NONLINEAR VIBRATIONS AND GALLOPING OF TRANSMISSION LINES' CONDUCTORS

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Nonlinear problem of spatial aeroelastic vibrations of iced conductors is considered. Mathematical model is formulated on the finite element method, taking into account finite deformations and the nonlinearity of the inertial forces.
Each finite element is associated with a local coordinate system for which the displacements, angles of rotation, the translational and rotational speed are considered strictly.

The tensile strain of the finite element is determined by quadratic approximation in dependence on its transverse displacements.

The displacements and twisting angles of the finite element at its ends as well as the coefficients of the expansions of these functions in sine series with integer number of loops per span are considered as generalized coordinates. The aerodynamic loads acting on the vibrating iced conductor are determined using the conventional quasi-steady formulas for the lift, drag and moment in dependence on the disturbed angle of attack.

The dynamic equations are obtained using d'Alembert-Lagrange principle. It is considered that the generalized coordinates are subjected to the linear relations relative to the generalized velocities. These relations are introduced to account for the interphase spacers and antigalloping dampers.

Variation of the problem functional, for which we seek steady-state value, is transformed by the addition of the constraint equations, multiplied by the undefined Lagrange multipliers. A variational problem for the transformed functional is solved as a free. The stationarity conditions, together with the differential equations of constraints, determine the desired values of generalized coordinates.

Nonlinear dynamic equations are integrated numerically using the integral curve length parameter as a problem argument.

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References

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