Efficient Algorithms for Statistical Analysis of Manifold-valued Data with Applications*

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Abstract

With the advent of new sensing technologies and high powered computing resources, manifold-valued data sets have become ubiquitous in Science and Engineering. The most commonly encountered examples are matrix-valued fields e.g., diffusion tensor, structure tensor, covariance matrix and probability density fields respectively. Since these data do not live in a vector space, standard vector-space operations to process them are inappropriate and mathematical tools borrowed from the field of Differential Geometry are required. As in conventional image analysis, it will be useful to compute statistics from these data sets in order characterize the data quantitatively. Once again, it is important to respect the geometry of the space in which these data lie and hence one has to rely on manifold-valued statistics. In this talk, I will present algorithms for efficiently computing the Fréchet (intrinsic) mean of the manifold-valued data as well as the Principal Geodesic Analysis (PGA). Several applications of the aforementioned algorithms to data drawn from the domains of Computer Vision and Medical Image Analysis will be presented interspersed during the talk.

*This research was in part funded by the NIH grant NS066340 and the NSF grant IIS-1525431.