Geometric Gaussian Mixture Learning of Plane Curves

Probability, Geometry

Topic

A deterministic plane may/curve can be represented probabilistically by a Gaussian Mixture (GM), providing access to probabilistic tools for uncertainty representation and propagation.

Conventionally, GMs are learned from sampled data using Expectation Maximization (EM), requiring both sampling and an iterative fitting procedure. This project investigates whether the geometry of a plane curve can instead be used to construct its corresponding GM directly.

Problem

The central question of this thesis is:

Can a Gaussian Mixture (GM) representation of a plane curve be constructed directly from its geometry, without sampling and Expectation Maximization?

The thesis will investigate geometry-induced Gaussian Mixture (GM) for planar curves, focusing on local and global geometric approximations and their probabilistic interpretation.

Prerequisites

- Firm grasp of Linear/Multilinear Algebra and Analysis
- PyTorch or an equivalent NumPy-like framework
- Some exposure to Functional Analysis and Differential Geometry is advantageous

References

- A Geometric Gaussian Mixture Representation of Plane Curves by Ali Darijani, Benedikt Stratmann, 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

Contact:
Ali Darijani
ali.darijani@iosb.fraunhofer.de ali.darijani@kit.edu ali.darijani@rwth-aachen.de
KIT/Fraunhofer Building 70.16, R124