DK Seminar

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Singular bifurcations in a model for Micro-Electro Mechanical Systems (MEMS)

Micro-Electro Mechanical Systems (MEMS) are very small structures combining electrical and mechanical components on a common substrate to perform several tasks. Electrostatic-elastic devices in particular consist of an elastic membrane is allowed to deflect above a ground plate under the action of an electric potential. They have been mathematically modelled by a parabolic PDE with a particular nonlinear source term that can lead to the touchdown phenomenon. In recent years, a new model depending on a small regularization parameter ε has been proposed, where considering additional insulating effects allows to avoid singularities. The regularized model presents several interesting features: in this talk we will in particular deal with the singular nature of the bifurcation diagram.

Our main focus is a saddle-node bifurcation point which, due to its singular nature, is very hard to obtain even numerically; its extremely sensitive dependence on the small regularization parameter makes indeed several algorithms break down for small values of ε. By means of geometric singular perturbation theory and blow-up techniques, we give a rigorous analysis of the bifurcation curve and its singular limit and compute a novel asymptotic expansion of the saddle-node bifurcation point.