INTRODUCTION

Morphometry is undergoing major changes on at least two fronts. One is the development of new methods by statisticians working on biological problems, and the other in the kinds of biological questions to which they are applied, especially a new look at development, evolution and variation in the form of organims. Form includes both size and shape. Up to now, size has been dealt with in a satisfactory quantitative manner, but shape has been reduced to a comparison of sizes of parts of organisms. Now, it is possible to dissect shape into linear and non-linear components for homologous landmarks. A number of workshops in the last few years and additional ones being organized are disseminating the results of this effort, and attest to the vigor and interest in morphometrics. We believe it is not too early to describe the emerging changes as radical departures from the past. A new paradigm is now being formulated. We also believe that the store of available problems and methods qualifies morphometrics as a discipline in its own right.

A central theme in the new Morphometrics is to consider landmarks directly, rather than to derive distances from them. The results are reported in organism space rather than in the abstract vector space of classical multivariate statistics and traditional morphometrics. However, classical multivariate techniques are still relevant in testing and inference. The benefits of such an integration are still not as widely appreciated as we would like, but further efforts such as this one will hopefully make the methodology more available. Fred Bookstein has pointed out that we have a "desperate need of a book-length primer" on the new morphometrics.

Much of the literature and examples in systematics are in two dimensions rather than in the three that we observe and study. It is clear from the description of the methods that the mathematics has been developed, algorithms are available, and numerical results are easily obtained for three dimensional data. Three dimensional (3-D) data acquisition is still expensive for the systematist, who now almost routinely uses 2-D video capture systems.

Three dimensional software is being developed and the speed of low cost desk top computers is increasing so that the dynamic graphics required will soon become widely available.

This volume reports on some of the methods and applications available in the new morphometrics. Bookstein in the first chapter has provided us with a good history of methods tracing the roots of the new perspective. Key phrases are "alternative visualizations", and "configuration of landmarks".

Roth in her essay outlines practical necessities in collecting adequate data for morphometric analysis, emphasizing care in photography and measurement. She discusses the relations between our customary 2-D perspectives and the 3-D reality of objects.

In fact there has been a 2-D emphasis in the new morphometrics applied to systematic work to date, and the gap that exists between the availability of data acquisition techniques and expensive computer displays required for the newer kinds of data used in medicine for example, will be closed in the near future.

Becerra, Bello and Valdecasas offer some practical advice on selection of equipment for 2-D image capture for morphometrics based on their experience with a selection of hardware and software available to them. They report also some experiments to give an idea of resolution and repeatability available on the lower cost systems built around IBM PC's and clones, and data acquistion software. We hope that gatherings in the near future will be able to discuss the pros and cons of various 3-D systems as clearly.

Slice offers a contribution dealing with outline data. He gives a useful critique of the use of fractal dimensions in describing two dimensional shapes - using leaves as examples. He offers many practical points in the use of this methodology, and discusses pitfalls to avoid.

Marcus gives some practical applications of classical multivariate statistics in his article, and discusses some relations between univariate and multivariate inferential statistics. The biplot method is explained, and heuristics on relations between student's t and Hotelling's T^2 as well as analysis of variance (ANOVA), and multivariate analysis of variance (MANOVA) are provided. Programs written for the software package MATLAB are included to support some of these methods.

Rohlf has contributed a clear algorithmic development of the technique of relative warps. His article is at the same time a user guide to his Thin Plate Spline Relative Warp (TPSRW) program provided with this volume. He explains all of the steps and interpretations with his now familiar data set on mosquito wings. Practical choices in terms of ontogenetic and exploratory studies are discussed as well. The relative warp technique in his hands is seen as an another way of operating with linear functions of the data, and in this way broadens our view of this family of techniques.

The most important test for a recipe is the tasting, and both Walker, and Loy et al. have done just that. Walker has extended resistant fit techniques to an exploration of landmark allometry and provided useful graphics. He has also contrasted alternative registration methods in both interpretation and presentation of his results.

Loy *et al.* apply Bookstein shape coordinates in their analysis of systematic diversity of European moles. They are interested in phylogenetic reconstruction, sexual dimorphism, and intra-specific variation in the skulls of these highly specialized mammals. This application also serves to illustrate the use of classical multivariate statistics with data derived from the new morphometrics.

Becerra has provided a useful discussion of electronic mail and other communication possibilities over BITNET and the Internet. His article serves as a primer for those new to these topics.

Finally the latest versions of GRF, TPS and TPSRW by Rohlf are provided on a disk included with this book. A completely new program TPSREGR is provided by Rohlf. See the Appendix and README file with that program for a discussion of its features. The latter especially, is a considerable revision of the original accompanying the Michigan Morphometrics Workshop volume. An appendix explains their installation and use. Also see the Appendix on how to obtain newer up to date versions.

Some programs are provided in MATLAB which means that they can be run on IBM PC´s or clones, Mac´s, work stations and other platforms if one has the package MATLAB avaible. Programs are included to produce the Biplots in the paper by Marcus, and a program TPSNEW and TPSRWZ3 that do thin plate splines and relative warp computations following the output and steps very closely in Rohlf's article. Other software included are documented in the README file included on the diskette accompanying this volume.

LESLIE F. MARCUS
ELISA BELLO
ANTONIO GARCIA-VALDECASAS

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