A New Approach on Computing Free Core Nutation

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Free core nutation (FCN) is a rotational modes of the earth related to non-alignment of the rotation axis of the core and of the mantle. FCN period by traditional theoretical methods is near 460 days with PREM, while the precise observations (VLBI + SG tides) say it should be near 430 days. In order to fill this big gap, astronomers and geophysicists give various assumptions, e.g., increasing core-mantle-boundary (CMB) flattening by about 5%, a strong coupling between nutation and geomagnetic field near CMB, viscous coupling, or topographical coupling etc. Do we really need these unproved assumptions? or is it only the problem of these traditional theoretical methods themselves? Earth models (e.g. PREM) provide accurate and robust profiles of physical parameters, like density and Lame parameters, but their radial derivatives, which are also used in all traditional methods to calculate normal modes (e.g.. FCN), nutation and tides of non-rigid earth theoretically, are not so trustable as the parameters themselves. A new stratified Galerkin method is proposed and applied to the computation of rotational modes, to avoid these problems. This new method can solve not only one order ellipsoid but also irregular asymmetric 3D earth model. Our primary result of the FCN period is 435 sidereal days.