شبكة المعلومات الجامعية

بسم الله الرحمن الرحيم

شبكة المعلومات الجامعية

التوثيق الالكتروني والميكروفيلم

شبكة المعلومات الجامعية

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التوثيق الإلكتروني والميكروفيلم

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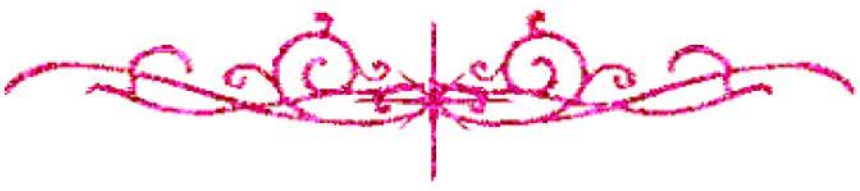

بالرسالة صفحات لم ترد بالأصل

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ANALYSIS OF ADVANCED EARTH ROTATION PARAMETERS MODELS AND THEIR EFFECT ON GEODETIC POSITION DETERMINATION

by

ABDEL-HAMID MOHAMED ABDEL-HAMID

A Thesis Submitted to the
Faculty of Engineering at Cairo University
in Partial Fulfillment of the
Requirements for the Degree of
DOCTOR OF PHILOSOPHY
in
CIVIL ENGINEERING

under the supervision of

Dr. MOHAMED S. ELHUSSAINY
Prof. of Surveying and Geodesy
Faculty of Engineering, Cairo University

Dr. MOUSTAFA A. BARAKA
Prof. of Surveying and Geodesy
Faculty of Engineering, Cairo University

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Approved by the
Examining Committee

Prof. Dr. Mohamed Safwat El Hossieny , Thesis Main Advisor

Prof. Dr. Moustafa Ahmed Baraka , Thesis Advisor

Prof. Dr. Youssef Abe El Aziz Ebrahiem, Member

Prof. Dr. Mohamed Mohamed Nassar, Member

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ABSTRACT

A new field in the geophysical sciences has recently emerged, namely space geodesy. An integral part of geodesy has always been the definition and realization of a terrestrial reference frame, celestial reference frame, and determination of the earth rotation parameters that link these two reference frames. The term "earth orientation " refers to the direction of earth's axis in space, with respect to the earth's crust. Such orientation is usually measured using five quantities commonly: two angles which identify the direction of the earth's rotation axis within the earth (polar motion); an angle describing the earth rotation variation rate (length of day or universal time); and two angles which characterize the direction of the earth's rotation axis in space (Precession and Nutation). With these five quantities, the orientation of the earth in space is fully described. Whoever, celestial nutations and precession are primarily products of earth's interactions with other celestial bodies, and define the orientation of the rotation axis with respect to the celestial sphere, and are largely periodic. Such celestial orientation is considered outside the scope of present investigation. The earth rotation parameters include the polar motion and rotation variation rate (length of day or universal time). This research will focuses on the earth rotation parameters because, it has proceeded rapidly over time.

In this research, the different coordinates systems used in geodetic positioning, such as: terrestrial, celestial, and satellite orbital coordinates systems, and their interrelationships with earth rotation variations parameters, will be studied, and the recent monitoring systems of the earth rotation variations like satellite laser ranging (SLR), very long baseline interferometry (VLBI), lunar laser ranging (LLR), and the global positioning system (GPS), are studied. The polar motion and rotation rate variation are considered complex oscillations, consisting of sum of several components. These components are different in amplitude, period and phase. The variations of periods, amplitudes and phases of the each component of the parameters under investigation, will be studied. Decomposition of earth rotation variation into separated components, is a useful way to describe the variation in the measured data. This can help to understand the behavior of this phenomenon. Understanding the behavior of these phenomena, which will help in producing and developing a more accurate and reliable prediction models for these parameters. Decomposition of earth rotation variation based on the spectral analysis of the up to date records of both polar

motion variation and universal time variation, over a long time span, using a more involved proposed alternative approach for the spectral analysis, based on a digital filter with Fast Fourier Transformation (FFT) methodology. In order to, come up with more reliable prediction models for these variations, as compared to corresponding results given by the IERS. Based on this investigation, the obtained results indicate that, the polar motion consists of the Chandler, annual, semi-annual and short terms. On the other hand, earth rotation variation rate consists of the secular deceleration, seasonal and zonal earth tides. By using the proposed prediction models the earth pole position can be predicted with accuracy 1cm., and the change in universal time can be predicted with accuracy 0.9 millisecond, after seven days in future.

The GPS satellite orbit is originally expressed in the celestial reference frame, while the ground receiver location is expressed in the conventional terrestrial reference frame. To compute the position's vector between the receiver and satellite positions, the satellite position must be transformed to the terrestrial reference frame. From this point of view, the earth rotation parameters play a very important role in GPS calculations. Satellite orbit information is provided in the form of Broadcast or Prices Ephemeris. The accuracy of positioning results basically depends on the accuracy of this ephemeris. Therefore, this research is focused on the relation between the GPS and earth rotation parameters. The effect of the earth rotation parameters on the orbital elements was studied. It is also examines the accuracy of GPS positioning, first the improvement in the absolute positioning, when using the precise ephemeris than the broadcast ephemeris. Secondly, for relative positioning for geodetic azimuth determination, where a compression between the geodetic azimuth, of certain selected ground baselines, as derived from astronomic observation, after being corrected for polar motion and gravimetric effects, as compared with the corresponding geodetic azimuth as derived from GPS baseline relative observation.

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