Bayesian Spatial Temporal Modeling Of Ecological Zero

Bayesian Spatial Temporal Modeling Of Ecological Zero Bayesian SpatialTemporal Modeling of Ecological Zeroes Abstract Ecological zeroes representing the absence of a species or trait in a given location and time are ubiquitous in ecological data Their presence poses significant challenges for traditional statistical methods often leading to biased estimates and inaccurate predictions Bayesian spatialtemporal models offer a powerful framework for addressing these challenges by integrating prior knowledge accounting for spatial and temporal dependencies and providing flexible model structures This article explores the application of Bayesian spatial temporal models for the analysis of ecological zeroes focusing on their conceptual foundation methodological implementation and practical applications 1 The analysis of ecological data often involves the presence of zeroes indicating the absence of a species trait or other ecological phenomenon at a particular location and time These zeroes can arise due to various factors such as Sampling limitations Zeroes may occur due to imperfect detection or sampling techniques True absence The species or trait may be truly absent from the location due to ecological constraints or unsuitable habitat Data limitations Data may be missing or incomplete leading to artificially high zero counts Traditional statistical methods such as generalized linear models GLMs struggle to adequately handle ecological zeroes These models typically assume that the data follow a specific distribution often neglecting the spatial and temporal dependencies inherent in ecological data This can result in biased estimates inaccurate predictions and potentially misleading conclusions Bayesian spatialtemporal models offer a more robust and flexible approach to analyzing data with ecological zeroes They leverage prior knowledge account for spatial and temporal dependencies and allow for greater model flexibility This framework provides a powerful tool for understanding the factors influencing the distribution and dynamics of ecological zeroes 2 2 Conceptual Framework Bayesian spatialtemporal models for ecological zeroes rely on the concept of latent variables to represent the underlying ecological processes driving the observed data These latent variables can represent factors such as habitat suitability species abundance or environmental conditions The observed data including both presence and absence zeroes are then modeled as a function of these latent variables The Bayesian framework allows for the incorporation of prior information on the latent variables and model parameters This prior information can be based on expert knowledge previous studies or general ecological principles By combining prior information with observed data Bayesian models can provide more accurate and robust estimates compared to traditional frequentist approaches 3 Methodological Implementation Implementing Bayesian spatialtemporal models for ecological zeroes involves several key steps Data preparation Clean and prepare data for analysis This includes handling missing values transforming variables and ensuring data consistency Model specification Define the model structure including the type of latent variables their relationships with the observed data and the spatial and temporal dependencies Prior selection Choose appropriate prior distributions for the latent variables and model parameters based on available knowledge and model assumptions Markov Chain Monte Carlo MCMC sampling Utilize MCMC algorithms to sample from the posterior distribution of the model parameters This involves generating a chain of parameter values that represent the models uncertainty Model assessment and inference Evaluate the model fit assess the influence of different parameters and interpret the results 4 Applications Bayesian spatialtemporal models find widespread applications in ecological research including Species distribution modeling Predicting the distribution of species based on environmental and spatial data accounting for ecological zeroes Habitat suitability assessment Estimating the suitability of different areas for specific species or communities incorporating spatial and temporal variations in habitat conditions Conservation planning Identifying areas of high conservation value prioritizing actions to 3 protect species and ecosystems and evaluating the effectiveness of conservation interventions Disease ecology Understanding the spread of diseases and predicting future outbreaks based on spatial and temporal data on disease incidence and environmental

factors Climate change impact assessment Evaluating the potential effects of climate change on species distributions habitat suitability and ecosystem functioning 5 Benefits and Limitations Bayesian spatialtemporal models offer several advantages over traditional methods for analyzing ecological zeroes Integration of prior knowledge Incorporates prior information improving model accuracy and robustness Handling spatial and temporal dependencies Accounts for the spatial and temporal relationships inherent in ecological data leading to more realistic predictions Flexible model structures Allows for different model structures enabling tailored analyses for specific ecological questions Uncertainty quantification Provides estimates of uncertainty for model parameters allowing for a more nuanced interpretation of results However some limitations should be considered Computational complexity Bayesian models can be computationally intensive requiring specialized software and expertise Model selection Selecting the appropriate model structure can be challenging and model comparison techniques may be needed to identify the best model Prior information Obtaining accurate prior information can be difficult and the choice of priors can influence the model results 6 Future Directions The field of Bayesian spatialtemporal modeling for ecological zeroes is rapidly evolving Future directions include Developing more efficient computational algorithms Improving the efficiency of MCMC methods to handle increasingly complex models and large datasets Integrating data from different sources Combining data from various sources such as remote sensing field observations and citizen science to enhance model predictions Developing more flexible and interpretable model structures Creating more flexible model structures that can capture complex ecological interactions and facilitate model 4 interpretation Applying Bayesian models to novel ecological challenges Utilizing Bayesian models to address emerging ecological challenges such as invasive species management climate change mitigation and biodiversity conservation 7 Conclusion Bayesian spatialtemporal models offer a powerful and flexible approach to analyzing ecological zeroes By leveraging prior knowledge accounting for spatial and temporal dependencies and providing a framework for uncertainty quantification these models provide a more comprehensive and accurate understanding of the factors influencing ecological absences Their application in various ecological research areas holds significant promise for advancing ecological knowledge and informing conservation and management decisions

Spatio-Temporal Modeling of Nonlinear Distributed Parameter SystemsTemporal Modeling of Information Diffusion in Online Social NetworksTemporal Modeling of Information Diffusion in Online Social NetworksConceptual Modeling for Traditional and Spatio-Temporal ApplicationsGeospatial Analysis and Modelling of Urban Structure and DynamicsActive Conceptual Modeling of LearningTheoretical Aspects of Spatial-Temporal ModelingQuantitative Analysis and Modeling of Earth and Environmental DataModern Methodology and Applications in Spatial-Temporal ModelingSpatio-temporal Modeling of Crime in Urban EnvironmentsSeparable Temporal Modeling of Point Processes on Linear Networks & Balancing Data Sufficiency and PrivacyConnectionist Models Of Neurocognition And Emergent Behavior: From Theory To Applications - Proceedings Of The 12th Neural Computation And Psychology WorkshopTemporal Models of Interaction as Support for Analysis in User-centered DesignSpatio-temporal Modeling of Environmental and Health ProcessesSpatio-temporal Modeling of Neuron FieldsSpatial-temporal Modeling of Ambient PM Concentration in Ohio and Franklin CountyLearning, Large Scale Inference, and Temporal Modeling of Determinantal Point ProcessesMultivariate Spatial-temporal Modeling of Environmental-health ProcessesMethods of Scale Modeling of Operating Processes of Highway Construction MachinesEncyclopedia of GIS Han-Xiong Li Guolin Niu □□□ Christine Parent Bin Jiang Peter P. Chen Gareth William Peters Jiaping Wu Gareth William Peters Yeondae Jung Medha Uppala Eddy J Davelaar Joshua David McClurg-Genevese Jun Li Raja Mohd Hafiz Affandi Raja Ahmad Jungsoon Choi Vladilen Ivanovich Balovnev Shashi Shekhar

Spatio-Temporal Modeling of Nonlinear Distributed Parameter Systems Temporal Modeling of Information Diffusion in Online Social Networks Temporal Modeling of Information Diffusion in Online Social Networks Conceptual Modeling for Traditional and Spatio-Temporal Applications Geospatial Analysis and Modelling of Urban Structure and Dynamics Active Conceptual Modeling of Learning Theoretical Aspects of Spatial-Temporal Modeling Quantitative Analysis and Modeling of Earth and Environmental Data Modern Methodology and Applications in Spatial-Temporal Modeling Spatio-temporal Modeling of Crime in Urban Environments Separable Temporal Modeling of Point Processes on Linear Networks & Balancing Data Sufficiency and Privacy Connectionist Models Of Neurocognition And Emergent Behavior: From Theory To Applications - Proceedings Of The 12th Neural Computation And Psychology Workshop Temporal Models of Interaction as Support

for Analysis in User-centered Design Spatio-temporal Modeling of Environmental and Health Processes Spatio-temporal Modeling of Neuron Fields Spatial-temporal Modeling of Ambient PM Concentration in Ohio and Franklin County Learning, Large Scale Inference, and Temporal Modeling of Determinantal Point Processes Multivariate Spatial-temporal Modeling of Environmental-health Processes Methods of Scale Modeling of Operating Processes of Highway Construction Machines Encyclopedia of GIS *Han-Xiong Li Guolin Niu □□□ Christine Parent Bin Jiang Peter P. Chen Gareth William Peters Jiaping Wu Gareth William Peters Yeondae Jung Medha Uppala Eddy J Davelaar Joshua David McClurg-Genevese Jun Li Raja Mohd Hafiz Affandi Raja Ahmad Jungsoon Choi Vladilen Ivanovich Balovnev Shashi Shekhar*

the purpose of this volume is to provide a brief review of the previous work on model reduction and identifi cation of distributed parameter systems dps and develop new spatio temporal models and their relevant identifi cation approaches in this book a systematic overview and classifi cation on the modeling of dps is presented fi rst which includes model reduction parameter estimation and system identifi cation next a class of block oriented nonlinear systems in traditional lumped parameter systems lps is extended to dps which results in the spatio temporal wiener and hammerstein systems and their identifi cation methods then the traditional volterra model is extended to dps which results in the spatio temporal volterra model and its identification algorithm all these methods are based on linear time space separation sometimes the nonlinear time space separation can play a better role in modeling of very complex processes thus a nonlinear time space separation based neural modeling is also presented for a class of dps with more complicated dynamics finally all these modeling approaches are successfully applied to industrial thermal processes including a catalytic rod a packed bed reactor and a snap curing oven the work is presented giving a unifi ed view from time space separation the book also illustrates applications to thermal processes in the electronics packaging and chemical industry this volume assumes a basic knowledge about distributed parameter systems system modeling and identifi cation it is intended for researchers graduate students and engineers interested in distributed parameter systems nonlinear systems and process modeling and control

this dissertation temporal modeling of information diffusion in online social networks by guolin niu □□□ was obtained from the university of hong kong pokfulam hong kong and is being sold pursuant to creative commons attribution 3 0 hong kong license the content of this dissertation has not been altered in any way we have altered the formatting in order to facilitate the ease of printing and reading of the dissertation all rights not granted by the above license are retained by the author abstract the rapid development of online social networks osns renders them a powerful platform for information diffusion on a massive scale osns generate enormous propagation traces an important question is how to model the real world information diffusion process although considerable studies have been conducted in this field the temporal characteristics have not been fully addressed yet this thesis addresses the issue of modeling the temporal dynamics of the information diffusion process based on empirical findings drawn from large scale propagation traces of a popular osn in china we demonstrate that the temporal characteristics has a significant impact on the diffusion dynamics hence a series of new temporal information diffusion models have been proposed by incorporating these temporal features experimental results demonstrate that these proposed models are more accurate and practical than existing discrete diffusion models moreover one application of information diffusion models i e the revenue maximization problem is studied specifically the thesis consists of three major parts 1 preliminaries i e introduction of research platform and collected dataset 2 modeling social influence diffusion from three different temporal aspects and 3 monetizing osns through designing intelligent pricing strategies in the diffusion process to realize the goal of revenue maximization firstly the research platform is introduced and the statistical properties of the data derived from this platform are investigated we choose renren the dominant social network website in china as our research platform and study its information propagation mechanisms specifically we concentrate on the propagation of sharing video behaviors and collect data on more than 2 8 million renren users and over 209 million diffusion traces the analysis result shows that the video access patterns in osns differ significantly from youtube like systems which makes understanding the video propagation behaviors in osns an important research task secondly the temporal modeling of information diffusion is explored by investigating temporal features using real diffusion traces we find that three factors should be considered in building realistic diffusion models including information propagation latency multiple influential sources and user diversities we then develop models to explain the information propagation process by incorporating these

factors and demonstrate that the models reflect reality well finally revenue maximization in the information diffusion process is studied specifically the pricing factor is explicitly incorporated into the product diffusion process to realize the goal of revenue maximization we develop a dynamic programming based heuristic dpbh to obtain the optimal pricing sequence application of the dpbh in the revenue maximization problem shows that it performs well in both the expected revenue achieved and in running time this leads to fundamental ramifications to many related osn marketing applications doi 10 5353 th b5317018 subjects online social networks

from environmental management to land planning and geo marketing the number of application domains that may greatly benefit from using data enriched with spatio temporal features is expanding very rapidly unfortunately development of new spatio temporal applications is hampered by the lack of conceptual design methods suited to cope with the additional complexity of spatio temporal data this complexity is obviously due to the particular semantics of space and time but also to the need for multiple representations of the same reality to address the diversity of requirements from highly heterogeneous user communities conceptual design methods are also needed to facilitate the exchange and reuse of existing data sets a must in geographical data management due to the high collection costs of the data yet current practice in areas like geographical information systems or moving objects databases does not include conceptual design methods very well if at all this book shows that a conceptual design approach for spatio temporal databases is both feasible and easy to apprehend while providing a firm basis through extensive discussion of traditional data modeling concepts the major focus of the book is on modeling spatial and temporal information parent spaccapietra and zimányi provide a detailed and comprehensive description of an approach that fills the gap between application conceptual requirements and system capabilities covering both data modeling and data manipulation features the ideas presented summarize several years of research on the characteristics and description of space time and perception in addition to the authors own data modeling approach mads modeling of application data with spatio temporal features the book also surveys alternative data models and approaches from industry and academia that target support of spatio temporal modeling the reader will acquire intimate knowledge of both thetraditional and innovative features that form a consistent data modeling approach visual notations and examples are employed extensively to illustrate the use of the various constructs therefore this book is of major importance and interest to advanced professionals researchers and graduate or post graduate students in the areas of spatio temporal databases and geographical information systems for anyone thinking of doing research in this field or who is developing a system based on spatio temporal data this text is essential reading mike worboys u maine orono me usa the high level semantic model presented and validated in this book provides essential guidance to researchers and implementers when improving the capabilities of data systems to serve the actual needs of applications and their users in the temporal and spatial domains that are so prevalent today gio wiederhold stanford u ca usa

a coming of age geospatial analysis and modelling in the early twenty first century forty years ago when spatial analysis first emerged as a distinct theme within geography s quantitative revolution the focus was largely on consistent methods for measuring spatial correlation the concept of spatial au correlation took pride of place mirroring concerns in time series analysis about similar kinds of dependence known to distort the standard probability theory used to derive appropriate statistics early applications of spatial correlation tended to reflect geographical patterns expressed as points the perspective taken on such analytical thinking was founded on induction the search for pattern in data with a view to suggesting appropriate hypotheses which could subsequently be tested in parallel but using very different techniques came the development of a more deductive style of analysis based on modelling and thence simulation here the focus was on translating prior theory into forms for generating testable predictions whose outcomes could be compared with observations about some system or phenomenon of interest in the intervening years spatial analysis has broadened to embrace both inductive and deductive approaches often combining both in different mixes for the variety of problems to which it is now applied

this volume is a collection of papers presented during the first international acm l workshop which was held in tucson arizona during the 25th international conference on conceptual modeling er 2006 included in this state of the art survey are 11

revised full papers carefully reviewed and selected from the workshop presentations these are rounded off with four invited lectures and an introductory overview and represent the current thinking in conceptual modeling research

this book provides a modern introductory tutorial on specialized theoretical aspects of spatial and temporal modeling the areas covered involve a range of topics which reflect the diversity of this domain of research across a number of quantitative disciplines for instance the first chapter provides up to date coverage of particle association measures that underpin the theoretical properties of recently developed random set methods in space and time otherwise known as the class of probability hypothesis density framework phd filters the second chapter gives an overview of recent advances in monte carlo methods for bayesian filtering in high dimensional spaces in particular the chapter explains how one may extend classical sequential monte carlo methods for filtering and static inference problems to high dimensions and big data applications the third chapter presents an overview of generalized families of processes that extend the class of gaussian process models to heavy tailed families known as alpha stable processes in particular it covers aspects of characterization via the spectral measure of heavy tailed distributions and then provides an overview of their applications in wireless communications channel modeling the final chapter concludes with an overview of analysis for probabilistic spatial percolation methods that are relevant in the modeling of graphical networks and connectivity applications in sensor networks which also incorporate stochastic geometry features

quantitative analysis and modeling of earth and environmental data space time and spacetime data considerations introduces the notion of chronotopologic data analysis that offers a systematic quantitative analysis of multi sourced data and provides information about the spatial distribution and temporal dynamics of natural attributes physical biological health social it includes models and techniques for handling data that may vary by space and or time and aims to improve understanding of the physical laws of change underlying the available numerical datasets while taking into consideration the in situ uncertainties and relevant measurement errors conceptual technical computational it considers the synthesis of scientific theory based methods stochastic modeling modern geostatistics and data driven techniques machine learning artificial neural networks so that their individual strengths are combined by acting symbiotically and complementing each other the notions and methods presented in quantitative analysis and modeling of earth and environmental data space time and spacetime data considerations cover a wide range of data in various forms and sources including hard measurements soft observations secondary information and auxiliary variables ground level measurements satellite observations scientific instruments and records protocols and surveys empirical models and charts including real world practical applications as well as practice exercises this book is a comprehensive step by step tutorial of theory based and data driven techniques that will help students and researchers master data analysis and modeling in earth and environmental sciences including environmental health and human exposure applications explores the analysis and processing of chronotopologic i e space time and spacetime data that varies spatially and or temporally which is the case with the majority of data in scientific and engineering disciplines studies the synthesis of scientific theory and empirical evidence in its various forms that offers a mathematically rigorous and physically meaningful assessment of real world phenomena covers a wide range of data describing a variety of attributes characterizing physical phenomena and systems including earth ocean and atmospheric variables environmental and ecological parameters population health states disease indicators and social and economic characteristics includes case studies and practice exercises at the end of each chapter for both real world applications and deeper understanding of the concepts presented

this book provides a modern introductory tutorial on specialized methodological and applied aspects of spatial and temporal modeling the areas covered involve a range of topics which reflect the diversity of this domain of research across a number of quantitative disciplines for instance the first chapter deals with non parametric bayesian inference via a recently developed framework known as kernel mean embedding which has had a significant influence in machine learning disciplines the second chapter takes up non parametric statistical methods for spatial field reconstruction and exceedance probability estimation based on gaussian process based models in the context of wireless sensor network data the third chapter presents signal

processing methods applied to acoustic mood analysis based on music signal analysis the fourth chapter covers models that are applicable to time series modeling in the domain of speech and language processing this includes aspects of factor analysis independent component analysis in an unsupervised learning setting the chapter moves on to include more advanced topics on generalized latent variable topic models based on hierarchical dirichlet processes which recently have been developed in non parametric bayesian literature the final chapter discusses aspects of dependence modeling primarily focusing on the role of extreme tail dependence modeling copulas and their role in wireless communications system models

increasing availability of georeferenced data provides researchers a new source they can use to study criminal behavior and law enforcement in space and time dimensions although these studies can help broaden our understanding of crime and criminal justice and examine criminological theories researchers or practitioners analyzing patterns of crime in space and time should be aware of the characteristics of the data and how to handle it with the proper quantitative method since spatio temporal data may violate the independence assumption in conventional regression due to a spatial and or a temporal structure an analysis ignoring these effects can result in statistically misleading inferences thus this dissertation is devoted to exploring three issues in the analysis of crime and law enforcement which may need a methodological adjustment to account for structures in both space and time dimensions the first chapter introduces the topics the rationales and the methodologies in the three papers detailed in chapters 2 through 4 in this dissertation chapter 2 investigates how temperature as well as socio economic factors are associated with crime in an urban environment using a bayesian analysis on three years of monthly data in seoul south korea this study shows that an association of temperature to assaults varies with economic status and commercial land use of an area chapter 3 investigates crime density in four time periods in a day with two types of population measures and environmental variables with a case study in a sub district of seoul the results show that ambient population better explains the variations of assaults for all time periods than residential population in addition socio economic factors that are also significantly associated with the assault are identified even after population factors are accounted for chapters 2 and 3 compare the results of models with different spatial and or temporal structures and find that the model accounting for both structures better explains the data chapter 4 connects crime clearance rates to installed public surveillance cameras using four years of data from dallas tx focusing on the interaction between pre post installation and camera distance the study shows that crime clearance rates are higher after camera installation however the effects of surveillance cameras are shown to be dependent on crime types finally chapter 5 summarizes the main findings and implications of each paper and discusses the delimitations and limitations to be addressed in future research

the first part of the dissertation focusses on spatial and temporal modeling of point processes on linear networks point processes on near linear networks can simply be defined as point events occurring on or near line segment network structures embedded in a certain space a separable modeling framework is presented that fits a formation and a dissolution model of point processes on linear networks over time two major applications of the separable temporal model are spider web building activity in brick mortar lines and wildfire ignition origins near road networks the second part of the dissertation focusses on analyses of large energy databases specifically the energy atlas database the main motivation of this part is to explore and understand the issues of balancing necessary data resolution while maintaining consumer privacy the issue of data resolution and its importance are explored by first tackling a specific policy objective this is achieved by applying a longitudinal quantile regression model to parcel level monthly energy consumption in the westwood neighborhood the model results aid in fulfilling efficiency goals outlined in the california senate bill 350 then the issue of record privacy is explored through a review of current privacy methods implementation data ownership and concluded with avenues of future research

this volume collects together most of the papers presented at the twelfth neural computation and psychology workshop ncpw12 held in 2010 at birkbeck college england the conference invited submissions on neurocomputational models of all cognitive and psychological processes the special theme of this conference was from theory to applications which allowed submissions of pure theoretical work and of pure applied work this topic extended the boundaries of the conference and

highlighted the extent to which computational models of cognition and models in general are integrated in the cognitive sciences the chapters in this book cover a wide range of research topics in neural computation and psychology including cognitive development language processing higher level cognition but also ecology based modeling of cognition philosophy of science and real world applications

abstract this research attempts to classify time as a key variable that can be used to understand and analyze the many aspects of the system of human interaction specifically human interaction with a based environment this is achieved by focusing on relevant factors in the data rather than on any specific set of variables and modeling these factors over time temporal modeling this hypothesis is challenged though a series of user testing in which the subjects navigate a set of sites their progress is monitored with respect to the kinds of interactions they have with the sites and is modeled to show how time can be used to illustrate successes and failures that the subjects have both first time use and concurrent use of the sites is considered the findings are correlated with each other to show patterns in the interactions and with the components of the sites themselves to show how elements in the design could help or hinder user interaction finally the techniques illustrated in this research are compared to other forms of user analysis and suggestions for their use in existing design methodologies are given in the end the intent is to show that by observing and analyzing the temporal states of a user within a given based environment one can accurately design for desired and successful user behavior and better predict future behavior

this paper is the first study that undertakes spatially complex and temporally dynamic time space modeling in ohio

keywords multivariate spatial temporal model air pollution modeling spatial epidemiology

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