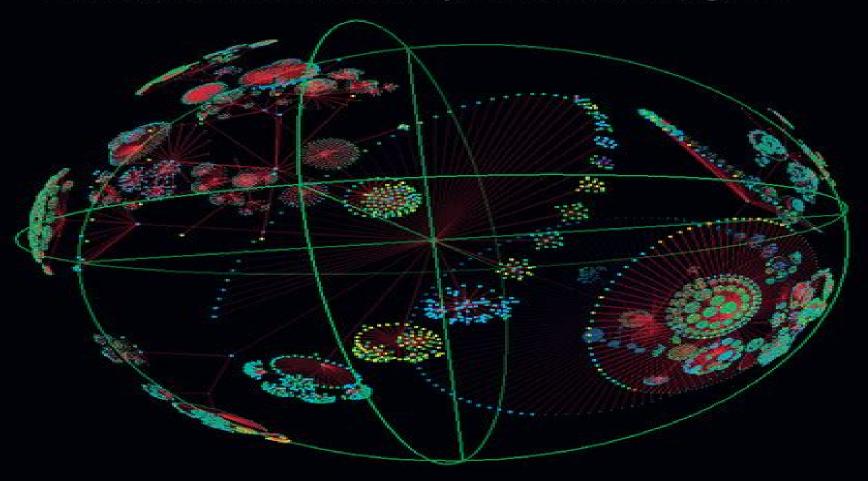
# Dynamical Processes on Complex Networks

Alain Barrat, Marc Barthélemy, Alessandro Vespignani



# **Dynamical Processes On Complex Networks**

Malgorzata A. Turalska

#### **Dynamical Processes On Complex Networks:**

Dynamical Processes on Complex Networks Alain Barrat, Marc Barthélemy, Alessandro Vespignani, 2012-10-11 The availability of large data sets have allowed researchers to uncover complex properties such as large scale fluctuations and heterogeneities in many networks which have lead to the breakdown of standard theoretical frameworks and models Until recently these systems were considered as haphazard sets of points and connections Recent advances have generated a vigorous research effort in understanding the effect of complex connectivity patterns on dynamical phenomena For example a vast number of everyday systems from the brain to ecosystems power grids and the Internet can be represented as large complex networks This new and recent account presents a comprehensive explanation of these effects Processes on Complex Networks Alain Barrat, Marc Barthélemy, Alessandro Vespignani, 2008-10-23 The availability of large data sets has allowed researchers to uncover complex properties such as large scale fluctuations and heterogeneities in many networks leading to the breakdown of standard theoretical frameworks and models Until recently these systems were considered as haphazard sets of points and connections Recent advances have generated a vigorous research effort in understanding the effect of complex connectivity patterns on dynamical phenomena This book presents a comprehensive account of these effects A vast number of systems from the brain to ecosystems power grids and the internet can be represented as large complex networks. This book will interest graduate students and researchers in many disciplines from physics and statistical mechanics to mathematical biology and information science Its modular approach allows readers to readily access the sections of most interest to them and complicated maths is avoided so the text can be easily followed by non experts in the subject <u>Dynamical Processes in Complex Networks</u> Michele Catanzaro, Romualdo Pastor-Satorras, Universitat Politècnica de Catalunya. Departament de Física i Enginyeria Nuclear, 2008 **Stability of Dynamical Processes on Complex Networks** Chiranjit Mitra, 2018 **Learning Dynamical Processes from Structure** in Complex Networks Sayat Mimar, 2022 Many physical biological social and technological systems have astonishing complex organization They are all composed of individual components that are interacting with each other in a certain fashion Such systems can be represented by networks that provide a convenient framework to analyze their topological properties Understanding structural organization of networks is imperative to study dynamical processes that are taking place over them and to model many real world complex systems Some examples include the spread of news or information in a social network or the robustness of Internet to cascading failures of routers It was previously reported that the underlying network architecture is able to control and shape these associated nonlinear dynamical processes In this thesis we aim at uncovering the exact connection between certain dynamical processes and complex topology of networks More precisely we study pattern formation as well as percolation phenomena We first articulate theoretical perspectives by studying reaction diffusion models and percolation processes on synthetic networks This gives us the freedom to systematically tune the

underlying network architecture by random graph models and monitor the effects on the dynamics Our results shed new light on the complex interplay between structure and dynamics that motivate us to investigate realistic scenarios For each case we extend our work to real world networks by performing analyses that capture empirical aspects of the systems considered Namely we propose an application to model the evolution of competing languages in a geographical region that spread over a contact network representing population flows We show the robustness and generalizability of our framework on two different data sets and discuss more applications in other socioeconomic systems such as opinion formation Additionally we develop a machine learning approach to study percolation transition happening on time evolving networks We find that identifying correct node subsets through a microscopic decomposition technique yields accurate results for the classification of sub critical and super critical percolation phases as well as for prediction of critical transition point We test our method on two different real world settings for both purposes and propose further applications Lastly we finish the thesis with a pure empirical study to predict urban economic welfare through the structural analysis of global mobility network We first determine the most effective network based predictor of economic prosperity by its correlation to various socioeconomic indicators. We then develop a generative model that captures the costs and benefits of allocating out flows of each urban area towards its neighbors Our results hint at the importance of leveraging inter urban connections for urban development and welfare Pages ix x Unraveling Complex Networks Under the Prism of Dynamical Processes Michael Thomas Schaub, 2014 Modularity and Dynamics on Complex Networks Renaud Lambiotte, Michael T. Schaub, 2022-02-03 Complex networks are typically not homogeneous as they tend to display an array of structures at different scales A feature that has attracted a lot of research is their modular organisation i e networks may often be considered as being composed of certain building blocks or modules In this Element the authors discuss a number of ways in which this idea of modularity can be conceptualised focusing specifically on the interplay between modular network structure and dynamics taking place on a network They discuss in particular how modular structure and symmetries may impact on network dynamics and vice versa how observations of such dynamics may be used to infer the modular structure They also revisit several other notions of modularity that have been proposed for complex networks and show how these can be related to and interpreted from the point of view of dynamical processes on networks Vulnerability and Dynamical Processes in Complex Networks Igor Mishkovski, 2012 Handbook of Research on Complex Dynamic Process Management: Techniques for Adaptability in Turbulent Environments Wang, Minhong, Sun, Zhaohao, 2009-07-31 Investigates the nature and history of dynamic processes essential to understanding the need for flexibility and adaptability as well as the requirements to improve solutions Temporal Properties of Dynamic Processes on Complex Networks Malgorzata A. Turalska, 2011 **Dynamics** On and Of Complex Networks, Volume 2 Animesh Mukherjee, Monojit Choudhury, Fernando Peruani, Niloy Ganguly, Bivas Mitra, 2013-06-04 This self contained book systematically explores the statistical dynamics on and of complex networks with a special focus on time varying networks In the constantly changing modern world there is an urgent need to understand problems related to systems that dynamically evolve in either structure or function or both This work is an attempt to address such problems in the framework of complex networks Dynamics on and of Complex Networks Volume 2 Applications to Time Varying Dynamical Systems is a collection of surveys and cutting edge research contributions exploring key issues challenges and characteristics of dynamical networks that emerge in various complex systems Toward this goal the work is thematically organized into three main sections with the primary thrust on time varying networks Part I studies social dynamics Part II focuses on community identification and Part III illustrates diffusion processes The contributed chapters in this volume are intended to promote cross fertilization in several research areas and will be valuable to newcomers in the field experienced researchers practitioners and graduate students interested in pursuing research in dynamical networks with applications to computer science statistical physics nonlinear dynamics linguistics and the social sciences This volume follows Dynamics On and Of Complex Networks Applications to Biology Computer Science and the Social Sciences 2009 ISBN 978 0 8176 4750 6

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Applications COMPLEX NETWORKS 2018 which was held in Cambridge on December 11 13 2018 The carefully selected papers cover a wide range of theoretical topics such as network models and measures community structure and network dynamics diffusion epidemics and spreading processes and resilience and control as well as all the main network applications including social and political networks networks in finance and economics biological and neuroscience networks and technological networks A Mathematical Modeling Approach from Nonlinear Dynamics to Complex Systems Elbert E. N. Macau, 2018-06-14 This book collects recent developments in nonlinear and complex systems It provides up to date theoretic developments and new techniques based on a nonlinear dynamical systems approach that can be used to model and understand complex behavior in nonlinear dynamical systems It covers symmetry groups conservation laws risk reduction management barriers in Hamiltonian systems and synchronization and chaotic transient Illustrating mathematical modeling applications to nonlinear physics and nonlinear engineering the book is ideal for academic and industrial researchers concerned with machinery and controls manufacturing and controls Introduces new concepts for understanding and modeling complex systems Explains risk reduction management in complex systems Examines the symmetry group approach to understanding complex systems Illustrates the relation between transient chaos and crises **Complex Networks &** Their Applications VI Chantal Cherifi, Hocine Cherifi, Márton Karsai, Mirco Musolesi, 2017-11-24 This book highlights cutting edge research in the field of network science offering scientists researchers students and practitioners a unique update on the latest advances in theory and a multitude of applications It presents the peer reviewed proceedings of the VI International Conference on Complex Networks and their Applications COMPLEX NETWORKS 2017 which took place in Lyon on November 29 December 1 2017 The carefully selected papers cover a wide range of theoretical topics such as network models and measures community structure network dynamics diffusion epidemics and spreading processes resilience and control as well as all the main network applications including social and political networks networks in finance and economics biological and ecological networks and technological networks **Complex Networks** Luciano da F. Costa, Alexandre Evuskoff, Giuseppe Mangioni, Ronaldo Menezes, 2011-11-11 This book constitutes the thoroughly refereed post conference proceedings of the Second International Workshop on Complex Networks CompleNet 2010 which was held in Rio de Janeiro Brazil in October 2010 The 21 revised papers presented were carefully reviewed and selected from 48 submissions The topics covered include community structure network metrics network models effect of topology to epidemics algorithms to classify networks self organized algorithms applied to complex networks as well as many applications of complex networks in biology image analysis software development traffic congestion language and speech sensor networks and synchronization Complexity and Geographical Economics Pasquale Commendatore, Saime Kayam, Ingrid Kubin, 2015-02-17 The uneven geographical distribution of economic activities is a huge challenge worldwide and also for the European Union In Krugman's New Economic Geography economic systems have a simple spatial structure This book shows

that more sophisticated models should visualise the EU as an evolving trade network with a specific topology and different aggregation levels At the highest level economic geography models give a bird eye s view of spatial dynamics At a medium level institutions shape the economy and the structure of financial and labour markets At the lowest level individual decisions interact with the economic social and institutional environment the focus is on firms decision on location and innovation Such multilevel models exhibit complex dynamic patterns path dependence cumulative causation hysteresis on a network structure and specific analytic tools are necessary for studying strategic interaction heterogeneity and nonlinearities **Multilayer**Networks Ginestra Bianconi,2018 Multilayer networks has become a central topic in Network Science The book presents a comprehensive account of this emerging field Multilayer networks are formed by several networks and include social networks financial markets multi modal transportation systems infrastructures molecular networks and the brain

Collective Dynamics in Complex Networks of Noisy Phase Oscillators Bernard Sonnenschein, 2016-11-21 This work aims to contribute to our understanding of the effects of noise and non uniform interactions in populations of oscillatory units In particular we explore the collective dynamics in various extensions of the Kuramoto model We develop a theoretical framework to study such noisy systems and we show through many examples that indeed new insights can be gained with our method The first step is to coarse grain the complex networks The oscillatory units are then characterized solely by their individual quantities so that identical units can be grouped together The second step consists of the ansatz that in all these groups the distributions of the oscillators phases follow time dependent Gaussians We apply this analytical two step method to oscillator networks with correlations between coupling strengths and natural frequencies to populations with mixed positive and negative coupling strengths and to noise driven active rotators which can perform excitable dynamics We calculate the rich phase diagrams that delineate the emergent rhythms Extensive numerical simulations are performed to show both the validity and the limitations of our theoretical results

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