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An investigation of the convergence to the stationary state in the Hassell mapping

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Abstract. We investigate the convergence to the fixed point and near it in a transcritical bifurcation observed in a Hassell mapping. We considered a phenomenological description which was reinforced by a theoretical description. At the bifurcation, we confirm the convergence for the fixed point is characterized by a homogeneous function with three exponents. Near the bifurcation the decay to the fixed point is exponential with a relaxation time given by a power law. Although the expression of the mapping is different from the traditional logistic mapping, at the bifurcation and near it, the local dynamics is essentially the same for either mappings.

Keywords: Hassell map, bifurcations, scaling law.

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1. Introduction

The study of the properties for nonlinear systems has been of interest of many authors along the decades. Sometimes these properties are associated with bifurcations cascades of dynamical systems that describe mathematically natural phenomena [1, 2, 3]. The interest for the subject increased since the work of May [4], which has applications to biology [5]. Since then, many different applications involving mappings were considered in different areas including physics [6, 7, 8], mathematics, biology, chemistry, engineering among others [9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20].

In this paper, we consider the Hassell mapping [21, 22, 23] with the main goal of understanding and describing the behavior of the convergence to the fixed point at the bifurcation and near it. We concentrate particularly on the transcritical bifurcation

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