A NOTE ON THE DEVELOPMENT OF THE RECIPROCAL DISTANCE IN PLANETARY THEORY

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ABSTRACT

In a development of the reciprocal distance ($1/\Delta$) between two planets, their orbital inclinations, in a sense, improve the convergence, though the development is carried out in powers of the inclinations. This is most clearly shown in the Neptune-Pluto case: if their inclinations, 2° and 17°, are assumed to be 0°, the two orbits cross each other. The development in the actual case ought to be easier than in the assumed case with vanishing inclinations. We take advantage of this fact by introducing Δ_o of the form

$$\Delta_o^2 = r^2 + r'^2 - 2rr'(cc' - ss')^2 \cos(v-v'),$$

such that,

$$\Delta^2 = \Delta_o^2 - 2rr' \{c^2 s'^2 \cos(v+v' - 2h') + s^2 c'^2 \cos(v+v'-2h) + s^2 s'^2 \cos(v-v' -2h+2h') + 2csc's' [\cos(v-v' - h+h') - \cos(v+v' - h-h)] + (2csc's' - s^2 s'^2) \cos(v-v')\},$$

where $c = \cos(i/2)$ and $s = \sin(i/2)$.

On the right-hand side, Δ_o^2 is always larger than $|2rr'\{\ \}|$ so far as the two orbits do not cross each other, and $1/\Delta$ is developed with $1/\Delta_o$ as the leading term. When $i' = 0$, Δ_o^2 is reduced to the form introduced by Brown & Shook in the case of asteriodal motion.

https://doi.org/10.1017/S0252921100062266 Published online by Cambridge University Press