Morphometrics for the Life Sciences

Recent Advances in Human Biology

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Recent Advances in Human Biology – Volume

7

Series editor: Charles E. Oxnard
Centre for Human Biology
The University of Western Australia

Morphometrics for the Life Sciences

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World Scientific

Singapore • New Jersey • London • Hong Kong

Published by

World Scientific Publishing Co. Pte. Ltd.

P O Box 128, Farrer Road, Singapore 912805

USA office: Suite 1B, 1060 Main Street, River Edge, NJ 07661

UK office: 57 Shelton Street, Covent Garden, London WC2H 9HE

British Library Cataloguing-in-Publication Data

A catalogue record for this book is available from the British Library.

MORPHOMETRICS FOR THE LIFE SCIENCES

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ISBN 981-02-3610-7

Printed in Singapore.

PROLOGUE

One aim of this volume is to introduce the subject matter of a comparatively new discipline, but one with ancient roots: morphometrics. Morphometrics is the quantitative description or measurement of the biological form. It represents the initial step in the elucidation of taxonomic and classification questions, in dealing with issues of structure and function, as well as providing the raw material for explanations of biological process. Thus, morphometrics is central to all the biological sciences. Morphometrics deals with the need to quantify, in a complete and precise manner, the visual information inherent in all biological organisms. While this visual information is readily apparent, it has been inexorably difficult to adequately characterize in numerical terms.

As a starting point for the study of morphometrics, when measurement is considered, it is the universally used conventional metrical approach (CMA), consisting of distances, angles and ratios that are immediately thought of. That CMA represents a very inefficient procedure for dealing with the complex and irregular forms that constitute a majority of biological organisms on earth is generally not recognized. Accordingly, a re-evaluation of the way such metrics continue to be used is imperative and has spawned a number of alternative methods over the last three decades. While a complete morphometric description of biological organisms is not yet possible, the appearance of these new approaches can be considered a promising endeavor for continuing advances in morphometrics as the 21st century progresses.

Another aim of this work is to continue in a more generalized setting, the application of Fourier Descriptors (FDs), Fourier Transforms (FTs) and wavelets to characterize the boundary outline of biological forms, which is taken up in Chapter 9. Part of this material represents: [1] a continuation of earlier research efforts and [2] an expansion of ideas initially formulated in an edited volume entitled: *Fourier Descriptors and their Applications in Biology* (1997).

Part one, *Theoretical Background*, consisting of six chapters is intended as an introduction to morphometrics. Chapters 1 and 2 introduce morphometrics and research methods respectively. These are followed by Chapter 3, which contains a brief history of measurement, which leads into Chapter 4, which describes the increasing use of quantification in biology. The last two chapters are more theoretical in nature and deal with a host of issues that impinge directly and indirectly on the quantitative analysis of the biological form. These include topics such as complexity, systems and models (Chapter 5) and the development of a formal model of form (Chapter 6).

Part two, *Morphometric Techniques*, is composed of four chapters followed by an epilogue. These chapters are more applied in character and deal with the numerous and quite diverse morphometric procedures that have been applied to biological datasets. Chapter 7 deals with multivariate morphometrics, Chapter 8 with coordinate

morphometrics, Chapter 9 with boundary morphometrics and Chapter 10 with structural morphometrics. A number of sources are provided that allow access to available software that can be used with the methods described in Chapter 7 through Chapter 10. Additionally, more sources are available via the Internet and the student will find that a diligent search will be rewarded.

Most of the material in this volume lends itself for a one-semester interdisciplinary course on morphometrics. It is presented at an introductory level, although extensive references are provided for the inquisitive student who wants to probe more deeply. While it is aimed at the biologically oriented student, it may also be profitably used by students in other related disciplines. An introductory course on morphometrics has been given to post-graduate students at the School of Dentistry, University of California at Los Angeles.

Various parts of the text have been presented at lectures given to the faculty and students at the University of Glasgow Dental School; University of Adelaide, Australia; The University of Otago, Dunedin, New Zealand; The Karolinska Institute, Stockholm; Tokyo Metropolitan University, Hachioji, Tokyo; Tokyo National Science Museum, Ueno, Tokyo; Nihon University School of Dentistry at Matsudo, Chiba; The National University of Singapore; and the University of Bourgogne, Dijon.

Pete E. Lestrel
Van Nuys, California
February 2000

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ACKNOWLEDGMENTS

The idea for this volume was in the back of my mind even before I had completed *Fourier Descriptors and their Applications in Biology* for Cambridge Press. However, its birth, so to speak, was a chance encounter, a consequence of my visiting Professor Charles Oxnard in Perth, Australia in 1996. Charles suggested I should consider writing it as a volume for the *Recent Advances in Human Biology* series of which he was Editor. Thus, *Morphometrics for the Life Sciences* was born. I am, needless to say, exceedingly grateful to Charles for that suggestion.

I am most indebted to Professor Fumio Ohtsuki, Tokyo Metropolitan University (TMU) for always being a gracious host starting with my first visit to Tokyo in 1995. In addition, for allowing me time in August of 1996 to initiate the first rough draft of the first two chapters of this volume, as well as having me return as Visiting Professor for three months in the summer of 1999 to supervise students and continue our joint research projects on human cranium shape changes and human growth in stature. I also wish to acknowledge the friendship of Professors Hideyuki Tanaka and Teruo Uetake, in whose company I was able to finally climb Mt. Fuji. I also want to mention my relationship with Dr. Osamu Takahashi, Nihon University School of Dentistry at Matsudo, who visited me for 15 months (1997-1999) to carry out a series of joint research projects dealing with human craniofacial complex. Finally, I want to indicate that I feel particularly honored by the gracious treatment I received from Dr. Shigeo Otake, Dean of the School, Professor Eisaku Kanasawa and Dr. Kazutaka Kasai, all from the Nihon University School of Dentistry where I delivered an invited lecture in June 1999.

I would like to thank Professor W. J. S. Kerr, University of Glasgow, Department of Orthodontics, for inviting me to beautiful Scotland and to participate in joint research on functional appliance therapy. Thanks must also go to Dr. Jan Huggare, Chairman of Orthodontics, University of Karolinska, for inviting me to come to Stockholm to give a lecture as well as allowing me the privilege to attend the Nobel Lecture in Physiology/Medicine for 1996 given to Professors Peter C. Doherty and Rolf M. Zinkernagel for their work concerning the specificity of cell-mediated immune defenses. Moreover, Jan was also instrumental in arraigning my 1999 lecture at the National University of Singapore when he was there for a year's appointment.

I am most grateful to Professor Eric Verrecchia, University of Bourgogne, Dijon, for inviting me to the Bio Geo Images '99 conference held in September 1999. Eric and I not only shared a fondness for the food and wine of the Burgundy region, but also a mutual admiration for the exceptional accomplishments of J. B. J. Fourier. I also wish to thank Dr. Hervé Drolon, University of Le Havre, for sending me reprints and for her helpful suggestions with respect to wavelets.

A debt of gratitude goes to Professor Neal Garrett, UCLA School of Dentistry for reviewing parts of the manuscript. I have heavily relied on his advice in the past so I am again grateful for his efforts. I am also especially grateful to Charles Wolfe for his unflagging long-term programming efforts, valuable and stimulating discussions, and for the thorough review of the manuscript. Thanks must go to Dr. Albert Bodt for taking the time out of a busy medical practice at Kaiser Permanente, to review the manuscript; and for his enthusiasm and close friendship for almost twenty years now. Any errors remaining, however, are solely my own.

Lastly and most certainly not least, I owe my wife Dagmar a great deal, not only whose talents as a librarian were particularly helpful, but also for being my soul mate in marriage for the last thirty-two years and who had to tolerate my many late nights and early mornings necessary to bring this project to completion.