Properties for the Fréchet mean in Billera-Holmes-Vogtmann tree space. (English)


Summary: The Billera-Holmes-Vogtmann (BHV) space of weighted trees can be embedded in Euclidean space, but the extrinsic Euclidean mean often lies outside of tree space. Sturm showed that the intrinsic Fréchet mean exists and is unique in tree space. This Fréchet mean can be approximated with an iterative algorithm, but bounds on the convergence of the algorithm are not known, and there is no other known polynomial algorithm for computing the Fréchet mean nor even the edges present in the mean. We give the first necessary and sufficient conditions for an edge to be in the Fréchet mean. The conditions are in the form of inequalities on the weights of the edges. These conditions provide a pre-processing step for finding the tree space orthant containing the Fréchet mean. This work generalizes to orthant spaces.

MSC:

62R20 Statistics on metric spaces
62H22 Probabilistic graphical models
62P10 Applications of statistics to biology and medical sciences; meta analysis
92D10 Genetics and epigenetics

Keywords:
Fréchet mean; phylogenetic trees; non-positively curved spaces

Software:
SageMath

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References:


[26] Vogtmann, K., Geodesics in the space of trees (2007), Last accessed July 31, 2018


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