Sergey Mikhailovich Afonin, J Astrophys Aerospace Technol 2017, 5:4(Suppl)
DOI: 10.4172/2329-6542-C1-015

Structural-parametric model of piezoactuator nanodisplacement

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Piezoactuator nanodisplacement is used in the majority of nanomanipulators for nanotechnology, nanobiology, power engineering, microelectronics, astronomy for large compound telescopes, antennas satellite telescopes and adaptive optics equipmen and for scanning tunneling microscopes (STMs), scanning force microscopes (SFMs), and atomic force microscopes (AFMs). Piezoactuator - piezomechanical device (piezoplate) intended for actuation of mechanisms, systems or management based on the piezoelectric effect, converts electrical signals into mechanical movement or force. The investigations of static and dynamic characteristics of a piezoactuator of nano- and micrometric movements as the control object are necessary for calculation of piezodrive mechatronics systems. By solving the wave equation using the Laplace transform with allowance for the corresponding equations of the piezoeffect, the boundary conditions on loaded working surfaces of the piezoactuator, the strains along the coordinate axes, it is possible to construct the structural parametric model of the piezoactuator. The transfer functions and the parametric structure scheme for the piezoactuator of the longitudinal, transverse, shift piezoeffects are obtained from the set of equations describing the corresponding structural-parametric model of the piezoactuator. Structural-parametric model, decision wave equation and transfer functions of the piezoactuator are obtained using kinematics of deformable bodies. Effects of geometric and physical parameters of the piezoactuator and external load on its dynamic characteristics are determined. For calculation of mechatronics systems for nanometric movements with the piezoactuator the parametric structural schematic diagrams and the transfer functions of the piezoactuator are obtained. Static and dynamic characteristics of the piezoactuator are determined. The generalized structural-parametric model of the piezoactuator provides the determination of its transfer functions and use automatic control theory for finding static and dynamic characteristics of the piezoactuator nanodisplacement.

Biography

Sergey Mikhailovich Afonin (PhD) is an Associate Professor in Department of Intellectual Technical Systems of National Research University of Electronic Technology (Moscow Institute of Electronic Technology MIET). He is a graduate of the National Research University of Electronic Technology MIET, Engineer in Electronic Technology, 1976. He completed his PhD in Electronic Technology Engineering and Control Systems in MIET during 1982. He received Academic title of Senior Researcher in MIET 1991; Aspirant MIET 1976–79; Junior Researcher MIET 1979–82; Senior Researcher MIET 1983–93; Associate Professor at MIET since 1993 to present time. He has contributed more than 200 scientific papers to professional publication and 16 inventions. He was the Recipient Silver medal VDNKH Russia and two Bronze medals VDNKH Russia.

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