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Riemannian Approaches to Feature Extraction and Intelligent Recognition Systems

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Abstract

Dimensionality reduction is essential for analyzing high-dimensional data, which often contains redundant information and increases computational costs. In applications like face recognition, high-resolution images require projection onto lower-dimensional subspaces that preserve their intrinsic structure.

Riemannian optimization addresses this by operating directly on smooth manifolds, using concepts like tangent spaces, gradients, and geodesics [1], [2], [3], [4], [5], [6], [7].

This work introduces Riemannian geometry principles and explores methods such as Riemannian Gradient Descent, Stochastic Gradient Descent, and the Stochastic Variance Reduced Gradient, providing a solid framework for dimensionality reduction and recognition tasks on Grassmann and Stiefel manifolds [8].

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