Article

A New Visualisation and Analysis Method for a Convolved Representation of Mass Computational Experiments with Biological Models

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Abstract: Modern computational biology makes widespread use of mathematical models of biological systems, in particular systems of ordinary differential equations, as well as models of dynamic systems described in other formalisms, such as agent-based models. Parameters are numerical values of quantities reflecting certain properties of a modeled system and affecting model solutions. At the same time, depending on parameter values, different dynamic regimes - stationary, oscillatory, established as a result of transient modes of various types - can be implemented in the system. Predicting changes in the solution dynamics type depending on changes of model parameters is an important scientific task. Nevertheless, this problem does not have an analytical solution for all formalisms in a general case. The routinely used method of performing a series of computational experiments, i.e. solving a series of direct problems with various sets of parameters followed by expert analysis of solution plots is labor-intensive with a large number of parameters and a decreasing step of the parametric grid. In this regard, the development of methods allowing to obtain and analyze information on a set of computational experiments in an aggregate form is relevant. This work is devoted to developing a method for visualization and classification of various dynamic regimes of a model using a composition of the dynamic time warping (DTW-algorithm) and principal coordinates analysis (PCoA) methods. This method allows to obtain a qualitative visualisation of the results of the set of solutions of a mathematical model and to carry out the correspondence between the values of the model parameters and the type of dynamic regimes of its solutions. This method has been tested on the Lotka-Volterra model and artificial sets of various dynamics.

Keywords: visualization; dynamic regime; mathematical model; dynamic time warping; computational experiment

1. Introduction

Modern computational biology is using mathematical models of biological systems, in particular systems of ordinary differential equations (ODE) [1–3] and partial differential equations (PDE) [3,4], as well as models of dynamic systems described in other formalisms, such as agent-based models [5–10], Boolean networks [11,12] and cellular automata [13,14]. Parameters are numerical values of quantities reflecting certain properties of a modeled system and affecting model solutions. At the same time, depending on the parameter values, different dynamic modes - nonstationary, oscillatory,

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applications of human factors knowledge focusing on the discovery and understanding of human interaction with products and systems for their improvement The book covers devices and their interfaces focusing on optimization of user devices and emphasizing visual and haptic feedback It then discusses user studies exploring the limits and capabilities of special populations particularly the elderly which can influence the design It also examines the effect of changes in force and kinematics physiology cognitive performance in the design of consumer products tools and workplaces Examining a variety of user centered evaluation approaches the concluding chapters details methods for developing products that can improve safety and human performance and at same time the efficiency of the system It reports on usability evaluations for different kinds of products and technologies particularly for cellular phones earphones earphone controls mattresses and pillows package and professional tools and service systems The book provides new methods that enhance performance expand capabilities and optimize the fit between people and technology **Life-Cycle Performance of Structures and Infrastructure Systems in Diverse Environments** Chun-Qing Li,Dan M. Frangopol,2025-07-14 Life Cycle Performance of Structures and Infrastructure Systems in Diverse Environments contains the lectures and papers presented at the Ninth International Symposium on Life Cycle Civil Engineering IALCCE 2025 Melbourne Australia 15 19 July 2025 This book includes the full papers of 228 contributions presented at IALCCE 2025 including the Fazlur R Khan Lecture seven Keynote Lectures and 220 technical papers The papers cover recent advances and cutting edge research in the field of life cycle civil engineering including emerging concepts new theories and innovative applications related to life cycle design assessment inspection monitoring repair maintenance rehabilitation and management of structures and infrastructure systems under uncertainty Major topics covered include life cycle carbon assessment of civil infrastructure systems life cycle design and assessment for structures and infrastructure systems life cycle management of civil infrastructure whole life costing life cycle risk analysis and optimization of civil infrastructure and life cycle digital tools for civil engineering among others This open access book provides both an up to date overview of the field of life cycle civil engineering and significant contributions to the process of making more rational decisions to mitigate the life cycle risk and improve the life cycle safety reliability resilience and sustainability of structures and infrastructure systems exposed to diverse environments in a changing climate for the purpose of enhancing the welfare of society It will serve as a valuable reference to all concerned with life cycle of civil engineering systems including students researchers practitioners consultants contractors decision makers and representatives of managing bodies and public authorities from all branches of civil engineering **Federal Register** ,2003-11 **Large-scale and High Performance Computations of Complex Turbulent Reacting Flows** Asghar Afshari,2006 **Energy and Water Development Appropriations for 2016** United States. Congress. House. Committee on Appropriations. Subcommittee on Energy and Water Development,2015 *11th International Symposium on High Performance Distributed Computing* ,2002 Forty two full papers from the July 2002 conference in Edinburgh discuss data

servers and grid storage adapting to grid behavior grid resource management applications frameworks parallel application analysis optimizing grid performance grid practice and experience communication and RPC protocols grid job submission and scheduling and adapti   <u>Mathematical Reviews</u> ,2005   *Proceedings of the ... IEEE International Symposium on High Performance Distributed Computing* ,2003   *X-Ray Absorption Fine Structure -- XAFS13* Britt Hedman,Piero Pianetta,2007-03-09 Stanford California USA 9 14 July 2006   <u>Advances in Human Factors and Ergonomics 2012- 14 Volume Set</u> Gavriel Salvendy,Waldemar Karwowski,2012-08-06 With contributions from an international group of authors with diverse backgrounds this set comprises all fourteen volumes of the proceedings of the 4th AHFE Conference 21 25 July 2012 The set presents the latest research on current issues in Human Factors and Ergonomics It draws from an international panel that examines cross cultural differences design issues usability road and rail transportation aviation modeling and simulation and healthcare   **IBM Journal of Research and Development** ,2006   **Proceedings of the 2003 ACM SIGCOMM Internet Measurment Conference** ,2003 Internet Service Providers ISPs can exploit path diversity to balance load and improve robustness Unfortunately it is difficult to evaluate the potential impact of these approaches without routing and topological data which are confidential In this paper we characterize path diversity in the real Sprint network We then characterize path diversity in ISP topologies inferred using the Rocketfuel tool Comparing the real Sprint topology to the one inferred by Rocketfuel we find that the Rocketfuel topology has significantly higher apparent path diversity As a metric path diversity is particularly sensitive to the presence of false or missing links both of which are artifacts of active measurement techniques We evaluate heuristics that improve the accuracy of the inferred Rocketfuel topologies Finally we discuss limitations of active measurements techniques to capture topological properties such as path diversity   **Bayesian Inference and Maximum Entropy Methods in Science and Engineering** Ali Mohammad-Djafari,2006-12-13 The MaxEnt workshops are devoted to Bayesian inference and maximum entropy methods in science and engineering In addition this workshop included all aspects of probabilistic inference such as foundations techniques algorithms and applications All papers have been peer reviewed   **Cornell University Courses of Study** Cornell University,1994

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