

Cosmological global dynamical systems analysis

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Abstract

We consider a dynamical systems formulation for models with an exponential scalar field and matter with a linear equation of state in a spatially flat and isotropic spacetime. In contrast to earlier work, which only considered linear hyperbolic fixed point analysis, we do a center manifold analysis of the non-hyperbolic fixed points associated with bifurcations. More importantly though, we construct monotonic functions and a Dulac function. Together with the complete local fixed point analysis this leads to proofs that describe the entire global dynamics of these models, thereby complementing previous local results in the literature.

Keywords: cosmology, dynamical systems, global dynamics, scalar field, perfect fluid

1. Introduction

Dynamical systems and dynamical systems methods were introduced in cosmology in 1971 by Collins [1] who treated two-dimensional dynamical systems while Bogoyavlensky and Novikov (1973) [2] used dynamical systems techniques for higher dimensional dynamical systems in cosmology. This early work has subsequently been followed up and extended by many researchers, see e.g. [3–5]. The first dynamical systems analysis involving a minimally coupled scalar field was given by Belinskii and co-workers [6–9] who used dynamical systems to explore inflation, primarily focusing on the potentials $V(\varphi) = \frac{1}{2}m^2\varphi^2$ and $V(\varphi) = \frac{1}{2}\lambda(\varphi^2 - \varphi_0^2)^2$. In 1987 Halliwell [10] treated an exponential scalar field potential in Friedmann–Lemaître–Robertson–Walker (FLRW) cosmology, where the scalar field and an

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Global Analysis Of Dynamical Systems

Khairul Saleh



Global Analysis Of Dynamical Systems:

Global Analysis of Nonlinear Dynamics Jian-Qiao Sun, Albert C. J. Luo, 2012-05-01 Global Analysis of Nonlinear Dynamics collects chapters on recent developments in global analysis of non linear dynamical systems with a particular emphasis on cell mapping methods developed by Professor C S Hsu of the University of California Berkeley This collection of contributions prepared by a diverse group of internationally recognized researchers is intended to stimulate interests in global analysis of complex and high dimensional nonlinear dynamical systems whose global properties are largely unexplored at this time

Global Analysis of Dynamical Systems H.W Broer, B Krauskopf, Gert Vegter, 2001-06-18 Contributed by close colleagues friends and former students of Floris Takens Global Analysis of Dynamical Systems is a liber amicorum dedicated to Takens for his 60th birthday The first chapter is a reproduction of Takens s 1974 paper Forced oscillators and bifurcations that was previously available only as a preprint of the University of Utrecht Among other important results it contains the unfolding of what is now known as the Bogdanov Takens bifurcation The remaining chapters cover topics as diverse as bifurcation theory Hamiltonian mechanics homoclinic bifurcations routes to chaos ergodic theory renormalization theory and time series analysis In its entirety the book bears witness to the influence of Takens on the modern theory of dynamical systems and its applications This book is a must read for anyone interested in this active and exciting field

Organising centres in the semi-global analysis of dynamical systems Khairul Saleh, 2005 *Organising Centres in the Semi-global Analysis of Dynamical Systems* Khairul Saleh, 2005 *Global Analysis of Dynamical Systems on Low-dimensional Manifolds*

Yi Song, 2008 Cell-to-Cell Mapping C.S. Hsu, 2013-03-09 For many years I have been interested in global analysis of nonlinear systems The original interest stemmed from the study of snap through stability and jump phenomena in structures For systems of this kind where there exist multiple stable equilibrium states or periodic motions it is important to examine the domains of attraction of these responses in the state space It was through work in this direction that the cell to cell mapping methods were introduced These methods have received considerable development in the last few years and have also been applied to some concrete problems The results look very encouraging and promising However up to now the effort of developing these methods has been by a very small number of people There was therefore a suggestion that the published material scattered now in various journal articles could perhaps be pulled together into book form thus making it more readily available to the general audience in the field of nonlinear oscillations and nonlinear dynamical systems Conceivably this might facilitate getting more people interested in working on this topic On the other hand there is always a question as to whether a topic a holds enough promise for the future and b has gained enough maturity to be put into book form With regard to a only the future will tell With regard to b I believe that from the point of view of both foundation and methodology the methods are far from mature

Introduction to Global Analysis, 1980-09-19 Introduction to Global Analysis

Global Analysis of Dynamic Models in Economics and Finance Gian Italo Bischi, Carl Chiarella, Iryna

Sushko,2012-08-07 The essays in this special volume survey some of the most recent advances in the global analysis of dynamic models for economics finance and the social sciences They deal in particular with a range of topics from mathematical methods as well as numerous applications including recent developments on asset pricing heterogeneous beliefs global bifurcations in complementarity games international subsidy games and issues in economic geography A number of stochastic dynamic models are also analysed The book is a collection of essays in honour of the 60th birthday of Laura Gardini Global Nonlinear Dynamics for Engineering Design and System Safety Stefano Lenci, Giuseppe

Rega,2018-09-24 This is the first book which exploits concepts and tools of global nonlinear dynamics for bridging the gap between theoretical and practical stability of systems structures and for possibly enhancing the engineering design in macro micro and nano mechanics Addressed topics include complementing theoretical and practical stability to achieve load carrying capacity dynamical integrity for analyzing global dynamics for interpreting predicting experimental behavior for getting hints towards engineering design techniques for control of chaos response of uncontrolled and controlled system models in applied mechanics and structural dynamics by also considering the effect of system imperfections from relatively simple systems to multidimensional models representative of real world applications potential and expected impact of global dynamics for engineering design The Global Analysis of Fuzzy Dynamical Systems Yung-Yaw Chen,1991 *Vibration Problems ICOVP 2011 : the 10th International Conference on Vibration Problems* ,2011

The Collected Papers of Stephen Smale Stephen Smale,Felipe Cucker,Roderick Wong,2000 This invaluable book contains the collected papers of Stephen Smale These are divided into eight groups topology calculus of variations dynamics mechanics economics biology electric circuits and mathematical programming theory of computation miscellaneous In addition each group contains one or two articles by world leaders on its subject which comment on the influence of Smale s work and another article by Smale with his own retrospective views Collected Papers Of Stephen Smale, The (In 3 Volumes) - Volume 1 Roderick S C

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the core themes of modern dynamical systems This book plays an important role in filling a gap in the present literature on hyperbolic dynamics and is highly recommended for all PhD students interested in this field Bifurcation and Chaos in Complex Systems ,2006-06-30 The book presents the recent achievements on bifurcation studies of nonlinear dynamical systems The contributing authors of the book are all distinguished researchers in this interesting subject area The first two chapters deal with the fundamental theoretical issues of bifurcation analysis in smooth and non smooth dynamical systems The cell mapping methods are presented for global bifurcations in stochastic and deterministic nonlinear dynamical systems in the third chapter The fourth chapter studies bifurcations and chaos in time varying parametrically excited nonlinear dynamical systems The fifth chapter presents bifurcation analyses of modal interactions in distributed nonlinear dynamical systems of circular thin von Karman plates The theories methods and results presented in this book are of great interest to scientists and engineers in a wide range of disciplines This book can be adopted as references for mathematicians scientists engineers and graduate students conducting research in nonlinear dynamical systems New Views for Difficult Problems Novel Ideas and Concepts Hilbert s 16th Problem Normal Forms in Polynomial Hamiltonian Systems Grazing Flow in Non smooth Dynamical Systems Stochastic and Fuzzy Nonlinear Dynamical Systems Fuzzy Bifurcation Parametrical Nonlinear Systems Mode Interactions in nonlinear dynamical systems Dynamical Systems and Control Firdaus E. Udawadia,H.I. Weber,George Leitmann,2004-05-10 The 11th International Workshop on Dynamics and Control brought together scientists and engineers from diverse fields and gave them a venue to develop a greater understanding of this discipline and how it relates to many areas in science engineering economics and biology The event gave researchers an opportunity to investigate ideas and techniq CAD for Control Systems Derek A. Linkens,2020-08-27 This comprehensive collection brings together current information on CAD for control systems including present and future trends in computer aided design exploring the areas of modeling simulation simulation languages environments and design techniques Presenting a systems approach to control d **Collected Papers Of Stephen Smale, The (In 3 Volumes) - Volume 3** Roderick S C Wong,Felipe Cucker,2000-06-30 This invaluable book contains the collected papers of Stephen Smale These are divided into eight groups topology calculus of variations dynamics mechanics economics biology electric circuits and mathematical programming theory of computation miscellaneous In addition each group contains one or two articles by world leaders on its subject which comment on the influence of Smale s work and another article by Smale with his own retrospective views

Lectures on Nonlinear Dynamics José Roberto Castilho Piqueira,Carlos Eduardo Nigro Mazzilli,Celso Pupo Pesce,Guilherme Rosa Franzini,2023-11-29 This book presents a compilation of lectures delivered at the S o Paulo School of Advanced Sciences on Nonlinear Dynamics categorized into four groups parametric resonance nonlinear modal analysis and model reduction synchronization and strongly nonlinear dynamics Interwoven seamlessly these groups cover a wide range of topics from fundamental concepts to practical applications catering to both introductory and advanced readers The first

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


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