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Structural-parametric model of electro-magneto-elastic actuator for nanotechnology

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For nanotechnology, nanoscience, nanobiology, power engineering, microelectronics, astronomy, antennas satellite telescopes and adaptive optics equipment is promising for use of mechatronics systems with electromechanical actuator based on electro-magneto-elasticity (piezoelectric, piezomagnetic, electrostriction, magnetostriction effects). Piezoelectric actuator (piezo actuator) – piezo mechanical device intended for actuation of mechanisms, systems or management based on the piezoelectric effect, converts electrical signals into mechanical movement or force. Piezo actuators are used in the majority of nano manipulators for scanning tunneling microscopes (STMs), scanning force microscopes (SFMs), and atomic force microscopes (AFMs). By solving the wave equation with allowance for the corresponding equation of the piezo effect, the boundary conditions on loaded working surfaces of piezo actuator, the strains along the coordinate axes, it is possible to construct a structural parametric model of the piezo actuator. Structural-parametric model, decision wave equation and matrix equations of electro magneto elastic actuator are obtained; its transfer functions are built. Effects of geometric and physical parameters of electro magneto elastic actuator and external load on its dynamic characteristics are determined. For calculation of mechatronics systems for nano-metric movements with electro-magneto-elastic actuator, the generalized parametric structural schematic diagram Figure 1 and the transfer functions of actuator are obtained. Static and dynamic characteristics of piezo actuator are determined. The generalized structural-parametric model of the electro-magneto-elastic actuator provides the determination of its transfer functions and use methods of automatic control theory in calculation of its static and dynamic characteristics for the electro-magneto-elastic actuator for nanotechnology and nanoscience. Using the solutions of the wave equation and matrix equation of the electro-magneto-elastic actuator and taking into account the features of the deformations along the coordinate axes, it is possible to construct the generalized structural-parametric model of the actuator and to describe its dynamic and static properties.

Biography

Sergey Mikhailovich Afonin is an Associate Professor in Department of Intellectual Technical Systems at National Research University of Electronic Technology (Moscow Institute of Electronic Technology MIET). He completed his Graduation in Electronic Technology at National Research University of Electronic Technology MIET and; PhD in Electronic Technology Engineering and Control Systems at National Research University of Electronic Technology MIET. He received academic title of Senior Researcher at MIET in 1991. He has published more than 200 scientific papers to professional publication.

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