МІНІСТЕРСТВО ОСВІТИ І НАУКИ УКРАЇНИ
НАЦІОНАЛЬНИЙ АВІАЦІЙНИЙ УНІВЕРСИТЕТ

ІНСТИТУТ АЕРОНАВІГАЦІЇ

АЕРОКОСМІЧНИЙ ІНСТИТУТ

ІНСТИТУТ ІНФОРМАЦІЙНО-ДІАГНОСТИЧНИХ СИСТЕМ

Тези доповідей

Київ
6-8 квітня
2016

Estimation of user location by data from diferent sources

Ivan Ostroumov

IAN NAU

Kyiv, Ukraine

ostroumovv@ukr.net

In paper has been discussed problem of positioning of personal electronic device into space. Key technologies were discussed and solution for coordinate accurate estimation by data from different sources

Keywords—positioning, cell phone, coordinates, weight alghoritm

I. INTRODUCTION

Positioning problems is one of the key for precise navigation. Today in market there are a lot of different technologies for positioning of portable electronic devices. Personal electronic devices like cell phone, tablet, laptop, car computers, smart watches are the part of any human activity nowadays. Problems of positioning of all of them into the space are still actual today, because each of available technics has got some specific limitation and can be useful only in some cases [1, 2, 3].

Positioning of portable electronic device in most cases grounded into radio waves using. This is providing strong limitation by area of available service that is extremely limited in urban area [2]. For example, inside city user is quite limited by propagation of radio waves and signal reflation is the main problem.

II. AVAILABLE TECHNOLOGIES

On board of each portable electronic device may be installed plenty of positioning technologies such as:
- Global Navigation Satellite System,
- inertial algorithms,
- positioning by cell phone network,
- positioning by data transfer network like 3G,
- positioning grounded into WiFi signal stress and others.

GNSS is the most universal, but extremely limited inside urban area. Cell phone network has valuable errors in positioning. 3G does not available in wide devices and expensive for many users. WiFi is operable only in space of assess point location. During some short time is possible to use inertial or interpolation (like Kalman filter, spline interpolation) algorithms but all of them has got limited time of operation and may be discussed like additional positioning tech. Therefore, today inside of smart devise is present more than one source of coordinate data. Each of them has got their own errors and time of operation. Software should to choose the most "true" data and use it.

III. COORDINATS ESTIMATION

Positioning data from different sources may be processed together but with mixing of errors. In case of limited memory space and process facility may be used weight approach. Coordinates from different sources may be sum together with multiplication by specific coefficients that reflects error influence into total results and divided into coefficients sum:

$$X_r = (G \times X)/(G \times I),$$

where

$$
G = \begin{bmatrix} \dfrac{1}{\sigma_{x1}^2} & \dfrac{1}{\sigma_{x2}^2} & \dfrac{1}{\sigma_{x3}^2} \\[2mm] \dfrac{1}{\sigma_{y1}^2} & \dfrac{1}{\sigma_{y2}^2} & \dfrac{1}{\sigma_{y3}^2} \\[2mm] \dfrac{1}{\sigma_{z1}^2} & \dfrac{1}{\sigma_{z2}^2} & \dfrac{1}{\sigma_{z3}^2} \end{bmatrix}, \; X = \begin{bmatrix} x_1 & y_1 & z_1 \\ x_2 & y_2 & z_2 \\ x_3 & y_3 & z_3 \end{bmatrix}.
$$

Matrix X represents coordinates of user from three different sources and σ^2 means errors of sensors by coordinates x, y, z. Matrix I is ones matrix which has 3 column and 3 lines with "1".

After that operation coordinates of personal electronic device may be accrued by different sources of data with minimum calculation resources and minimization of error.

REFERENCES

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

[2] Остроумов І. В. Застосування методів позиціонування у мережі мобільного зв'язку для навігації рухомих об'єктів / І. В. Остроумов // Сучасні інформаційні та інноваційні технології на транспорті: Матеріали Міжнародної науково-практичної конференції. Том.2 – Херсон: Видавництво Херсонського державного морського інституту, 2010. – 2010. – С. 57-59.

[3] Ostroumov I.V Navaids facility for aircraft positioning / I.V Ostroumov, I.V.Ostroumov // The Sixth World Congress "AVIATION IN THE XXI-st CENTURY" - "Safety in Aviation and Space Technologies". Volume 2. – Kyiv: NAU. – 2014. – P. 3.2.1-3.2.