26th International Conference on **Advanced Nanotechnology**

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2nd Edition of International Conference on
Materials Technology and Manufacturing Innovations

October 04-05, 2018   Moscow, Russia

Absolute stability of control system with electromagnetoelastic actuator for nanotechnology applications

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The application of the electromagnetoelastic actuator based on the electromagnetoelasticity for the piezoelectric, piezomagnetic, electrostriction, magnetostriction effects is promising in the nanotechnology, the nano-biology, the power engineering, the microelectronics and the adaptive optics equipment. The correcting devices are chosen for providing the high quality of the control systems for the deformation of the piezo actuator. The analytical expressions for the sufficient absolute stability conditions of the system with the hysteresis nonlinearity of the electromagnetoelastic actuators are written using the Yakubovich absolute stability criterion with the condition on the derivative, which is the development of the Popov absolute stability criterion. For the Lyapunov-stable control system, the Yakubovich absolute stability criterion for the systems with the single hysteresis nonlinearity provides the simplest and pictorial representation of results of the investigation of the stability and the possibility of the synthesis of the correcting devices of the system ensuring the stability of the strain control systems with the electromagnetoelastic actuators. The characteristics of the electromagnetoelastic actuators are the alternating-sign hysteresis type for the piezo actuators and the constant-sign butterfly type for the electrostriction actuators. In the magnetostriction and electrostriction actuators their initial operating point is chosen on one wing of the butterfly, for example, in the first quadrant, for the deformation range to be symmetric at both sides of the initial point. For the butterfly characteristic the initial working point displaced by the half deformation range. The values of the tangents of the inclination angles of the tangent line to the hysteresis nonlinearity on the butterfly wing for the electromagnetoelastic actuator are determined similar to the hysteresis characteristic. The stationary set of the control systems is the segment of the straight line. The absolute stability conditions with the condition on the derivative of the control systems with piezo actuator deformation in the case of the longitudinal, transverse and shift piezo effect for the hysteresis characteristic of the deformation of the piezo actuator are obtained. The obtained absolute stability conditions for the control system with the electromagnetoelastic actuator allow one to estimate and calculate the characteristics of the control system for the deformation of the electromagnetoelastic actuator.

Biography

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

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Nano Research & Applications
ISSN: 2471-9838

Advanced Nanotechnology 2018
& Materials-Manufacturing 2018
October 04-05, 2018

Volume 4

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