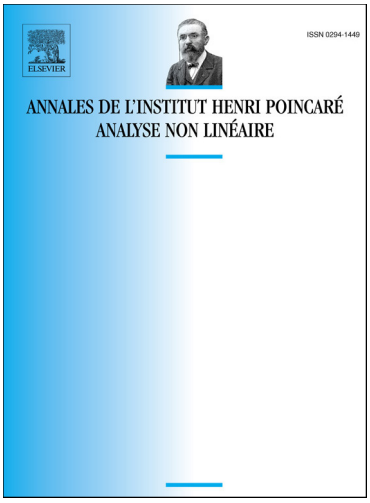
Accepted Manuscript



Spatially discrete reaction-diffusion equations with discontinuous hysteresis

Pavel Gurevich, Sergey Tikhomirov

PII: S0294-1449(17)30121-X
DOI: https://doi.org/10.1016/j.anihpc.2017.09.006
Reference: ANIHPC 2871

To appear in: *Annales de l'Institut Henri Poincaré - Analyse non linéaire*

Received date: 6 May 2015
Revised date: 10 March 2017
Accepted date: 21 September 2017

Please cite this article in press as: P. Gurevich, S. Tikhomirov, Spatially discrete reaction-diffusion equations with discontinuous hysteresis, *Ann. I. H. Poincaré – AN* (2017), https://doi.org/10.1016/j.anihpc.2017.09.006

Spatially discrete reaction-diffusion equations with discontinuous hysteresis

Pavel Gurevich*, Sergey Tikhomirov†

Abstract

We address the question: Why may reaction-diffusion equations with hysteretic nonlinearities become ill-posed and how to amend this? To do so, we discretize the spatial variable and obtain a lattice dynamical system with a hysteretic nonlinearity. We analyze a new mechanism that leads to appearance of a spatio-temporal pattern called *rattling*: the solution exhibits a propagation phenomenon different from the classical traveling wave, while the hysteretic nonlinearity, loosely speaking, takes a different value at every second spatial point, independently of the grid size. Such a dynamics indicates how one should redefine hysteresis to make the continuous problem well-posed and how the solution will then behave. In the present paper, we develop main tools for the analysis of the spatially discrete model and apply them to a prototype case. In particular, we prove that the propagation velocity is of order $at^{-1/2}$ as $t \to \infty$ and explicitly find the rate a.

Contents

*Free University of Berlin, RUDN University, email: gurevich@math.fu-berlin.de
†Saint-Petersburg State Univeristy; email: s.tikhomirov@spbu.ru