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Motion of the Three Viscoelastic Planets in Gravitational Field of the Mutual Attraction

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The translational-rotational motion of the three viscoelastic planets in gravitational field of the mutual attraction is studied. We model the planets by the homogeneous isotropic viscoelastic bodies, which in the natural non-deformed state occupy the spherical regions in the three-dimensional Eucliden space. The problem is being solved within the framework of the linear model of the theory of elasticity. The functional of the inner dissipative forces corresponds to the Kelvin-Voigt model.
Each of the planets deforms due to its rotation around its mass center and its movement relative to the system's mass centre: the planet is being compressed endwise its axis of rotation and tidal humps appear aloud the lines binding the planet's mass centers. The changes in the planet's shape in their turn alter its translational-rotational movement.
The system of equations of motion of the considered mechanical system is deduced from the D'Alembert-Lagrange variational principle and represents a complicated integro-differential system of equations in the banach space. The method of separation of motions is applied to the obtained system of equations and an approximate system of ordinary differential equations is deduced witch describes the translational-rotational motion of the planets, taking into account the perturbations caused by elasticity and dissipation. Unperturbed system of equations corresponds to the problem of the motion of the three rigid spheres interacting under the law of universal gravitation.
Boundary problem of finding the vector of elastic displacement, describing forced oscillation of the planet under the influence of external forces and inertial forces of the translational motion is solved for each of the planets. Due to the planets' sphericity in their natural non-deformed state, the solutions of the boundary problems can be represented analytically as a sum of finite number of spherical functions. The solutions of the boundary problems are used to form the perturbing additives to the equations of motion. As a result of this procedure we get a vectorial perturbated system of ordinary differential equations on the radius of the planets' mass centers and the vectors of the planets' angular momentums.
The stationary motion of the system of the three viscoelastic planets when the dissipative functional is equal to zero (the analogue of the triangular libration points in the classical three-body problem) is founded. According to this movement, the spheres move as one solid body with constant angular velocity, and the spheres' mass centers lie on a plan, orthogonal to the vector of angular velocity. If in unperturbed problem the mass centers of the planets form an equilateral triangle, the presence of perturbations leads to the emergence of the additives to stationary values of the triangle's side lengths, as the result of which the triangular in general case becomes inequilaterally. Due to the presence of dissipation of the system, the stationary triangular configuration is unsteady.
This work is an extension of the series of articles [1-4] devoted to the problem of the viscoelastic spheres motion in gravitational field, the model problem for investigating the tidal evolution of the planets motion.
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