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Editorial of the Special Issue on Manifold Learning

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In many information analysis tasks, one is often confronted with thousands to millions dimensional data, such as images, documents, videos, web data, bioinformatics data, etc. Conventional statistical and computational tools are severely inadequate for processing and analysing high-dimensional data due to the curse of dimensionality, where we often need to conduct inference with a limited number of samples. On the other hand, naturally occurring data may be generated by structured systems with possibly much fewer degrees of freedom than the ambient dimension would suggest. Recently, various works have considered the case when the data is sampled from a submanifold embedded in the much higher dimensional Euclidean space. Learning with full consideration of the low dimensional manifold structure, or specifically the intrinsic topological and geometrical properties of the data manifold is referred to as manifold learning, which has been receiving growing attention in our community in recent years.

This special issue is to attract articles that (a) address the frontier problems in the scientific principles of manifold learning, and (b) report empirical studies and applications of manifold learning algorithms, including but not limited to pattern recognition, computer vision, web mining, image processing and so on. A total of 13 submissions were received. The papers included in this special issue are selected based on the reviews by experts in the subject area according to the journal's procedure and quality standard. Each paper is reviewed by at least two reviewers and some of the papers were revised for two rounds according to the reviewers' comments.

The special issue includes 6 papers in total: 3 papers on the foundational theories of manifold learning, 2 papers on graph-based methods, and 1 paper on the application of manifold learning to video compression. The papers on the foundational theories of manifold learning cover the topics about the generalization ability of manifold learning, manifold ranking, and multi-manifold factorization.

In the paper entitled "Manifold Learning: Generalizing Ability and Tangential Proximity", Bernstein and Kuleshov propose a tangential proximity based technique to address the generalized manifold learning problem. The proposed method ensures not only proximity between the points and their reconstructed values but also proximity between the corresponding tangent spaces.

The traditional manifold ranking methods are based on the Laplacian

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regularization, which suffers from the issue that the solution is biased towards constant functions. To overcome this issue, in the paper entitled "Manifold Ranking using Hessian Energy", Guan et al. propose to use the second-order Hessian energy as regularization for manifold ranking.

In the paper entitled "Multi-Manifold Concept Factorization for Data Clustering", Li et al. incorporate the multi-manifold ensemble learning into concept factorization to better preserve the local structure of the data, thus yielding more satisfactory clustering results.

The papers on graph-based methods cover the topics about label propagation and graph-based dimensionality reduction.

In the paper entitled "Bidirectional Label Propagation over Graphs", Liu et al. propose a novel label propagation algorithm to propagate labels along positive and negative edges in the graph. The construction of the graph is novel against the conventional approach by incorporating the dissimilarity among data points into the affinity matrix.

In the paper entitled "Locally Regressive Projections", Lijun Zhang proposes a novel graph-based dimensionality reduction method that captures the local discriminative structure of the data space. The key idea is to fit a linear model locally around each data point, and then use the fitting error to measure the performance of dimensionality reduction.

In the last paper entitled "Combining Active and Semi-Supervised Learning for Video Compression", motivated from manifold regularization, Zhang and Ji propose a machine learning approach for video compression. Active learning is used to select the most representative pixels in the encoding process, and semi-supervised learning is used to recover the color video in the decoding process. One remarking property of this approach is that the active learning algorithm shares the same loss function as the semi-supervised learning algorithm, providing a unified framework for video compression.

Many people have been involved in making this special issue possible. The guest editor would like to express his gratitude to all the contributing authors for their insightful work on manifold learning. The guest editor would like to thank the reviewers for their comments and useful suggestions in order to improve the quality of the papers. The guest editor would also like to thank Prof. Ruqian Lu, the editor-in-chief of the International Journal of Software and Informatics, for providing the precious opportunity to publish this special issue. Finally, we hope the reader will enjoy this special issue and find it useful.

Guest Edtior:

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