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**High-speed Bigradient Algorithms with a Modified Reference Model in the Task of Control of a Vibratory Gyroscope**

*The article is devoted to the task of adaptive control of a single-axis vibratory gyroscope with a modified reference model of the desired dynamics of the mechanical subsystem. In order to enhance the astatism of the system and ensure smoothness of the controlling forces, additional integrators are connected to the gyroscope inputs.**The smooth control algorithms and the algorithms of the sliding mode with a tuning surface for the system with integrator were designed by the speed bi-gradient method. Synthesis of the control algorithms based on employment of an additional modified reference model for the trajectory tracking error of the reference model was proposed. A modified model was selected in the form of a linear Hurwitz system with an input proportional to the discrepancy between the output of the input cascade and the virtual control of the gyroscope. The purposes of the modification were improvement of the identifying properties and reduction of the energy consumption for control. These goals were achieved by a structural correspondence of the model error and modified reference model not only on the intersections of the hypersurfaces (the discrepancy was identically equal to zero), but also outside of them. Note, that entry of a discrepancy either in the unstable reference model of oscillation or in a virtual control does not allow achievement of the specified goal. The design procedure, condition of the applicability, stability analysis of the adaptive control system and the robustness were presented. The theoretical results were proved by a closed-loop system simulation in MATLAB.*

***Keywords****: high-speed bigradient method, tunable sliding mode, vibratory gyroscope, stability, Lyapunov function, robustness, modified reference model*

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