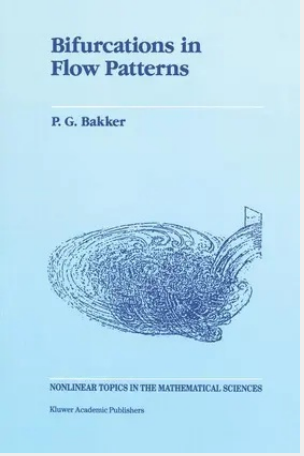
Bakker

Bifurcations in Flow Patterns

Some Applications of the Qualitative Theory of Differential Equations in Fluid Dynamics



The main idea of the present study is to demonstrate that the qualitative theory of diffe rential equations, when applied to problems in fluid-and gasdynamics, will contribute to the understanding of qualitative aspects of fluid flows, in particular those concerned with geometrical properties of flow fields such as shape and stability of its streamline patterns. It is obvious that insight into the qualitative structure of flow fields is of great importance and appears as an ultimate aim of flow research. Qualitative insight fashions our know ledge and serves as a good guide for further quantitative investigations. Moreover, quali tative information can become very useful, especially when it is applied in close corres pondence with numerical methods, in order to interpret and value numerical results. A qualitative analysis may be crucial for the investigation of the flow in the neighbourhood of singularities where a numerical method is not reliable anymore due to discretisation er rors being unacceptable. Up till now, familiar research methods -frequently based on rigorous analyses, careful nu merical procedures and sophisticated experimental techniques -have increased considera bly our qualitative knowledge of flows, albeit that the information is often obtained indirectly by a process of a careful but cumbersome examination of quantitative data. In the past decade, new methods are under development that yield the qualitative infor mation more directly. These methods, make use of the knowledge available in the qualitative theory of differen tial equations and in the theory of bifurcations.

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