

# Nonparametric Bayes inference on manifolds with applications to hypersphere and shape spaces

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**Abstract:** Statistical inference on non-Euclidean manifolds has lot of applications in biology, image analysis, machine vision, dimension reduction problems, spatial modelling and many other fields. The manifolds arising in many such applications are the so called landmark based shape spaces. The planar shape space, for example, is the space of all similarity shapes of images in 2D consisting of say  $k$  points or landmarks (or  $k$ -ads).

A fundamental problem in nonparametric inference is density estimation. In my talk I will present nonparametric Bayes density modelling techniques using random kernel mixtures on general compact metric spaces and on manifolds in particular, especially on the unit sphere and the planar shape space.

I will present sufficient conditions on the kernel, prior and the underlying space for the density model to have full support and for weak and strong posterior consistency at any true density. The theory will be extended to consider sample dependent priors for which the conditions for consistency will be shown to be relaxed. Suitable kernels will be presented on the hypersphere and the planar shape space which satisfy these regularity conditions.

Density estimation will be extended to perform classification, i.e. regression with the feature variable lying on a manifold and a categorical response. As a special case, nonparametric Bayes hypothesis testing to distinguish between two or more distributions on a manifold will be performed.

Applications of shape and spherical data analysis using real and simulated examples will be presented. For example the shape of a gorilla skull will be used to predict its gender while random samples on the hypersphere will be used to discriminate between their underlying distributions.

This talk is based on joint work with Prof. R. Bhattacharya and Prof. D. Dunson.