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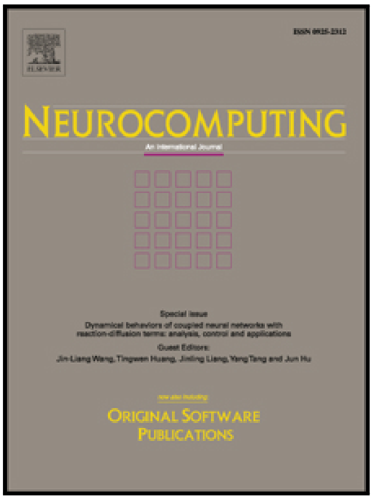

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Abstract

Subspace segmentation is to group a given set of n data points into multiple clusters, with each cluster corresponding to a subspace. Prevalent methods such as Sparse Subspace Clustering (SSC) and Low-Rank Representation (LRR) are effective in terms of segmentation accuracy, but computationally inefficient while applying to gigantic datasets where n is very large as they possess a complexity of $O(n^3)$. In this paper, we propose an iterative method called Random Sample Probing (RANSP). In each iteration, RANSP finds the members of one subspace by randomly choosing a data point (called "seed") at first, and then using Ridge Regression (RR) to retrieve the other points that belong to the same subspace as the seed. Such a procedure is repeated until all points have been classified. RANSP has a computational complexity of $O(n)$ and can therefore handle large-scale datasets. Experiments on synthetic and real datasets confirm the effectiveness and efficiency of RANSP.

Keywords: clustering, subspace segmentation, large-scale, random sample probing

1. Introduction

Subspace segmentation assumes that the data points can be clustered into different groups and every group can be fitted with a low dimensional subspace, which has been widely used in serval areas such as machine learning, signal processing, data mining, and machine vision [1, 2, 3, 4, 5, 6].

In the past several years, subspace segmentation have attracted much attention, and many statistical methods have been proposed and investigated in the literature. To deal with low-dimensional data (e.g., 3D data in computer graphics), Random Sample Consensus (RANSAC) [7], which estimate the model of subspaces is an iterative fashion, is probably the most widely used method due to its high efficiency and effectiveness. However, RANSAC is inappropriate for high-dimensional data, because its time consumption will increase exponentially as the dimension of data. Moreover, the segmentation accuracy produced by RANSAC may drop fast when the data dimension goes high. K-Subspace [8], a generalization of the well-known K-Means [9] method, may apply to high-dimensional data, but suffers from the problem of local minimum and thus can only achieve limited performance in many subspace