Piecewise smooth system with a nonregular switching curve via a nonlinear double-regularization

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Considering a class of piecewise smooth vector fields with a nonregular switching manifold, we are interested in an analysis of the preservation of the bifurcations according to a regularization process. Thanks FAPESP by the support, process 2021/14695-7.

Traveling waves in gravitational fingering instability

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The poster is devoted to viscous / gravitational fingering phenomenon - the unstable displacement of miscible liquids in porous media with the speed determined by Darcy's law. Laboratory and numerical experiments show the linear growth of the mixing zone, and we are interested in determining the exact speed of propagation of fingers. One of the possible mechanisms of slowing down the fingers' growth is due to convection in the transversal direction, that we try to explain by introducing a semi-discrete "toy" model of incompressible porous medium equation (IPM). In the simplest setting we show the structure of gravitational fingers - the mixing zone consists of space-time regions of constant intermediate concentration and the profile of propagation is characterized by two consecutive travelling waves which we call a terrace. The main tool in the proof is a reduction to pressure-free transverse flow equilibrium (TFE) model using geometrical singular perturbation theory and the persistence of stable and unstable manifolds under small perturbations. Based on joint work with S. Tikhomirov and Ya. Efendiev (SIMA, 2025).