Multivariate Functional Halfspace Depth

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In functional analysis the observations typically consists of one set of curves, measured at a discrete set of time points. We consider multivariate functional data, where the measurements consists of several sets of curves, measured at the same time points. We propose a new depth function for this type of data, called multivariate functional halfspace depth (MFHD). A population version of this depth function is defined and its properties are studied.

This depth function can for example also be applied to observed curves and their derivatives, or to warped curves and their warping functions. It allows to estimate the central tendency of the curves, and to estimate the variability among the curves. We show how our multivariate approach yields better estimates than existing depth functions for univariate curves.

We also illustrate how MFHD can be useful to detect globally outlying curves as well as curves that are only outlying on parts of their domain. Finally its usefullness for the classification of new curves is shown.

Key Words: statistical depth, functional data, time warping, multivariate data.