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BOOK REVIEW

S.M. Onishchenko "Rigid optimal stabilization and observation nonlinear systems under uncertain conditions. Part 1", Kiev, Alfa Reklama, 2017, 352 p., ISBN 978-966-288-172-1

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Stability is generally understood system property does not change when the small (in a certain sense), variations in the initial conditions, external influences, system parameters, and perhaps in some other disturbing influences.

A common method of stable systems different classes research (for nonlinear systems – is unique) is the second (forward) Lyapunov method. Unfortunately, its design is somewhat limited because of a sufficient nature obtained with its help the results, as to a research tool in it are some special functions used – Lyapunov functions. However, this drawback has to be tolerated.

At the same time, we note that the second Lyapunov method is still true for not only the effective *analysis* systems stability, but also as the basic method for *synthesis* stable systems. It allows, under certain conditions, not only to establish the stability of the system as its passive property, but also actively synthesize (using feedback) its stability, ensuring stabilization of system. Thus, the stabilization of the system can be regarded as an active ensuring its stability as opposed to the passive detection of its property. The solution of nonlinear systems stabilization problem is subject of this monograph.

In the synthesis of stabilization systems with the involvement of control theory is often a problem of their optimization taking account of established quality criteria. It comes with constraints on the control when the energy is not enough, for the exact solution of the problem of stabilization particular system. The book sets out the procedure to optimize the proposed methods of hard synthesis stabilization systems.

To ensure the stability of the synthesized control systems (their stabilization) is practically impossible without uncontrolled perturbations acting on these systems. The author has long been a supporter of their limitation hypothesis. Therefore, in the monograph the stabilization problem is considered under conditions of uncertainty.

Part 1 of the monograph is devoted to presenting the theoretical foundation of proposed direction of nonlinear systems *rigid* stabilization, which is based on the direct Lyapunov method. The term *rigid stabilization* is due to enough rigid conditions imposed on the coefficients matrix of quadratic forms – Lyapunov functions. Their structure is rigidly fixed multiplicative parameterization of the lower or upper quasi-triangular nonsingular matrices.

Chapter 1 provides an analysis of possible design methods using synthesis of nonlinear systems stabilization - direct, inverse and semi-inverse methods. Particular attention is paid to direct methods and are analyzed:

- monotonous stabilization;
- stabilization of systems using the first approximation of their open state;
- systems stabilization with linear coupling of the control matrix with the coefficient matrix of the Lyapunov function;
- rigid stabilization of nonlinear systems.

Chapter 2 discussed in details all six of direct methods for the synthesis of nonlinear systems rigid stabilization and shows that only three of them are constructive.

Chapter 3 is devoted to analysis of rigid synthesis modal methods of nonlinear systems stabilization.

Chapter 4 discusses:

- stabilizability conditions in the nonlinear systems rigid synthesis methods,
- communication of controllability and stabilizability conditions for nonlinear dynamical systems,
- problem of uncontrolled linear systems stabilizability.

Chapter 5 presents:

- The results of the optimization methods for the rigid synthesis of nonlinear systems stabilization.
- Analyzed dependence of stabilizing management structure from its synthesis methods.
- Stabilization of nonlinear systems is studied:
    - by the vector of output variables,
    - according to incomplete vector of states,
    - with a singular structure of their regulators.
- There was proposed the stabilization of nonlinear systems status observer using direct rigid synthesis methods.