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About the calculation of the frequencies of lunar-solar tides in the model of viscoelastic Earth

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The problem of calculating the Earth tidal deformations under the influence of gravity of the Moon and the Sun is considered. The Earth is assumed to be a viscoelastic body that is axisymmetric in an undeformed state and has an axisymmetric absolutely solid core. The elastic displacements at the boundary of the viscoelastic part and the solid core equal to zero, and another boundary is free. Viscoelastic material is assumed to move according to the Kelvin - Voigt model. The center of mass of the Earth – Moon system moves in a slowly changing elliptical orbit around the Sun under the influence of gravitational forces from the Sun and the Moon. For this problem the Sun and the Moon are considered as material points. Previously, this problem was considered in [1], with a significant number of simplifications and assumptions.

The equations that describe the Earth's deformations, are obtained from the d'Alembert-Lagrange variational principle [2].Also, according to the modal approach, the displacement vector is represented as an infinite series of eigenforms of the elastic part's free oscillations. As a result, for modal variables an infinite system of ordinary differential equations of the second order is written The system can be simplified using the physical observation, that under the influence of viscous friction in the free oscillations in the material are damped and therefore the deformations occur in a quasi-static way [2], which allows us to discard the inertial terms in the equations. As a result, in the obtained simplified system it can be noted that only the equations for the first four forms contain the non-zero right-hand sides, which means that the deformations of the remaining forms are (under quasi-static condition) small and can be neglected. As a result, we have a system of eight equations. The right-hand sides of these equations are due to the gravitational interactions between the Earth and the Sun and between the Earth and the Moon which means that they depend on their radius vectors. Therefore they can are expressed through the angles that determine these radius vectors, as well as the angles that determine the orientation of the Earth in space. By expanding the right-hand sides of the equations as a series in powers of a small parameter (which is taken as the ratio of the Earth's radius to the distance from the Earth to the Moon), we can represent them as series containing sines and cosines of the combinations of aforementioned angles. Since the angles can be considered as uniformly changing over not too long time periods, this allows us to approximate the frequency of the Earth tidal deformations.

References

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