Preface

This book aims to explain how to use R to perform morphometrics. Morphometric analysis is the study of shape and size variations and covariations and their covariations with other variables. Morphometrics is thus deeply rooted within statistical sciences. While most applications concern biology, morphometrics is becoming common tools used in archeological, palaeontological, geographical, or medicine disciplines. Since the recent formalizations of some of the ideas of predecessors, such as D'arcy Thompson, and thanks to the development of computer technologies and new ways for appraising shape changes and variation, morphometrics have undergone, and are still undergoing, a revolution. Most techniques dealing with statistical shape analysis have been developed in the last three decades, and the number of publications using morphometrics is increasing rapidly. However, the majority of these methods cannot be implemented in available software and therefore prospective students often need to acquire detailed knowledge in informatics and statistics before applying them to their data. With acceleration in the accumulation of methods accompanying the emerging science of statistical shape analysis, it is becoming important to use tools that allow some autonomy. R easily helps fulfill this need.

R is a language and environment for statistical computing and graphics. Although there is an increasing number of computer applications that perform morphometrics, using R has several advantages that confer to users considerable power and possible new horizons in a world that requires rapid adaptability. Indeed, the R language and environment is suitable for both basic users and developers, and can run on most operating systems (Windows, Linux, or Apple OS). With one single environment, morphometric analysis can be performed from data acquisition to data analysis, and results can be presented in the form of graphs, both accurate and esthetic. Results can also be included in further tests with independent data, using the wide range of functions and packages available with R. R gathers the achievements of the *R core development team*, numerous contributors of online available packages, and possibly your own interaction. The advanced user can develop and modify his/her own or programmed functions. R is highly evolvable and offers a single and integrative environment to perform a wide range of statistical analyses; all characteristics make this software suitable for beginners. In addition, R is taught more and more in universities

and increasingly used worldwide. Newcomers can easily get specific advice about both practical and scientific questions with the international assistance provided by the R-help web list and many online and inexpensive manuals. Finally, R is freely distributed over the Internet.

However, there was obviously a need for bringing the R and morphometric approaches together. The book is a guide for performing and for developing modern morphometrics with R. Exercises and examples can be used as tutorials, and the combination of the book with R can be used as a teaching instrument. Besides the need for supplying knowledge about R and morphometrics, the book expresses the need for reducing the gaps between theoreticians, developers, and users. For this goal, I deliberately favoured an approach involving customized functions directly written by the user, rather than the explanation of a selected package. Functions from specific "morphometric" packages are nevertheless briefly presented for faster computation. I hope that this book will not be only a guide for using R code for performing morphometrics, but also a helpful document for helping users to acquire autonomy and to develop programs for their own scientific needs. For the book to be fully useful, I strongly encourage you to work with R. It only requests you to download and install R on your computer: something that will take a few minutes.

The first chapter of the book deals with general considerations and an introduction to R. It directly brings users into contact with the R language and environment. The second chapter explains how to gather and capture data with R; a section of this chapter is concerned with the organization of files. Since image analysis is often a prerequisite for morphometric measurement, some applications and development of R applied to basic image analysis is provided as well. The third chapter is designed to guide you within the field of traditional and multivariate morphometrics. The fourth chapter deals with statistical analysis of shape using landmark data, and the fifth chapter presents R applications and developments for the statistical analysis of outlines. The sixth chapter presents statistical analysis considering the specifics of morphometric data (especially those based on landmarks and outlines). This chapter mainly relies on biological applications, but readers will find examples of code that can be applied to other fields. Finally, the last chapter explains how to progress further with R to perform simulation, and to hybridize R with other software for more specialized issues. For some examples, I used original data files (image files, codes, and datasets); these are provided online.[1]

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[1] http://www.springer.com/statistics/stats+life+sci/book/978-0-387-77789-4
and http://www.isem.cnrs.fr/spip.php?article840

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[2] `http://www.morphometrics.org/morphmet.html`
[3] `http://tolstoy.newcastle.edu.au/R`

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