CBMS Conference on Elastic Functional and Shape Data Analysis (EFSDA)

Introduction

While functional and shape data analysis are old topics in statistics, studied off and on over last several decades, the early years of the new millennium saw a renewed focus and energy in these areas. This focus was both exciting, because it sought new directions and resources, and productive, because it was application-oriented and data driven. This new interest was fueled by many factors, the most prominent among them being increasing availability of large datasets involving structured data, especially in the fields of computer vision and medical imaging. It was also propelled by increases in computation power and storage, a growing interest in Riemannian methods, and a favorable atmosphere for the confluence of ideas from geometry and statistics. Despite a long history of research and methods in function and shape analysis, several groups took a fresh look at shape analysis during this period. As a result, they came up with novel approaches, based on mathematical tools that were new to this community, and made them practical using elegant computational solutions. This goal of the workshop is to provide a self-contained treatment of this new generation of methods in shape analysis of functions, curves and surfaces, with a focus on statistical modeling and inference.

What differentiates this material from past approaches is that it integrates the *registration problem* into shape analysis. Registration is concerned with matching of points across objects when their shapes are being compared and quantified. The past methods mostly treated registration as a pre-processing step, handled using an arbitrary off the shelf technique, followed by an unrelated metric for shape comparison. Instead, this approach seeks a unified, comprehensive solution. It develops elegant Riemannian frameworks that provide both quantification of shape differences and registration of curves at the same time. Additionally, these methods are used for statistically summarizing given curve data, performing dimension reduction, and modeling the observed variability. This material investigates different mathematical representations and associated (invariant) Riemannian metrics that play a role in facilitating shape analysis. The focus is largely on certain square-root representations that *flatten* shape spaces and allow more traditional vector-space-based statistical analyses to become applicable.

This workshop is intended for researchers who are interested in improving their skills in this broad interdisciplinary problem area. These participants can be from statistics, engineering, applied mathematics, neuroscience, biology, bioinformatics, and other related areas.