

**Springer Series
in Statistics**

Christopher G. Small

**The Statistical
Theory of Shape**



Springer

Statistical Theory Of Shape

R. Berthilsson



Statistical Theory Of Shape:

The Statistical Theory of Shape Christopher G. Small, 2012-12-06 In general terms the shape of an object data set or image can be defined as the total of all information that is invariant under translations rotations and isotropic rescalings Thus two objects can be said to have the same shape if they are similar in the sense of Euclidean geometry For example all equilateral triangles have the same shape and so do all cubes In applications bodies rarely have exactly the same shape within measurement error In such cases the variation in shape can often be the subject of statistical analysis The last decade has seen a considerable growth in interest in the statistical theory of shape This has been the result of a synthesis of a number of different areas and a recognition that there is considerable common ground among these areas in their study of shape variation Despite this synthesis of disciplines there are several different schools of statistical shape analysis One of these the Kendall school of shape analysis uses a variety of mathematical tools from differential geometry and probability and is the subject of this book The book does not assume a particularly strong background by the reader in these subjects and so a brief introduction is provided to each of these topics Anyone who is unfamiliar with this material is advised to consult a more complete reference As the literature on these subjects is vast the introductory sections can be used as a brief guide to the literature

The Statistical Theory of Shape Christopher G. Small, 1996 **A Statistical Theory of Shape** R. Berthilsson, 1997 **Shape and Shape Theory** D. G. Kendall, D. Barden, T. K. Carne, H. Le, 2009-09-25

Shape and Shape Theory D G Kendall Churchill College University of Cambridge UK D Barden Girton College University of Cambridge UK T K Carne King s College University of Cambridge UK H Le University of Nottingham UK The statistical theory of shape is a relatively new topic and is generating a great deal of interest and comment by statisticians engineers and computer scientists Mathematically shape is the geometrical information required to describe an object when location scale and rotational effects are removed The theory was pioneered by Professor David Kendall to solve practical problems concerning shape This text presents an elegant account of the theory of shape that has evolved from Kendall s work Features include A comprehensive account of Kendall s shape spaces A variety of topological and geometric invariants of these spaces Emphasis on the mathematical aspects of shape analysis Coverage of the mathematical issues for a wide range of applications The early chapters provide all the necessary background information including the history and applications of shape theory The authors then go on to analyse the topic in brilliant detail in a variety of different shape spaces Kendall s own procedures for visualising distributions of shapes and shape processes are covered at length Implications from other branches of mathematics are explored along with more advanced applications incorporating statistics and stochastic analysis Applied statisticians applied mathematicians engineers and computer scientists working and researching in the fields of archaeology astronomy biology geography and physical chemistry will find this book of great benefit The theories presented are used today in a wide range of subjects from archaeology through to physics and will provide fascinating reading to anyone

engaged in such research Visit our web page <http://www.wiley.com>

Statistical Theory of Shape Isomers Arthur M. Aframe,1973 *Some Questions of the Statistical Theory of Shape Identification* A. G. Frantsuz,FOREIGN TECHNOLOGY DIV WRIGHT-PATTERSON AFB OHIO.,1968 An analysis of the statement of certain problems in mathematical statistics arising in connection with the problem of form recognition The problem in particular is concerned with the theory of estimates with respect to small samples in the case of multi variate distributions synthesis of secondary characteristics describing an object from primary characteristics reduction of the number of characteristics to a given number with minimal loss of information Author

A Statistical Theory for Shape Analysis of Curves and Surfaces with Applications in Image Analysis, Biometrics, Bioinformatics and Medical Diagnostics ,2010 Over the five year period this project has mainly been concerned about developing a theory for statistical analysis of shapes of objects both two and three dimensional Focusing on the boundaries of these objects our framework is for shape analysis of curves and surfaces The main achievements were development of tools for

- 1 Quantifying Shape Differences Given any two objects we can quantify differences between their shapes
- 2 Achieve Desired Invariance Our notion of shape is invariant to certain transformations of curves rigid motion scaling and re parameterization
- 3 Compute Summary Statistics Given a collection of shapes and shape classes we can generate summary statistics mean covariance etc to characterize a shape class
- 4 Stochastic Modeling We have developed probability models that capture observed variability in shape classes These models form priors for Bayesian inferences
- 5 Statistical Inferences We have studied statistical evaluations such as hypothesis testing likelihood ratios performance bounds etc for shape analysis

The salient components of this differential geometric framework are following First we define a space of curves or surfaces by choosing a mathematical representation for these objects and establish a Hilbert submanifold s for such representations Then we choose a Riemannian metric usually an elastic metric for measuring distances on such manifolds We arrive at a shape manifold by imposing remaining invariances in the representation For these shape spaces we have developed two numerical techniques for computing geodesic paths Finally we define and compute empirical statistics and define probability models on tangent bundles The resulting statistical models are then used to characterize objects in images according to shapes for using in object detection tracking and recognition We have demonstrated these tools in different application understanding

Statistical Theory of Signal Detection Carl W. Helstrom,1960

Statistical Theory and Method Abstracts ,1998 *Journal of the Physical Society of Japan* Nihon Butsuri Gakkai,1982 *Proceedings of the Michigan Morphometrics Workshop* F. James Rohlf,Fred L. Bookstein,1990 *Geophysical Research Papers* Air Force Cambridge Research Laboratories (U.S.). Geophysics Research Directorate,1955

Disorder in Physical Systems John Michael Hammersley,Geoffrey Grimmett,D. J. A. Welsh,1990 This volume is dedicated to John Hammersley one of the most influential of all researchers in random phenomena It provides a unique survey of the current state of mathematical research in this field which has seen great advances in recent decades As

Hammersley's colleagues and collaborators the contributors are all leading figures in their respective fields. They describe progress in such areas as percolation theory, random networks, lattice animals, stochastic geometry, diffusions, covering problems, Monte Carlo methods, and operations research. Computational complexity, random fields, convergence on random variables, classical and quantum mechanics, and analytic number theory are also covered. Researchers and graduate students in a variety of disciplines will find this an authoritative and up-to-date survey of many of the most exciting developments in mathematics today.

Algebraic Frames for the Perception-action Cycle, 2000 **Quarterly Bulletin of the Canadian Mining Institute** Canadian Institute of Mining and Metallurgy, Canadian Institute of Mining, Metallurgy and Petroleum, 1928 **The New Republic**, 1922 Advances in Applied Probability, 2000 Soviet Physics, JETP., 1986
Physics, Uspekhi, 2007 *Reprint* Bell Telephone Laboratories, 1926

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