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Precession, Nutation, and Wobble of the Earth
V. Dehant & P. M. Mathews

Cambridge University Press. 2015, 554 p. ISBN 9781107092549, 90.00 GBP

This great book describes and explains observational and computational aspects of three apparently tiny changes in the Earth's motion and orientation, viz., precession, nutation, and wobble.

The three introductory chapters of this book present fundamental definitions, elementary geodetic theory, and celestial/terrestrial reference systems – including transformations between reference frames.

The next chapter on observational techniques describes the principle of accurate measurements of the orientation of the Earth's axis, as obtained from measurements of extra-galactic radio sources using Very Long Baseline Interferometry and GPS observations.

Chapter 5 handles precession and nutation of the rigid Earth (i.e., a celestial body that cannot, by definition, deform) and the subsequent chapter takes deformation into consideration, viz., the effect of a centrifugal force caused by a constant-rate rotation that causes the Earth's shape and structure to become ellipsoidal. Deformations caused by external solar-system bodies are discussed in terms of deformability parameters.

The next three chapters handle additional complex deviations: non-rigid Earth and more general Earth models, anelastic Earth parameters, and the effects of the fluid layers (i.e., ocean and atmosphere) on Earth rotation. Chapter 10 complements Chapter 7 with refinements that take into account diverse small effects such as the effect of a thermal conductive layer at the top of the core, Core Mantle and Inner Boundary coupling effects on nutation, electromagnetic coupling, and so-called topographic coupling.

Chapter 11 covers comparison of observation and theory, and tells us that the present-date precision of the nutation theory is at the level of milliarcseconds in the time domain, and of a tenth of a microsecond in the frequency domain (with some exceptions). This chapter is followed by a 25-page chapter of definitions of equator, equinox, celestial intermediate pole and origin, stellar angle, universal time, and more.

Chapter 13 treats the planet Mars, as it is also rapidly rotating, has an equatorial bulge and an obliquity that is comparable to that of the Earth.

The last chapter is followed by three Appendices, viz., Rotation representation, Clairaut theory and Definitions of equinoxes. Appendix A deals with rotation vector and rotation matrix, specifically applied to small angles, such as in the case of rotation from change of pole position. Appendix B expresses the Earth's gravitational potential, and the first-order hypothesis that the Earth is in hydrostatic equilibrium, and that its uniformly-rotating surface is an equipotential corresponding to the mean sea level. Appendix C presents a set of definitions of equinoxes.

This book is extremely well documented with more than 50 pages of references that are very up to date. The illustrations (exclusively line art diagrams) are all of good quality and the data tables are rich and well formatted. The language is clear and direct, but with nearly 1500 mathematical formulae, this reference work primarily appeals to the community of mathematically-schooled researchers, although anyone lecturing or teaching in celestial mechanics will see this jewel as a treasure trove to be visited on.

Christiaan Sterken
Vrije Universiteit Brussel
Pleinlaan 2, B-1050 Brussels, Belgium