



# Math Model-Circadian

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# Mathematical Models Of The Circadian Sleepwake Cycle

**Joseph S. Takahashi, Fred W.  
Turek, Robert Y. Moore**



## **Mathematical Models Of The Circadian Sleepwake Cycle:**

**Mathematical Models of the Circadian Sleep-wake Cycle** Martin C. Moore-Ede, Charles A. Czeisler, 1984      **The Mathematical Structure of the Human Sleep-Wake Cycle** Steven H. Strogatz, 2013-03-13

Over the past three years I have grown accustomed to the puzzled look which appears on people's faces when they hear that I am a mathematician who studies sleep. They wonder but are usually too polite to ask what does mathematics have to do with sleep. Instead they ask the questions that fascinate us all: Why do we have to sleep? How much sleep do we really need? Why do we dream? These questions usually spark a lively discussion leading to the exchange of anecdotes, last night's dreams, and other personal information. But they are questions about the function of sleep and interesting as they are, I shall have little more to say about them here. The questions that have concerned me deal instead with the timing of sleep. For those of us on a regular schedule, questions of timing may seem vacuous. We go to bed at night and get up in the morning, going through a cycle of sleeping and waking every 24 hours. Yet to a large extent the cycle is imposed by the world around us.

**Some Mathematical Questions in Biology** Gail A. Carpenter, 1987-12-31

The articles in this collection are based on lectures given at the 20th Annual Symposium on Some Mathematical Questions in Biology held in May 1986 and sponsored jointly by the AMS, the Society for Industrial and Applied Mathematics, and Section A of the American Association for the Advancement of Science. For the past thirty years, due particularly to the fundamental work of Pittendrigh, Aschoff, and Wever, theoretical analysis of circadian rhythms and sleep have gone hand in hand with experimental and clinical studies. Circadian rhythms have been investigated at levels ranging from cell fragments to humans, from biochemistry to behavior. This experimental diversity is reflected in a diversity of modeling approaches, several of which are represented in this collection. One class of models focuses on the circadian sleep and activity cycles of humans, for which some investigators postulate pacemaker systems with two coupled oscillators, while others propose single oscillator models. Other analyses focus upon the activity patterns of small vertebrates or upon anatomical data and physiological recordings. The mathematical formulations and analyses utilize nonlinear dynamical systems, stochastic models, and computer simulations. The articles in this volume discuss, analyze, and compare these various experimental, theoretical, and mathematical approaches.

**Rhythms in Physiological Systems** Hermann Haken, Hans P. Koepchen, 2012-12-06

Rhythms are a basic phenomenon in all physiological systems. They cover an enormous range of frequencies with periods from the order of milliseconds up to some years. They are described by many disciplines and are investigated usually in the context of the physiology of the respective function or organ. The importance given to the research on rhythmicity is quite different in different systems. In some cases, where the functional significance is obvious, rhythms are at the center of interest, as in the case of respiration or locomotion. In other fields, they are considered more or less as interesting epiphenomena or at best as indicators without essential functional significance, as in the case of cardiovascular or EEG rhythms. Recently, the study of physiological rhythms has attracted growing interest in several fields.

especially with respect to rhythm research in humans and its rapidly spreading applications in basic behavioral research and as a diagnostic tool in clinical medicine This development was favored by two methodological and conceptual advances on the one hand the availability of non invasive methods of continuous recording of physiological parameters and their computer assisted evaluation and on the other the rapid development of theoretical analyses for example the understanding of dynamic systems the generation of coordinated macroscopic processes in systems comprising many single elements and the mathematical tools for treating nonlinear oscillators and their mutual coupling

**Circadian Clocks** Joseph S. Takahashi, Fred W. Turek, Robert Y. Moore, 2012-12-06 The Handbook of Behavioral Neurobiology series deals with the aspects of neurosciences that have the most direct and immediate bearing on behavior It presents the most current research available in the specific areas of sensory modalities This volume explores circadian rhythms

**The Neurosciences and the Practice of Aviation Medicine** Anthony N. Nicholson, 2017-03-02 This book brings the neurosciences to operational and clinical aviation medicine It is concerned with the physiology and pathology of circadian rhythmicity orientation hypotension and hypoxia and with disorders of the central nervous system relevant to the practice of aviation medicine The chapters on circadian rhythmicity and orientation deal with the impaired alertness and sleep disturbance associated with desynchrony and with the effects of linear and angular accelerations on spatial awareness Hypotension and hypoxia cover cerebral function during increased gravitational stress clinical aspects of exposure to acute hypoxia the mild hypoxia of the cabin of transport aircraft adaptation and acclimatization to altitude and decompression at extreme altitudes and in space Disorders of particular significance to the practice of aviation medicine such as excessive daytime sleepiness epilepsy syncope hypoglycaemia headache and traumatic brain injury are covered while neuro ophthalmology the vestibular system and hearing also receive detailed attention The potentially adverse effects of the aviation environment and of disorders of the nervous system are brought together and the text covers the neurological examination as it relates to aircrew and explores current management and therapeutics The Neurosciences and the Practice of Aviation Medicine is an essential work for those involved in the practice of aviation medicine where familiarity with the effects of the aviation environment on the nervous system and understanding the pathophysiology of relevant clinical disorders are of prime concern The authors from leading centres of excellence are physiologists concerned with the aviation environment and physicians involved in the day to day practice of medicine They bring to this authoritative text wide experience and expertise in both the experimental and clinical neurosciences

*Principles and Practice of Sleep Medicine E-Book* Meir H. Kryger, Thomas Roth, William C. Dement, 2010-11-01 Principles and Practice of Sleep Medicine 5th Edition by Meir H Kryger MD FRCPC Thomas Roth PhD and William C Dement MD PhD delivers the comprehensive dependable guidance you need to effectively diagnose and manage even the most challenging sleep disorders Updates to genetics and circadian rhythms occupational health sleep in older people memory and sleep physical examination of the patient comorbid insomnias and much more keep you current on

the newest areas of the field A greater emphasis on evidence based approaches helps you make the most well informed clinical decisions And a new more user friendly full color format both in print and online lets you find the answers you need more quickly and easily Whether you are preparing for the new sleep medicine fellowship examination or simply want to offer your patients today s best care this is the one resource to use Make optimal use of the newest scientific discoveries and clinical approaches that are advancing the diagnosis and management of sleep disorders Stay on top of the hottest topics in sleep medicine with 56 new chapters including Postpartum Sleep Disturbances Fatigue Risk Management What does Brain Imaging Reveal about Sleep Genesis and Maintenance Physician Examination of the Sleep Patient Forensic Sleep Medicine Pathophysiology and Models of Insomnia Treatment of Insomnia Developing Treatment Guidelines Restrictive Lung Disorders Sleep Medicine in the Elderly Obstructive Obstructive Sleep Apnea Metabolic and Renal Disorders Sleep Apnea Obesity and Bariatric Surgery Sleep and Renal Disease Theories of Dreaming Why We Dream Sleep Stress and Burnout Evaluating Sleep EEG and Sleep Stage Scoring And more Master the newest areas in the field with 5 new sections covering Sleep Mechanisms and Phylogeny Genetics of Sleep Physiology in Sleep Occupational Sleep Medicine Sleep Medicine in the Elderly Access the complete contents online fully searchable and follow links to abstracts for most bibliographical references Apply evidence based approaches wherever available Find answers more easily thanks to a new user friendly full color format **Ultradian**

**Rhythms in Life Processes** David Lloyd, Ernest L. Rossi, 2012-12-06 Profound progress has been made in the fields of chronobiology and psychobiology within the past decade in theory experiment and clinical application This volume integrates these new developments on all levels from the molecular genetic and cellular to the psycho social processes of everyday life We present a balanced variety of research from workers around the globe who discuss the fundamental significance of their approach for a new understanding of the central role of ultradian rhythms in the self organizing and adaptive dynamics of all life processes The years since the publication of Ultradian rhythms in physiology and behavior by Schultz and Lavie in 1985 have seen a burgeoning realization of the ubiquity and importance of ultradian rhythms within and between every level of the psychobiological hierarchy The experimental evidence lies scattered through a disparate literature and this volume attempts albeit in a highly selective manner to bring together some of the different strands The editors are very conscious of the omission of many important current aspects e g we have not included any of the fascinating and indeed long and well established experiments with plants Bunning 1971 1977 Guillaume and Koukkari 1987 Millet et al 1988 Johnsson et al 1990 that are widely regarded as having initiated the whole field of chronobiology De Mairan 1729 Neither have we reviewed recent developments on glycolytic oscillations since a great deal of the seminal work was already completed by 1973 Chance et al 1973 Sleep—Wake Disorders K. Meier-Ewert, M. Okawa, 2013-06-29 Sleep wake disorders frequently give rise to severe ailments and varied distresses in a great number of people in the world disturbing their physical and mental activities and their social function Sleep wake disorders are now classified into a great number of categories according to their clinical

features and etiological factors Patients with sleep wake disorders are taken care of not only by specialists for such disorders but also by general physicians and specialists of different physical and mental disorders In the recent years the nature of sleep and sleep wake disorders have been intensively studied by investigators belonging to different fields of science including medicine biology and psychology in many countries It is very important for the progress of research that investigators working in the related fields in different countries meet together and exchange their findings and ideas The Japanese German International Symposium on Sleep Wake Disorders was held on October 9 10th 1996 in the old beautiful city of Erfurt Germany This symposium was organized by Professor Karlheinz Meier Ewert Schwalmstadt Germany and Dr Masako Okawa Ichikawa Japan with support of the German Society of Sleep Research President at that time Professor J H Peter and of the Japanese Society of Sleep Research President at that time Professor Y Hishikawa

Fundamentals of Neural Network Modeling Randolph W. Parks, Daniel S. Levine, Debra L. Long, 1998 Provides an introduction to the neural network modeling of complex cognitive and neuropsychological processes Over the past few years computer modeling has become more prevalent in the clinical sciences as an alternative to traditional symbol processing models This book provides an introduction to the neural network modeling of complex cognitive and neuropsychological processes It is intended to make the neural network approach accessible to practicing neuropsychologists psychologists neurologists and psychiatrists It will also be a useful resource for computer scientists mathematicians and interdisciplinary cognitive neuroscientists The editors in their introduction and contributors explain the basic concepts behind modeling and avoid the use of high level mathematics The book is divided into four parts Part I provides an extensive but basic overview of neural network modeling including its history present and future trends It also includes chapters on attention memory and primate studies Part II discusses neural network models of behavioral states such as alcohol dependence learned helplessness depression and waking and sleeping Part III presents neural network models of neuropsychological tests such as the Wisconsin Card Sorting Task the Tower of Hanoi and the Stroop Test Finally part IV describes the application of neural network models to dementia models of acetylcholine and memory verbal fluency Parkinsons disease and Alzheimers disease Contributors J Wesson Ashford Rajendra D Badgaiyan Jean P Banquet Yves Burnod Nelson Butters John Cardoso Agnes S Chan Jean Pierre Changeux Kerry L Coburn Jonathan D Cohen Laurent Cohen Jose L Contreras Vidal Antonio R Damasio Hanna Damasio Stanislas Dehaene Martha J Farah Joaquin M Fuster Philippe Gaussier Angelika Gissler Dylan G Harwood Michael E Hasselmo J Allan Hobson Sam Leven Daniel S Levine Debra L Long Roderick K Mahurin Raymond L Ownby Randolph W Parks Michael I Posner David P Salmon David Servan Schreiber Chantal E Stern Jeffrey P Sutton Lynette J Tippet Daniel Tranel Bradley Wyble

**A Mathematical Model of the Sleep-wake Cycle** Weiwei Yin, 2007 The daily sleep wake cycle usually consists of three distinct states wakefulness non rapid eye movement NREM and rapid eye movement REM The process of switching between different states is complex but a common assumption is that it is regulated primarily by two

processes the circadian and the homeostatic process via reciprocal interactions of several downstream neuron groups. These interactions not only result in often rapid transitions from one state to another but also allow for a certain degree of bi-stability that locks the organism in a given state for some while before it switches back. In order to better understand how the behavioral states are regulated by different neuron groups I describe how to use the S system method for the development of a mathematical model consisting of two phases. The first phase covers the switch between wakefulness and sleep which is controlled by the interactions between wake and sleep promoting neurons whereas the second phase addresses the generation of NREM/REM alternation which is believed to be regulated by REM OFF and REM ON neurons. In this set up I interpret the circadian rhythm as external input and homeostatic regulation as a feedback controller. Both open loop and closed loop forms of the two phase model are investigated and implemented. Discharging activities of the corresponding neuron groups and the switches of behavioral states are shown in the simulation results from which we can easily identify the basic roles of wake and sleep promoting neurons, REM OFF and REM ON neurons. The special regulatory function of the neuropeptide orexin is also tested by simulation. Circadian Rhythms in the Central Nervous System P.H.

Redfern, 1985-06-18      **Integrative Biological Psychiatry** Hinderk M. Emrich, Michael Wiegand, 2012-12-06 Professor Detlev Ploog. On March 19-21, 1989 a symposium entitled Integrative Biological Psychiatry was held at the Ringberg Castle, Bavaria, to honor the scientific work of Detlev Ploog who retired at that time from his position as the Director of the Max Planck Institute of Psychiatry in Munich. The lectures represent an overview of the scientific work conducted at the Max Planck Institute within the recent past and thus also reflect the scientific intentions and research strategies of Detlev Ploog who brought together extremely divergent tendencies within basic and clinical research and integrated the findings to elucidate new perspectives for fundamental psychiatric problems. His ability to combine topics such as brain and behavior with neuropsychological, neuroethological, psychopharmacological and behavioral aspects generated a scientific climate in which psychiatric research flourished. The chapters in the present volume represent a documentation of this integrative view on psychiatry and we who worked together with Detlev Ploog as his university colleagues at the Ludwig Maximilians University, H.H. the Technical University of Munich, H.L. and as his successor at the Max Planck Institute, F.H. wish him also after his retirement continued scientific success with many additional contributions to modern psychiatry. Hanns Hippus, Florian Holsboer, Hans Lauter. Preface. One of the main purposes of science is to elaborate models of natural processes that should be as realistic as possible. Pathways in Applied Immunology Konrad Messmer, Mechthild Stein, 2012-12-06. This book is dedicated to the memory of Walter Brendel, late Professor of Experimental Surgery and Chairman of the Institute for Surgical Research at the University of Munich, Germany. For 20 years, Walter Brendel organized the renowned Round Table Symposium on Applied Immunology, first in Kitzbühel and later in Axams, Austria. On the occasion of the 20th symposium in January 1989, he gathered together a number of scientists who have been leaders in the field of transplantation immunology.

and clinical transplantation for the past two decades All of them had participated at previous meetings some on a regular basis Many of the new discoveries in applied immunology and transplantation medicine were first presented and vividly discussed at the Round Table Symposia The annual Kitzbiihel Axams meetings became well known and invitations much sought after not only for this reason but also because of the uniquely intimate atmosphere that promoted the free exchange of research findings and theoretical cut and thrust

*Behaviour Analysis in Theory and Practice* Derek E. Blackman, Helga Lejeune, 2013-05-24 This edited book addresses four themes of contemporary importance in the experimental and applied analysis of behaviour chronobiology relationships between time and behaviour the emergence of rational thinking language and behavioural medicine The current empirical and theoretical status of each theme is considered in individual chapters the authors of which are distinguished research scientists drawn from a wide range of scholarship and with a distinctive European dimension This cultural and theoretical diversity emerges from the fact that each chapter is developed from a paper originally presented by invitation at the Second European Meeting on the Experimental Analysis of Behaviour which was held in Li ge Belgium in 1988 Within the four themes individual topics address issues such as circadian rhythms in behaviour temporal regulation in children and in animals the emergence of equivalence relations in children and animals the development of thinking in mentally retarded children reasoning and associative learning in animals rule governed behaviour theoretical issues relating language to the theory of mind the relationship between behavioural and visceral functions the relevance of behavioural approaches to the prevention of AIDS and the development of self detection skills for breast cancer The book makes an important contribution to the literature of contemporary behaviour analysis by reviewing issues of current interest and importance from a broad theoretical base

National Library of Medicine Current Catalog National Library of Medicine (U.S.), *Local Aspects of Sleep and Wakefulness* Giulio Bernardi, Francesca Siclari, Michele Bellesi, 2020-03-24

Department of Transportation and related agencies appropriations for 1989 United States. Congress. House. Committee on Appropriations. Subcommittee on Department of Transportation and Related Agencies Appropriations, 1989

**Department of Transportation and Related Agencies Appropriations for 1990: Testimony of members of Congress and other interested individuals and organizations** United States. Congress. House. Committee on Appropriations. Subcommittee on Department of Transportation and Related Agencies Appropriations, 1989

*Biological Clocks and Shift Work Scheduling* United States. Congress. House. Committee on Science and Technology. Subcommittee on Investigations and Oversight, 1983

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