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BOOK REVIEW

"Comparison Method and Stability of Motions of Nonlinear Systems" by A.Yu. Aleksandrov and A.V. Platonov

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The monograph **"The Comparison Method and Stability of Motions of Nonlinear Systems"** by A.Yu. Aleksandrov and A.V. Platonov.

Publishing house: Saint Petersburg University Press, 2012.

Pages: 263.

Language: Russian.

Readership: pure and applied mathematicians, applied physicists, industrial and control engineers, communication network specialists, and upper-level undergraduate and graduate students studying stability theory and control theory.

Contents: Introduction, Differential inequalities and comparison systems, Absolute stability and ultimate boundedness of nonlinear systems, Stability of motions of complex systems by nonlinear approximation, References.

This self-contained monograph is devoted to the problem of stability analysis for broad classes of systems of nonlinear differential equations. Along with the describing of classical results, the book presents recently developed novel approaches for stability investigation of motions of nonlinear systems in critical, in the Lyapunov sense, cases. The developments in this area are remarkable, from both the theoretical and the practical point of view.

In Chapter 1, the basic notions and principal results of the differential inequalities theory and the comparison method are presented. Several classical approaches for the decomposition and aggregation of complex systems are considered. A special attention is devoted to stability criteria of linear and nonlinear Wazewskii systems. Furthermore,

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new conditions of ultimate boundedness of solutions for autonomous Wazewskii systems are proposed.

The absolute stability and absolute ultimate boundedness problems for nonlinear systems are studied in Chapter 2. The Persidskii-type systems and some of their generalizations are considered. Several approaches for the constructing of Lyapunov functions for such systems are proposed. By means of these functions, the conditions of absolute stability and absolute ultimate boundedness are found. Moreover, an emphasis is placed on the analysis of nonlinear switched systems. To provide the absolute stability or the absolute ultimate boundedness uniform with respect to a switching law for a system of such type, it is sufficient to construct a common Lyapunov function for the corresponding family of subsystems. In the monograph, new conditions in terms of linear inequalities of a special form are presented to guarantee the existence of common Lyapunov functions. The problem of the solvability for the obtained inequalities systems is investigated, and constructive algorithms for finding their solutions are proposed.

Chapter 3 is devoted to the problem of stability analysis of complex (large-scale, multiconnected) systems by nonlinear approximation. First, classical results by N.N. Krasovskii and V.I. Zubov on the stability by homogeneous and generalized homogeneous approximation are presented. Next, the case when a system of the first approximation is nonlinear and inhomogeneous is studied, and original stability conditions are obtained. After that, new forms of decomposition and aggregation of complex systems are proposed, and the effectiveness of their usage for the stability investigation of essentially nonlinear complex systems is demonstrated. Moreover, the approaches for finding the estimates of transient times for multiconnected systems in critical cases are developed. Finally, the problem of stability analysis of equilibrium positions of mechanical systems on the base of decomposition is studied.

The monograph contains a lot of examples of the applications of obtained results and proposed approaches in control problems, mechanics and population dynamics.

In summary, this book is valuable for all those who are interested in stability theory and its applications. It covers a broad spectrum of important topics. The book is well written and the presentation of the material is well organized. The book is issued only in Russian, however it will be also definitely interesting for the English-speaking specialists.