Asymptotic behavior of solutions in the critical case of stability with q pairs of purely imaginary eigenvalues

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Abstract

The study of the asymptotic behavior of solutions remains a challenging problem in the stability theory for many important critical cases. It is well known that, for linear autonomous systems of differential equations, properties of asymptotic and exponential stability are equivalent. Power estimates for solutions of the systems defined by homogeneous vector fields were obtained by N. N. Krasovskii and V. I. Zubov.

This presentation is focused on the study of the critical case of stability under the assumption that the matrix of the linear approximation has q pairs of purely imaginary eigenvalues. The purpose of this investigation is to derive asymptotic estimates of solutions of a nonlinear system explicitly. The central manifold theory and reduction principle are used as basic methods of the study.

The main result provides an asymptotic estimate of the solutions in the case of stability with respect to the third order forms. A Lyapunov function for the system with stable and critical components is constructed. The result obtained is illustrated by an example of a double pendulum with partial dissipation.

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