

HIERARCHY OF SUBFAMILIES OF THE POLYNOMIAL FAMILY OF DYNAMICAL SYSTEMS

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Problems solved through mathematical modeling run like a red thread through all branches of modern science and engineering, forming their fabric - from astrophysics and biophysics to mechanical engineering and urban infrastructure, from economics and sociology to earthquake resistance of structures and environmental research. The key role in the construction of mathematical models of diverse processes and phenomena belongs to dynamic systems. The problem turns out to be reduced to the study of the characteristics of those curves that are determined by the differential equations of the corresponding dynamical system. In the process of their analysis, the phase space of a dynamic system is divided into separate trajectories. For these trajectories, their limiting behavior is investigated in order, first of all, to classify possible equilibrium positions. In addition, possible sources and sinks of the phase flow of the system are identified. As a result, phase portraits of the dynamic system are constructed and criteria for their implementation are established. The identification of phase portraits acceptable for a dynamic system means that the researcher has the opportunity to predict the development paths of the process, whose model this dynamic system served. Polynomial systems play a special role among dynamical systems due to the convenience of their use as mathematical models and the feasibility of their detailed analysis. This paper is devoted to an extensive hierarchically branched family of polynomial dynamical systems with mutually simple polynomials in the right-hand sides of their equations. A large number of subfamilies of their global family have been studied within the framework of the methods of the qualitative theory of ordinary differential equations and dynamical systems. A number of methods have been developed specifically for the purposes of this original study. All topologically independent phase portraits of numerous subfamilies belonging to different levels of the hierarchy have been identified.

References.

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