

Supplementary materials of “Statistical analysis of locally parameterized shapes”. Simulation code documentation.

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March 12, 2022

1 Description

Simulation of discrete skeletal representation (ds-rep). The simulation is based on a ds-rep template obtained from SlicerSALT toolbox (Vicory et al., 2018). The skeletal PDM consists of 71 numbered points. Each point represents a location of a frame as depicted in Figure 1. Frame #16 is the s-centroid frame.

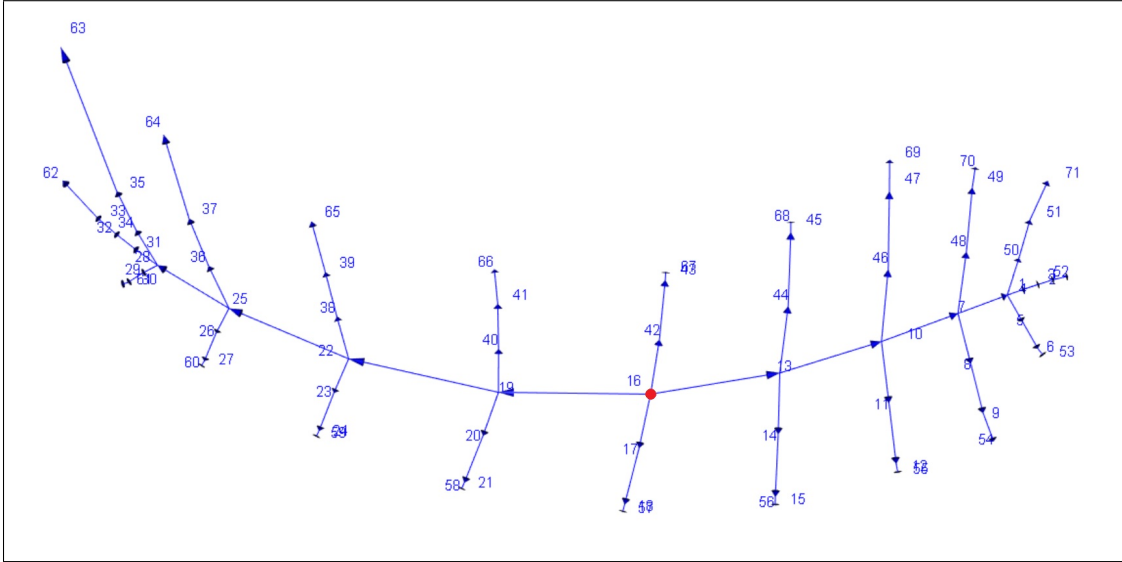


Figure 1: Frame indices. Frame #16 is the s-centroid frame.

1.1 Required libraries

The required libraries are: “fields” v13.3, “viridis” v0.6.2, “viridisLite” v0.4.0, “spam” v2.7, “dotCall64” v1.0, “ks” v1.13.2, “rotations” v1.6.3, “dplyr” v1.0.7, “ggplot2”

v3.3.5, “numDeriv” v2016.8.1, “pracma” v2.3.3, “truncnorm” v1.0, “Directional” v5.2, “data.table” v1.14.2, “RiemBase” v0.2.5, “matlib” v0.9.5, “rgl” v0.108.3, and “shapes” v1.2.6.

2 Code

The “main.R” file consists of two parts.

Part I: Loading libraries, functions, and the simulation data. The applicant should be able to load the ds-rep template by command `load(“simulationData.RData”)`. The Windows 10 environment is recommended.

Part II: Running the function “ds_rep_Analysis”. The arguments of the function are described in Table 1. The function generates two groups of ds-reps. Then based on the type of analysis (i.e., LP-ds-rep, GP-ds-rep, and EDMA), generates a set of plots to show the significant GOPs as discussed in the main manuscript.

References

Dhillon IS, Sra S (2003) Modeling data using directional distributions. Tech. rep., Citeseer

Jung S, Dryden IL, Marron J (2012) Analysis of principal nested spheres. *Biometrika* 99(3):551–568

Vicory J, Pascal L, Hernandez P, Fishbaugh J, Prieto J, Mostapha M, Huang C, Shah H, Hong J, Liu Z, et al. (2018) Slicersalt: Shape analysis toolbox. In: International Workshop on Shape in Medical Imaging, Springer, pp 65–72, URL <http://salt.slicer.org/>

ds_rep_Analysis	
Argument	Value
simulationData	ds-rep template for the simulation.
typeOfAnalysis	“LP_ds_rep”: LP-ds-rep analysis. “GP_ds_rep”: GP-ds-rep analysis. “EDMA”: EDMA analysis of the skeletal PDMs.
typeOfStudy	“shapeAnalysis”: Study with scaling. “sizeAndShapeAnalysis”: Study without scaling.
typeOfStudy4directions	“PNS”: Euclideanization by PNS residuals (Jung et al., 2012). “tangent space”: Euclideanization by mapping data to the tangent space.
typeOfMeanDirection	“PNS”: PNS mean for spherical data. “Frechet”: Fréchet mean for spherical data.
typeOfTest	“Permutaion”: Hypothesis testing by permutation. “Parametric”: Hypothesis testing by Hotelling’s T^2 test with normality assumption.
nSamplesG1	A natural number. Number of simulations for the first group.
nSamplesG2	A natural number. Number of simulations for the second group.
rotatingSpinalFramesId	A vector of indices of the spinal frames subject to the bending. Default frames are #19, #22, #25.
rotateAboutWhichAxis	1, 2, and 3 for the bending axis.
thetaG1	A real number in $[-\frac{\pi}{2}, \frac{\pi}{2}]$ as the degree of bending (upward, and downward) of the first group.
thetaG2	A real number in $[-\frac{\pi}{2}, \frac{\pi}{2}]$. as the degree of bending (upward, and downward) of the second group.
kappa(1-4)	A real number as the concentration parameter of von Mises-Fisher distribution for directional data (Dhillon and Sra, 2003).
noiseSDradii	A real number as a standard deviation of the truncated normal distribution for adding noise to the spokes’ lengths.
noiseSDConnectionLength	A real number as a standard deviation of the truncated normal distribution for adding noise to the connections’ lengths.

Table 1: Simulation parameters.