN NAU
Kyiv, Ukraine
ostroumovv@ukr.net

***Abstract* — The article represents the methodology for estimation of the Earth's magnetic field characteristics. It is proposed to use a group of sensors inside of a tablet or a cell phone as a measurement device.**

Keywords — sensors; magnetic field; magnetometers.

I. INTRODUCTION

Global Earth's Magnetic field is one of the most important things in planetary structure. Also magnetic field is one of the key elements for navigation purposes.

Nowadays different international programs investigate and monitor characteristics of magnetic field.

Modern navigation devices and sensors grounded on magnetic field characteristics have been using magnetic field models which don't contain data about humane-based part of magnetic field. In result non accurate model produce errors which will be in result of positioning or heading error

II. MAGNETIC FIELD DESCRIPTION

Magnetic variations in the earth's magnetic field can be divided into two main categories [1]. The first are longtime variations (10-106 years), which have their cause in the interior of the earth.

The magnetic field has a horizontal component (H) and a vertical component (Z) [2, 3]. We further on define two direction angles, inclination (I) and declination (D). Inclination is defined as the angle between the horizontal plane and the direction of the magnetic field. D and I are measured in degrees or radians [3].

A geomagnetic observatory is a location where absolute vector observations of Earth's magnetic field are recorded accurately and continuously, with a time resolution of one minute or less, over a long period. The site of the observatory must be magnetically clean and remain so for the foreseeable future.

Unfortunately different sensors inside of mobile phone have different time of measurements. It means that each sensor measures in some specific time scale. To make clear this time problem it is necessary to interpolate coordinates to unify sensors data time. The easiest way to do it is the usage of polynomial approximation.

The input data are the result of measurement of sensors that located in the device. All measurements are performed in "Body" coordinate systems. Body coordinate system refers to the body of cell phone frame.

Center of Body coordinate system has been located in the center of mobile phone, usually. Axis X directed in front, Y- go to the right and Z- up by normal.

In result let's represent measurements in East-North-Up (ENU) coordinate system. The ENU coordinate system is a local system specific to any point on the Earth. It is formed from a plane tangent to the ellipsoid model surface at this point. The axis E is directed to the east, N to the north and U - up orthogonal to the tangent plane.

The coordinates transformation between Body and ENU is realized with the help of angular coordinates of device: pitch (θ), roll (φ) and yaw (ψ). Roll is the rotation around the front-to-back axis. Pitch is the rotation around the side-to-side axis. Yaw is the rotation around the vertical axis.

As a result of software measurement we obtained text files with measured data. Pitch, roll and azimuth - these variables determine the position of device in the space.

For data verification international world magnetic model has been used. The predicted state of intensity vector of magnetic field for local area of investigation has been calculated by NOAA data with the help of MATLAB specific software on the same date and time of real data measurement.

III. CONCLUSIONS

Represented methodic of theses parameters evaluation shows the cheapest way to improve navigation equipment functionality.

As a result we processed our data and get appropriate graphs and results.

REFERENCES

[1] National Geomagnetism Program. USGS. Official web site: – http://geomag.usgs.gov

[2] Kharchenko V. P. Avionics / V. P. Kharchenko, I. V. Ostroumov – K. : NAU. – 2012–281 p.

[3] Ostroumov I. Local magnetic field data processing / I. Ostroumov, O. Mironyuk, M. Nychak // Proceeding of the NAU. – 2015. – is. 1. – P. 23-28.