ROTATIONAL VELOCITY OF AN EARTH MODEL WITH A LIQUID CORE

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ABSTRACT

There have been many papers discussing the rotation of the Earth (Jeffreys and Vicente, 1957; Molodenskij, 1961; Rochester, 1973; Smith, 1974; Shen and Mansinha, 1976). This report summarizes the application of the perturbation method of celestial mechanics to calculate the rotation of the Earth (Takagi, 1978). In this solution the Earth is assumed to consist of three components: a mantle, liquid outer core, and a solid inner core, each having a separate rotational velocity vector. Hamiltonian equations of motion were constructed to solve the rotational motion of the Earth.

Using the results of Jacobs (1976) and that of Shen and Mansinha (1976), the perturbation of the rotational velocity can be expressed as the result of superficial forces acting over the boundary surfaces, terms due to dynamical processes in the Earth, terms due to the differences among the amplitudes of the motions of the rotation axes of the three components, terms due to the non-coincidence of the rotation axes, and terms due to the internal motion in the outer core. The results may be summarized as follows:

a. The dissipative terms at the boundaries have been discussed in detail by Crossley and Smylie (1975).
b. The term due to body forces shows periodic motion, but it disappears for diurnal nutation.
c. The effects of deformation show periodic variation, but only a term due to the outer core effects diurnal nutation.
d. A periodic term arises from the difference between the amplitudes of the motion of the rotation axes of the three components.
e. The discrepancy among the directions of the rotation axes causes secular terms.
f. Motion in the outer core causes periodic motion, but this disappears for diurnal nutation.

It should be noted that periodic motion in the rotational velocity is expressed in one of two forms: either $\int \sin\theta \sin(\sigma t + \psi)dt$ or $\int \sin(\sigma t + \psi)dt$, where σ is the frequency of the perturbing effective

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torque, θ is the precession and nutation in obliquity and ψ that in longitude.

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