* Electronic Address: sergey.tikhomirov@mis.mpg.de
[1] Max Planck Institute for Mathematics in the Sciences
† Electronic Address: gurevich@math.fu-berlin.de
[2] Free University of Berlin

Rattling in spatially discrete reaction-diffusion equations with hysteresis

Sergey Tikhomirov[1*], Pavel Gurevich[2†]

Hysteresis naturally appears as a mechanism of self-organization and is often used in control theory. Important features of hysteresis are discontinuity and memory. We consider reaction-diffusion equations with hysteresis. Such equations describe processes in which diffusive and non-diffusive instances interacts according to a hysteresis law. Due to the discontinuity of hysteresis, these equations are not always well-posed. We consider a spatial discretization of the problem and present a new mechanism of pattern formation, which we call rattling. The profile of the solution forms two hills propagating with non-constant velocity. The profile of hysteresis forms a highly oscillating quasiperiodic pattern, which explains mechanism of ill-posedness of the original problem and suggests a possible regularization. Rattling is very robust and persists in arbitrary dimension and in systems acting on different time scales.