

are not related at the sequence level to TA systems [14,15]. However, both systems are regulated by a bistable switch involving the Spo0A transcriptional regulator [14,15]. A bistable switch, cued initially by stochastic variations in gene expression at the single-cell level, divides a population of genetically identical cells into two stable but alternative cell states [16]. Two regulatory mechanisms have been proposed to bring about bistability — either a positive-feedback loop or a pair of reciprocally repressing repressors [16]. It is not readily apparent how the regulatory circuit that governs MrpC and MazF-mx activity could give rise to bistability (Figure 1). In particular, even though MrpC2 positively regulates the expression of *mrpC* in a positive-feedback loop, it also activates transcription of *mazF-mx*. This predicts that MrpC and MrpC2 would accumulate in parallel with MazF-mx. Therefore, it is not evident that the positive-feedback loop involved in *mrpC* expression would give rise to bistability, although *M. xanthus* cells do sort into survivors (spores) and non-survivors (dead

cells) under starvation conditions. Is there a hidden bistable switch to be discovered or is there a different logic for the design of the programmed cell death circuit involved in *M. xanthus* development?

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## Fly Vision: Neural Mechanisms of Motion Computation

A wide range of novel approaches are being used to dissect the visual system of the fly, both the neural networks of motion detection and the performance of these networks under complex natural stimulus conditions.

Martin Egelhaaf

Anyone who observes two flies chasing each other will be fascinated by their breathtaking aerial acrobatics: the human eye is hardly able even to follow their flight paths, but the pursuing fly is quite capable of catching its speeding target. During their virtuoso flight manoeuvres, flies can make up to ten sudden, so-called saccadic turns per second, during which they reach angular velocities of up to 4,000 degrees per second [1,2]. The flies rely to a great extent on information extracted by the neural circuits in their brain from the rapid displacements of the retinal images across the eyes. This visual motion information is then

transformed in a series of processing steps into motor control signals that are used to steer the flight course. A lot of progress has been made in the last few years in determining what information is encoded by networks of output neurons of the fly visual system under natural stimulus conditions [3,4], but the cellular mechanisms underlying local motion detection — the first step of visual motion computation — are still largely unknown. But progress is being made towards elucidating these mechanisms, as illustrated by recent studies combining genetic tools with behavioural [5] or, even more specifically, electrophysiological analyses [6].

The fly visual system is optimised for reliable performance in flight behaviour and is amenable to analysis by a broad spectrum of neuronal and behavioural methods; it has consequently proved to be an outstanding model system for tracing the computations which serve to process image motion proceeding from the eyes [2,7–9]. Retinal image motion is not perceived directly by the eye; rather, the photoreceptors in the retina register just a continuously changing spatial array of brightness values. From this, the nervous system has to go through a series of steps to evaluate information on the image movements. Local motion detectors in the medulla compare the brightness data of adjacent light-sensitive cells (Figure 1, upper right). Movement is signaled when two of these detectors report the same brightness value in immediate succession, for example, bright-bright. During this process, each motion detector reacts with a large excitatory signal to movement in a given direction and with a negative

# Neural Computation Of Pattern Motion

**G Thomas**



## **Neural Computation Of Pattern Motion:**

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**Mathematical Modelling in Motor Neuroscience: State of the Art and Translation to the Clinic. Ocular Motor Plant and Gaze Stabilization Mechanisms** ,2019-06-23 Mathematical Modelling in Motor Neuroscience State of the Art and Translation to the Clinic Ocular Motor Plant and Gaze Stabilization Mechanisms Volume 248 the latest release in the Progress in Brain Research series highlights new advances in the field with this new volume presenting interesting chapters on a variety of topics including Mathematical modeling in clinical and basic motor neuroscience The math of medicine the computational lessons learned from the human disease Mathematical models an extension of the clinician s mind From differential equation to linear control systems the study of the VOR Closed lop and nonlinear systems State space equations and learning Integrators and optimal control and much more Provides the authority and expertise of leading contributors from an international board of authors Presents the latest release in the Progress in Brain Research series Includes the latest information on mathematical modeling in motor neuroscience **Computational Methods in Neural Modeling** José Mira,2003-05-22 The two volume set LNCS 2686 and LNCS 2687 constitute the refereed proceedings of the 7th International Work Conference on Artificial and Natural Neural Networks IWANN 2003 held in Ma Menorca Spain in June 2003 The 197 revised papers presented were carefully reviewed and selected for inclusion in the book and address the following topics mathematical and computational methods in neural modelling neurophysiological data analysis and modelling structural and functional models of neurons learning and other plasticity phenomena complex systems dynamics cognitive processes and artificial intelligence methodologies for net design bio inspired systems and engineering and applications in a broad variety of fields *Biomedical Index to PHS-supported Research* ,1993 [Encyclopedia of Neuroscience, Volume 1](#) Larry R. Squire,2009-06-12 The Encyclopedia of the Neuroscience explores all areas of the discipline in its focused entries on a wide variety of topics in neurology neurosurgery psychiatry and other related areas of neuroscience Each article is written by an expert in that specific domain and peer reviewed by the advisory board before acceptance into the encyclopedia Each article contains a glossary introduction a reference section and cross references to other related encyclopedia articles Written at a level suitable for university undergraduates the breadth and depth of coverage will appeal beyond undergraduates to professionals and academics in related fields **Computational Models of Visual Processing** Michael S. Landy,J. Anthony Movshon,1991 The more than twenty contributions in this book all new and previously unpublished provide an up to date survey of contemporary research on computational modeling of the visual system The approaches represented range from neurophysiology to psychophysics and from retinal function to the analysis of visual cues to motion color texture and depth The contributions are linked thematically by a consistent consideration of the links between empirical data and

computational models in the study of visual function An introductory chapter by Edward Adelson and James Bergen gives a new and elegant formalization of the elements of early vision Subsequent sections treat receptors and sampling models of neural function detection and discrimination color and shading motion and texture and 3D shape Each section is introduced by a brief topical review and summary Contributors Edward H Adelson Albert J Ahumada Jr James R Bergen David G Birch David H Brainard Heinrich H B lthoff Charles Chubb Nancy J Coletta Michael D Zmura John P Frisby Norma Graham Norberto M Grzywacz P William Haake Michael J Hawken David J Heeger Donald C Hood Elizabeth B Johnston Daniel Kersten Michael S Landy Peter Lennie J Stephen Mansfield J Anthony Movshon Jacob Nachmias Andrew J Parker Denis G Pelli Stephen B Pollard R Clay Reid Robert Shapley Carlo L M Tiana Brian A Wandell Andrew B Watson David R Williams Hugh R Wilson Yuede Yang Alan L Yuille From Neuron to Action Lüder Deecke, John Eccles, Vernon B.

Mountcastle, 2013-03-09 A rich source of information about human voluntary movement in health and disease can be found in this book The most esteemed researchers in their respective fields bring you up to date articles Their collected work combines fundamental research in the life sciences with clinical neuroscience in a unique overview The interdisciplinary aspects of motor physiology uncover a wealth of information for researchers from neighboring disciplines For example oculomotor research vestibular research equilibrium sensory research and cognition evolution synaptic and elementary processes and the neurological sciences can be discovered *Theoretical Aspects of Neural Computation: A*

*Multidisciplinary Perspective* Kwok-Yee M. Wong, Dit-Yan Yeung, 1998-06 Over the past decade or so neural computation has emerged as a research area with active involvement by researchers from a number of different disciplines including computer science engineering mathematics neurobiology physics and statistics The workshop brought together researchers with a diverse background to review the current status of neural computation research Three aspects of neural computation have been emphasized neuroscience aspects computational and Mathematical aspects and statistical physics aspects This book contains 28 contributions from frontier researchers in these fields Thoroughly re edited and in some cases revised post workshop these papers collated into this review volume provide a top class reference summary of the state of the art work done in this field *Closing the Loop Around Neural Systems* Steve M Potter, Eberhard E Fetz, Ahmed El Hady, 2014-12-03

Closed loop neurophysiology has been accelerated by recent software and hardware developments and by the emergence of novel tools to control neuronal activity with spatial and temporal precision in which stimuli are delivered in real time based on recordings or behavior Real time stimulation feedback enables a wide range of innovative studies of information processing and plasticity in neuronal networks This Research Topic e Book comprises 16 Original Research Articles seven Methods Articles and seven Reviews Mini Reviews and Perspectives all peer reviewed and published in Frontiers in Neural Circuits The contributions deal with closed loop neurophysiology experiments at a variety of levels of neural circuit complexity Some include modeling and theoretical analyses New enabling technologies and techniques are described Novel

work is presented from experiments in vitro in vivo and in humans along with their clinical and technological implications for improving the human condition

Visual Detection of Motion Andrew T. Smith, Robert J. Snowden, 1994 The brain's ability to detect movement within the retinal image is crucial not only for determining the trajectories of moving objects but also for identifying and interpreting image motion resulting from eye and head movements This book summarizes our knowledge of how information about image motion is encoded in the brain Key Features Valuable reference source for those involved in the rapidly expanding area of motion perception Strong emphasis on integration of physiological computation and psychophysical approaches Topics include Principles of local motion detection Inputs to local motion detectors Integration of motion signals Higher order interpretation of motion Motion detection and eye movements

What can simple brains teach us about how vision works Davide Zoccolan, David D. Cox, Andrea Benucci, R. Clay Reid, 2015-11-18 Vision is the process of extracting behaviorally relevant information from patterns of light that fall on retina as the eyes sample the outside world Traditionally nonhuman primates macaque monkeys in particular have been viewed by many as the animal model of choice for investigating the neuronal substrates of visual processing not only because their visual systems closely mirror our own but also because it is often assumed that simpler brains lack advanced visual processing machinery However this narrow view of visual neuroscience ignores the fact that vision is widely distributed throughout the animal kingdom enabling a wide repertoire of complex behaviors in species from insects to birds fish and mammals Recent years have seen a resurgence of interest in alternative animal models for vision research especially rodents This resurgence is partly due to the availability of increasingly powerful experimental approaches e g optogenetics and two photon imaging that are challenging to apply to their full potential in primates Meanwhile even more phylogenetically distant species such as birds fish and insects have long been workhorse animal models for gaining insight into the core computations underlying visual processing In many cases these animal models are valuable precisely because their visual systems are simpler than the primate visual system Simpler systems are often easier to understand and studying a diversity of neuronal systems that achieve similar functions can focus attention on those computational principles that are universal and essential This Research Topic provides a survey of the state of the art in the use of animal models of visual functions that are alternative to macaques It includes original research methods articles reviews and opinions that exploit a variety of animal models including rodents birds fishes and insects as well as small New World monkey the marmoset to investigate visual function The experimental approaches covered by these studies range from psychophysics and electrophysiology to histology and genetics testifying to the richness and depth of visual neuroscience in non macaque species

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