

# Analysis of a model for the dynamics of riots

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## Abstract

This paper is concerned with modeling the dynamics of social outbursts of activity, such as protests or rioting activity. In this sequel to our work in [5], written in collaboration with J-P. Nadal, we model the effect of restriction of information and explore the effects that it has on the existence of *spherical waves*. The systems involve the coupling of an explicit variable representing the intensity of rioting activity and an underlying (implicit) field of social tension. We prove the existence of global solutions to the Cauchy problem in  $\mathbb{R}^d$  as well as the existence of *traveling wave solutions* under certain parameter regimes. We furthermore explore the effects of heterogeneities in the environment with the help of numerical simulations, which leads to pulsating waves in certain cases. We analyze the effects of periodic domains as well as the *barrier problem* with the help of numerical simulations and discuss many open problems.

## 1 Introduction

The need to understand the spatio-temporal dynamics of social outbursts, such as protests or rioting activity, has been highlighted with many current events. For example, the fatal shooting of Michael Brown in Ferguson, Missouri (USA) by a white police officer in August of 2014 led to a two-week period of protests, which subsided until the grand jury's decision not to indict the officer in question [9]. A similar wave of protests was later observed in New York City (USA) after the grand jury's decision not to indict the police officer involved in Eric Garner's chokehold case [13]. As many individuals throughout the U.S. and the rest of the world are keeping a close watch on these and similar cases there is a risk of increased social tension spreading throughout the country and abroad [11, 20, 14]. We think of protests as outbursts of social activity which are induced by an initial shock and grow, due to a self-reinforcement mechanism and/or continuing external shocks, for some period of time. We sometimes refer to this initial shock as the triggering event. Clearly, it is important not only to understand when these outbursts of activity will occur, but also how they will spread geographically. This motivated us to introduce various models that include what we believe to be the bare essential mechanisms which are necessary to capture the stylized facts of outbursts of social activity, in particular related to protests or civil unrest, in [5] written in collaboration with J-P. Nadal. The models we introduced involve the coupling of an explicit variable representing the intensity of rioting activity and an underlying (implicit) field of social tension. The effects of exogenous and endogenous factors as well as various propagation mechanisms are also included in the system. It must be said that the purpose of these series of works is not to understand the economic, social or political origins of riots, and much less to discuss the legitimacy or lack thereof of

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