Quantifying variation in manifolds using data depth

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Abstract: Several statistical methods such as principal component analysis and analysis of variance are effective in analyzing variation in high dimensional data when the space of variation is linear. However, describing variability is much more difficult when the data varies along nonlinear modes. Simple examples of nonlinear variation in functional data are horizontal shift of curves of common shape, frequency change of acoustic signals of common shape, or lighting change in images of the same object. This presentation shows novel data depth functions that would extend data depth concepts to describe variation of multivariate data when the space of variation is a manifold or the result of nonlinear variation in the data. We propose new ways of defining depth in manifolds which respect the geometry of the support of the distribution. We illustrate these new depth measures for Riemannian manifolds of non-negative curvature.