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Theory of dimensionally dependent physically nonlinear Euler-Bernoulli beams in an aggressive medium with account of coupling of temperature and deformation fields

Jan Awrejcewicz, Tatyana Y. Yakovleva, Ekaterina Y. Krylova, Anastasiya O. Sinichkina, Vadim A. Krysko - jr.

Abstract: In this paper a dimensionally dependent theory of physically nonlinear beams described by the kinematic theory of the first approximation is constructed. The basis of the developed theory is the moment theory of elasticity. The physical nonlinearity is taken into account following the Birger method of variable elasticity parameters, according to which the physical parameters of the beam material are not constant, but are functions of coordinates and a stress-strain state of the structure. The input partial differential equations of motion are obtained from the Hamilton variation principle. Equations take into account the relationship between deformation and temperature fields, material dependence on temperature and the aggressive medium properties in which the beam is located. The governing equations are nonlinear of the hyperbolic-parabolic type and exhibit different dimension. The equation of beam motion is one-dimensional, and the equation of thermal conductivity is two-dimensional. It means that no any restrictions for temperature distribution over beam thickness are employed. A calculation algorithm with nested iterations is developed in order to solve the problem in a reliable and validated way.
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[1] Jan Awrejcewicz, Professor: Lodz University of Technology, Faculty of Mechanical Engineering, Department of Automation, Biomechanics and Mechatronics, 1/15 Stefanowski Str., 90-924 Lodz, POLAND (awrejcew@p.lodz.pl), the author presented this contribution at the conference.

[2] Tatyana Y. Yakovleva, Ph.D.: Department of Mathematics and Modeling, Saratov State Technical University, Politehnicheskaya 77, 410054 Saratov, RUSSIAN FEDERATION, and Cybernetic Institute, National Research Tomsk Polytechnic University, 634050 Tomsk, Lenin Avenue, 30, RUSSIAN FEDERATION (Yan-tan1987@mail.ru).

[3] Ekaterina Y. Krylova, Associate Professor: Saratov State University, Russian Federation, Politehnicheskaya 77, 410054 Saratov, RUSSIAN FEDERATION (Kat.Krylova@bk.ru).

[4] Anastasiya O. Sinichkina, M.Sc. (Ph.D. student): Department of Mathematics and Modeling, Saratov State Technical University, Politehnicheskaya 77, 410054 Saratov, RUSSIAN FEDERATION (andreevaanastasiaolegovna@gmail.com).

[5] Vadim A. Krysko - jr., M.Sc. (Ph.D. student): Department of Mathematics and Modeling, Saratov State Technical University, Politehnicheskaya 77, 410054 Saratov, RUSSIAN FEDERATION (vadimakrysko@gmail.com).