Abdolali, Maryam; Gillis, Nicolas
Beyond linear subspace clustering: a comparative study of nonlinear manifold clustering algorithms. (English) Zbl 1486.68139
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Summary: Subspace clustering is an important unsupervised clustering approach. It is based on the assumption that the high-dimensional data points are approximately distributed around several low-dimensional linear subspaces. The majority of the prominent subspace clustering algorithms rely on the representation of the data points as linear combinations of other data points, which is known as a self-expressive representation. To overcome the restrictive linearity assumption, numerous nonlinear approaches were proposed to extend successful subspace clustering approaches to data on a union of nonlinear manifolds. In this comparative study, we provide a comprehensive overview of nonlinear subspace clustering approaches proposed in the last decade. We introduce a new taxonomy to classify the state-of-the-art approaches into three categories, namely locality preserving, kernel based, and neural network based. The major representative algorithms within each category are extensively compared on carefully designed synthetic and real-world data sets. The detailed analysis of these approaches unfolds potential research directions and unsolved challenges in this field.

MSC:
68T05 Learning and adaptive systems in artificial intelligence
62H30 Classification and discrimination; cluster analysis (statistical aspects)
62R07 Statistical aspects of big data and data science
62R30 Statistics on manifolds
68T07 Artificial neural networks and deep learning
62-02 Research exposition (monographs, survey articles) pertaining to statistics
68-02 Research exposition (monographs, survey articles) pertaining to computer science

Keywords:
subspace clustering; nonlinear subspace clustering; manifold clustering; Laplacian regularization; kernel learning; unsupervised deep learning; neural networks

Software:
mctoolbox

Full Text: DOI arXiv

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