

Abstract

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LINEAR MODELS FOR SOME SHAPE DATA

Technological advances in recent years have a wealth of complex data digital imaging, which analyzed using the principles of effective form analysis. Such data often lies on either high-dimensional infinite dimensional manifolds. Also with computing power not strong enough to deal with this data, it is necessary to develop a sound methodology in theory to the analysis computationally efficient manner. Shape data can be defined as the information remaining to describe the shape of an object after removing the effects of location, rotation and scale. There are numerous techniques in the literature to remove the effects of location, rotation and scale and thereby define and compare the shapes of objects. Everyone knows what is meant by 'shape'. However, it is not a trivial matter to define shape in a manner that is susceptible to mathematical and statistical analysis and it is only over the last two three decades that appropriate definitions have been developed and studied. In this thesis, we tried to give a brief discussion of these ideas. A method, which does not require the removal of the effects of location and rotation, is to define the shape according to the bending of important shape curves. This method can naturally provide a technique for investigating facial shape. When considering a patient's face there are a number of curves which outline the important features of the face. Describing these feature curves gives a large amount of information on the shape of the face. In this thesis, approaches are proposed for analyzing longitudinal three-dimensional data where is presented in a novel application within the area of shape analysis, illustrated by comparing facial skeletal and soft-tissue shape between patients with dental malocclusion before and after orthodontic treatment. Both are anatomical landmarks of facial skeletal and soft-tissue shape. In Chapter 1, an introduction to the linear model considered is presented and it contains a general introduction expressing the definitions and the main information used in the remaining chapters. Moreover, it also highlights some theories and results that are related to the main items of this thesis, Chapter 2 presents the statistical shape definition of a shape and introduces the area of statistical shape analysis in detail, specifically presenting the technicalities of shape space and distances. In some addition methods in the literature in the area of shape analysis are presented. In Chapter 3, the procrustes alignments of a set of shapes to remove unwanted effects are discussed. The concept of tangent coordinates is introduced as a projection of shape data into a Euclidean space, to enable the use of multivariate methods. An outline is given of thin-plate splines and deformations for the analysis of surfaces. It gives a broad overview of some standard shape analysis techniques, including Procrustes methods for alignment of objects, and gives further details of methods based on curvature. Functional data analysis techniques which are of use throughout the thesis are also discussed. In chapter 4, will discuss comparison between Cross-sectional studies and longitudinal studies. Moreover, explain methods that have been developed in the field of landmark-based statistical shape analysis, and apply these methods to an example three-dimensional data set taken from the field of orthodontics. Landmark-based methods apply to shapes that have been represented as a set of landmarks, points, of interest as opposed to shapes that are represented by boundary information this methods is aimed at describing and comparing the shapes of objects. Areas of application are often in fields related to medicine biology, with shapes of interest that are often complex and no geometric. Shape analysis methods allow clinicians and researchers to analyze shape differences and shape changes within individuals, across groups, and over time. These can occur due to growth, varying treatment techniques, natural differences between groups