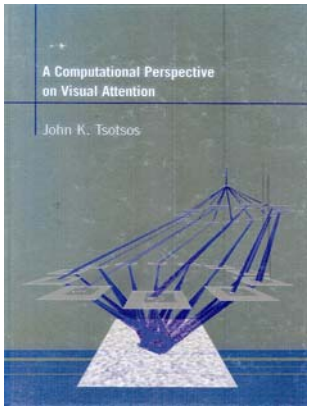


A Computational Perspective on Visual Attention. John K. Tsotsos. The MIT Press, 55 Hayward Street, Cambridge, MA 02142, USA. 2011. xvi + 308 pp. Price: US$ 40.00/£29.95.

This book by John Tsotsos is timely given the large amount of empirical research on attention in psychology and neuroscience in the last 60 years. It consists of six chapters. Three Appendices cover some mathematical aspects, including complexity theory, proof of bounds of visual matching, and representation of visual motion. The book does assume some background of computational fundamentals as well as basic findings from neuroscience and cognitive psychology.

In the last 30 years, many models have been developed ranging from formal models by Bundesen, Logan and others to computational models pioneered by Tsotsos. In addition, neural network models of visual attention have been developed that are based on findings from neurophysiology. Mathematical and computational models have been extended to fit with data from cognitive and systems neuroscience as well, resulting in a fair amount of interdisciplinary work and some success in evaluating different models. Still these models have a long way to go in explaining the large amount of behavioural and neural data about visual attention.

The work is based on the computational approach to the study of visual attention developed by Tsotsos in the past 25 years. The book captures the vision of Tsotsos that has been reasonably successful with its focus on algorithmic complexity.

Chapter 1 defines attention as the process through which the brain controls and tunes information processing. Different scientific domains approach the problem differently and this chapter discusses them in a fairly succinct manner. The chapters points out to the different (sometimes contradictory ways) in which attention is defined, making it difficult to achieve progress.

Chapter 2 discusses the computational complexity of different visual problems most specifically visual search. The pyramidal architecture is discussed and the author elucidates the purpose of visual attention as solving computational problems that arise out of the underlying architecture. According to Tsotsos, attention arises out of the necessity to handle the computational complexity of the decision problem in vision and he discusses nine theorems that constitute the foundational aspects of computational vision.

Chapter 3 discusses different elements of visual attention and relates them in the form of a taxonomy that can be utilized for modelling attention. Tsotsos briefly discusses both models developed in biological and computer vision. He then discusses four main computational hypotheses proposed for visual attention: saliency map, temporal tagging, emergent attention and selective routing.

In the following chapters, Tsostos focuses on his model of attention based on selective tuning developed over the past 25 years. In his words, the model uses a hierarchical, top-down, recursive pruning strategy that results in the reduction of computational complexity and solves many of the problems due to the visual architecture discussed earlier in chapter 2. In the selective tuning model, a winner takes all mechanism operates at the top layer and inputs that do not contribute to the winner are pruned or inhibited. This process percolates recursively downwards enabling object recognition. He discusses the ST model with fixation control and follows it up with a discussion on some differences with other models like the biased competition model and the saliency map-based models to end chapter 4.

Chapter 5 discusses representational aspects, especially the concept of pyramidal lattice structure. This is followed by a discussion on the different kinds of neurons used in the ST model and the way they function. Selection mechanisms in different aspects of the neural model are discussed in detail. Other aspects linked to task guidance, inhibition of return and top-down tracing are also presented in this chapter. A detailed table that compares ST with five other neural net models is also presented.

Chapter 6 focuses on the main problems in vision, presenting the relationship between attention, recognition and binding. After introducing the problem of recognition, Tsostos discusses not one but four different binding processes: convergence binding, partial recurrence binding, full recurrence binding and iterative recurrence binding. He ends the chapter by discussing the algorithm for the binding decision process.

After discussing the basic components of the model in chapters 4–6, Tsotsos moves on to demonstrate the application of the ST model to perception of visual motion in chapter 7. Results at different stages of the network functioning are presented using multiple figures. This is followed by the application of the ST model to visual search, a commonly used paradigm to study visual attention in neuroscience and psychology.

In chapter 8, Tsotsos moves on to explanations of the different functional aspects of attention discussed earlier based on the ST model. A model is evaluated not only by the explanations of the empirical phenomena already discovered, but also by successful predictions. He discusses ten predictions and the experimental evidences that have confirmed these predictions pointing to the success of the ST model. The chapter ends with a discussion of behavioural and imaging experiments that have provided support for the ST model.

The final chapter wraps up the loose ends with a discussion of issues including working memory, learning, eye movements, the communication of high spatial resolution information and executive control. He ends by emphasizing the dynamic tuning aspects and the fact that vision is a general-purpose processing system.

This book differs from the one by Claus Bundesen's on principles of selective attention in terms of establishing computational limits for various algorithms. Bundesen's book is based on his more formal mathematical approach focusing on race models. Tsotsos relies on computational modelling and development of algorithms for basic perceptual and attentional processes. They also focus on different empirical findings. In some way, they complement each other with their differing focus.

One minor problem is specific lack of comparisons between Tsotsos' model

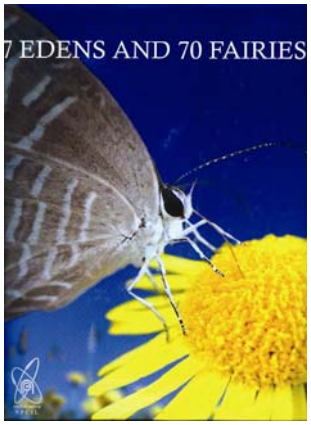
and other models of visual attention. This would have enabled one to see the advantages and disadvantages of approaching the problem from slightly differing perspectives that can explain similar empirical data. Perhaps with different assumptions and approaches, it would have been difficult to achieve in a single book given the current status of the discipline. In addition, perception involves information from more than one modality and it is not clear how the computational perspective presented in the volume can be directly extended to multimodal situations, especially when there is a need to combine information, say vision and touch in the context of object recognition and action planning.

Another aspect that would have been welcome is to extend the modelling or point to the way computational models can be extended to account for recent results indicating the dependence of attentional processes on emotion and motivation. Studies clearly show that emotional stimuli can attract attention and influence the nature of selection and control processes involved in visual perception, especially of socially relevant stimuli. Motivational and goal-driven processes influence attentional processes and these in turn influence visual perception. In addition, as a consequence of attention, information selected or not selected is attached with a value that would in turn affect later perception. This is all the more imperative given that the visual system has evolved to perceive certain classes of stimuli present in a given environment, especially the social environment in the case of the human visual system.

On the whole, this book is definitely recommended for those who want to understand and model visual attention. It would be especially valuable to neuroscientists and psychologists interested in the computational perspective on visual attention. The book fills a large void given the lack of comprehensive books on computational modelling of attention, and one hopes that this book would inspire other books that discuss different computational models of attention in greater detail in future.

NARAYANAN SRINIVASAN

Centre of Behavioural and Cognitive Sciences,
University of Allahabad,
Allahabad 211 002, India
e-mail: ammuns@yahoo.com

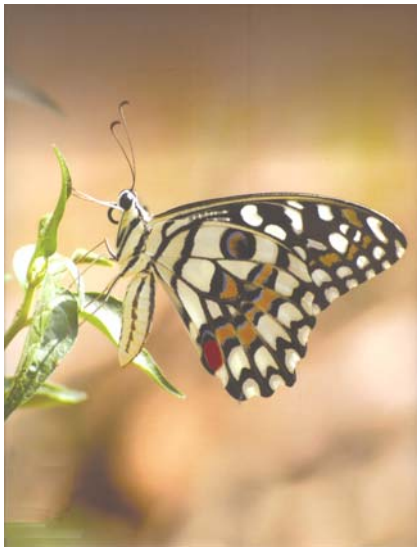


7 Edens and 70 Fairies. J. Devaprakash. Corporate Communications Group, NPCIL, Mumbai. 2012. 200 pp. Price not mentioned.

Butterflies (order Lepidoptera) are one of the well-studied insects in India and hitherto about 1200 species are recorded within its political boundaries. Butterflies, due to their colourful morphology and day-flying nature have attracted the attention of naturalists and artists from earlier times. Like birds, English common names are available for most of the Indian species and they can be easily observed and identified in the field, thus making them popular among students, naturalists, photographers and professional biologists. The adult and larval stages of butterflies are closely associated with specific habitats and food plants. Hence they are widely recognized as good indicators of environment quality and used in ecology and conservation studies.

The earliest record of accurate documentation of Indian butterflies dates back to the 17th century natural history paintings of Ustad Mansur, a renowned artist in the court of Emperor Jehangir. However, it was Carl Linnaeus who scientifically described many common Indian butterflies such as Twany Coster (*Acraea violae* (Linnaeus, 1758)), Peacock Pansy (*Junonia almanac* (Linnaeus, 1758)), etc. With increased interest in butterfly collection during the late 18th and early 19th century in Europe, extensive collections of butterflies were made from different parts of India and many new species were described. This fascination for exotic insects in Europe resulted in the publication of Westwood's (1848) *The Cabinet of Oriental Entomology* which featured colour illustrations of many beautiful butterflies and other insects from the Indian region. During the second half of the 19th century, many important publications were made on Indian butterflies. Lepidopterologists such as E. Y. Watson, T. R. Bell, C. B. Antram, W. H. Evans, Frederic Moore, C. T. Bingham and Lionel de Nicéville significantly contributed to the knowledge on Indian butterflies. The ten-volume colour illustrated *Lepidoptera Indica* by Frederic Moore published between 1890 and 1913 is a natural history classic. The fauna of India volumes on butterflies by C. T. Bingham (1905 and 1907) and Talbot (1939 and 1947) are detailed taxonomic monographs for Indian butterflies and summarize all the information gathered up to that time. The first illustrated field guide to Indian butterflies titled *The Butterflies of Indian Region* was published by Wynter-Blyth in 1957. This popular field guide encouraged many students and amateur naturalists to take up butterfly studies in India. In the last 20 years, many field guides in regional languages and English with colour photos have been published on Indian butterflies. Now a vibrant community of butterfly enthusiasts comprising professionals, students, teachers, photographers and naturalists exists in India. This community exchanges information on biology, ecology and distribution of Indian butterflies through on-line discussion groups.

The book under review is a documentation of biodiversity, especially butterflies of seven nuclear power plants of



Lovely Lime. A Lime Butterfly, an ace flyer, rests after a long flight.