

3D Shape

Its Unique Place in Visual Perception

[Zygmunt Pizlo](#)

The uniqueness of shape as a perceptual property lies in the fact that it is both complex and structured. Shapes are perceived veridically--perceived as they really are in the physical world, regardless of the orientation from which they are viewed. The constancy of the shape percept is the *sine qua non* of shape perception; you are not actually studying shape if constancy cannot be achieved with the stimulus you are using. Shape is the only perceptual attribute of an object that allows unambiguous identification. In this first book devoted exclusively to the perception of shape by humans and machines, Zygmunt Pizlo describes how we perceive shapes and how to design machines that can see shapes as we do. He reviews the long history of the subject, allowing the reader to understand why it has taken so long to understand shape perception, and offers a new theory of shape.

Until recently, shape was treated in combination with such other perceptual properties as depth, motion, speed, and color. This resulted in apparently contradictory findings, which made a coherent theoretical treatment of shape impossible. Pizlo argues that once shape is understood to be unique among visual attributes and the perceptual mechanisms underlying shape are seen to be different from other perceptual mechanisms, the research on shape becomes coherent and experimental findings no longer seem to contradict each other. A single theory of shape perception is thus possible, and Pizlo offers a theoretical treatment that explains how a three-dimensional shape percept is produced from a two-dimensional retinal image, assuming only that the image has been organized into two-dimensional shapes.

Pizlo focuses on discussion of the main concepts, telling the story of shape without interruption. Appendixes provide the basic mathematical and computational information necessary for a technical understanding of the argument. References point the way to more in-depth reading in geometry and computational vision.

Zygmunt Pizlo is Professor of Psychological Sciences and Electrical and Computer Engineering (by courtesy) at Purdue University.

Endorsements

"Zygmunt Pizlo, an original and highly productive scientist, gives us an engaging and valuable book, with numerous virtues, arguing that the question of how we perceive 3D shape is the most important and difficult problem for both perceptual psychology and the science of machine vision. His approach (a new simplicity theory) requires and invites much more research, but he believes it will survive and conquer the central problem faced by psychologists and machine vision scientists. If he is right, the prospects for the next century in both fields are exciting."

--**Julian Hochberg**, Centennial Professor Emeritus, Columbia University

"The very accessible book is a must-read for those interested in issues of object perception, that is, our ordinary, but highly mystifying, continual visual transformations of 2-D retinal images into, mostly unambiguous, 3-D perceptions of objects. Pizlo carefully traces two centuries of ideas about how these transformations might be done, describes the experiments thought at first to support the theory, and then experiments establishing that something is amiss. Having laid doubt on all theories, he ends with his own new, original theory based on figure-ground separation and shape constancy and reports supporting experiments. An important work."

--**R. Duncan Luce**, Distinguished Research Professor of Cognitive Science, University of California, Irvine, and National Medal of Science Recipient, 2003

"Pizlo's book makes a convincing case that the perception of shape is in a different category from other topics in the research field of visual perception such as color or motion. His insightful and thorough analysis of previous research on both human and machine vision and his innovative ideas come at an opportune moment. This book is likely to inspire many original studies of shape perception that will advance our knowledge of how we perceive the external world."

--**David Regan**, Department of Psychology, York University, and recipient, Queen Elizabeth II Medal, 2002

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