

Implicit Diffeomorphisms Using Gaussian Mixtures

Geometry, Probability

Problem

Sometimes you need a probabilistic representation of a differentiable mapping, and for many reasons having it in Gaussian Mixture form is useful.

Gaussian Mixtures are commonly fitted to data using expectation maximization. The algorithm is not guaranteed to converge to the optimum, is data hungry, and can be computationally expensive.

The project will explore the construction, implementation, and evaluation of such geometry-induced Gaussian mixtures. Possible directions include:

- Constructing local Gaussian components from a partition of the parameter domain.
- Propagating local probability density function through the push forward of the mapping.
- Investigating the resulting joint, forward, and inverse probabilistic representations.
- Studying the influence of the partition and local approximation on the quality of the representation.

Prerequisites

- Firm grasp over Linear/Multilinear Algebra and Analysis
- Good understanding of Probability and Statistics
- PYTORCH or an equivalent NUMPY-like framework
- Some exposure to Differential Geometry is advantageous
- Interest in numerical methods and mathematical modelling

References

- Introduction to Topological Manifolds by John Marshall Lee
- Introduction to Smooth Manifolds by John Marshall Lee
- Introduction to Riemannian Manifolds by John Marshall Lee
- A Geometric Gaussian Mixture Representation of Plane Curves by Ali Darijani, Benedikt TStratmann, Jürgen Beyerer
- Closed-Form Gaussian Mixture Representations of d-Dimensional Triangulated Domains by Ali Darijani, Benedikt Stratmann, Uwe D. Hanebeck, Ratan Bahadur Thapa, Jürgen Beyerer, Nehal Afifi

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