Defense Announcement

SEMI-SUPERVISED AND DEEP LEARNING IN OPTIMAL SUBSPACES FOR CLASSIFICATION OF DISPARATE HYPERSPECTRAL DATA

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Recent developments in remote sensing allow us to acquire enormous quantities of data via ground-based, airborne, and spaceborne platforms. Hyperspectral imagery (HSI) is a special type of remote sensing data, which not only captures spatial information over large areas, but also can provide rich spectral information of objects in the scene. The high spectral and spatial resolution hyperspectral images hence provide unprecedented capability for mapping and monitoring over extended areas. On the other hand, these data pose multiple challenges on image classification techniques, especially when the labeled reference data are not sufficient for training reliable models. In this dissertation, we present new frameworks for the classification of hyperspectral images with limited labeled data, potentially collected from different sensors and platforms. Specifically, we introduce new active and semi-supervised learning approaches that can enable creation of interactive and efficient training libraries. By utilizing the contextual information in both spatial and spectral domains, new querying strategies (metrics) are proposed to intelligently select samples for labeling such that the best classification performance can be achieved with the least amount of reference data. We also propose a transformation learning based domain adaptation algorithm that enables effective classification of data in the target-domain using limited source-domain data. An optimal subspace is constructed through jointly optimizing feature discriminability and aligning class distributions among data sources. Within this optimal subspace, labeled data from the supplementary data source can be used to improve the classification performance in the domain where limited labeled data is available. We further extend the domain adaptation algorithm into a deep learning framework, where a large amount of labeled data from the supplementary data source can be used to create domain-invariant and discriminative features for building robust classification model. We evaluate the proposed methods on several hyperspectral datasets and use them to solve real-world hyperspectral image classification problems. The results from extensive experiments demonstrate the efficacy of the proposed approaches compared to the state-of-the-art in hyperspectral image classification.