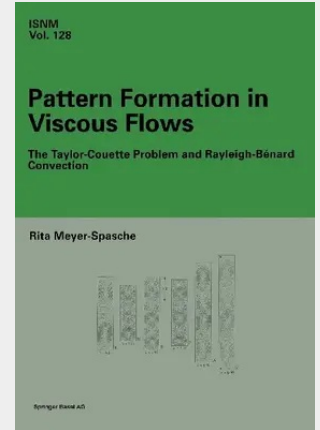


Pattern Formation in Viscous Flows

The Taylor-Couette Problem and Rayleigh-Bénard Convection

It seems doubtful whether we can expect to understand fully the instability of fluid flow without obtaining a mathematical representation of the motion of a fluid in some particular case in which instability can actually be observed, so that a detailed comparison can be made between the results of analysis and those of experiment. - G.I. Taylor (1923) Though the equations of fluid dynamics are quite complicated, there are configurations which allow simple flow patterns as stationary solutions (e.g. flows between parallel plates or between rotating cylinders). These flow patterns can be obtained only in certain parameter regimes. For parameter values not in these regimes they cannot be obtained, mainly for two different reasons: • The mathematical existence of the solutions is parameter dependent; or • the solutions exist mathematically, but they are not stable. For finding stable steady states, two steps are required: the steady states have to be found and their stability has to be determined.

The Taylor-Couette system is one of the most studied examples of fluid flow exhibiting the spontaneous formation of dynamical structures. In this book, the variety of time independent solutions with periodic spatial structure is numerically investigated by solution of the Navier-Stokes equations.



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