A Nonparametric Riemannian Framework on Tensor Field with Application to Foreground Segmentation

**Motivation**: Nonparametrically reformulate the existing tensor-based GMM algorithms. The idea is to allow the data to show the underlying structure, instead of imposing one.

**Issue**: applying a nonparametric approach outside Euclidean spaces isn’t trivial and requires use of differential geometry to deal with the Riemannian structure and curvature of the manifold.

**Our Approach**: Founded on the mathematically rigorous KDE paradigm on general Riemannian manifolds we define a KDE specifically to operate on the tensor manifold.

\[
f_{N,K}(Z) = \frac{1}{N} \sum_{i=1}^{N} \frac{1}{\theta_{Z_i}(Z)} \frac{1}{h^n} K\left(\frac{D(Z,Z_i)}{h}\right)
\]

\[
\theta_p(Q) = \frac{\mu_{\exp_p g}}{\mu_g} (\exp_p^{-1} Q)
\]

The tensor manifold is endowed with two well-founded Riemannian metrics:

- **Affine-Invariant**
- **Log-Euclidean**