Defense Announcement

Semi-supervised and Deep Learning for Hyperspectral Image Analysis

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Hyperspectral imaging is a technique which uses hyperspectral sensors to collect spectral information across the electromagnetic spectrum for each pixel in the image of a scene, with the purpose of identifying materials and detecting objects. The recorded hyperspectral data cover a wide range of wavelengths including visible and invisible light. The rich spectral information provides much more precise characteristics of materials, compared to natural color images. With such a wealth of spectral information, hyperspectral images have a variety of applications in remote sensing, such as target detection and land cover classification. In this dissertation, new algorithms and methods for semi-supervised learning and deep learning are proposed for hyperspectral image analysis. Specifically, a new semi-supervised dimensionality reduction algorithm named Semi-supervised Local Fisher Discriminant Analysis (SLFDA) is proposed to find a lower dimensional subspace for the high dimensional hyperspectral data, aiming to perform discriminant analysis on both labeled and unlabeled samples. Another semi-supervised learning system is also proposed that uses active learning to detect and identify unknown classes in a scene. We also present a deep learning method based on convolutional recurrent neural networks (CRNN) for hyperspectral data classification. Furthermore, a novel semi-supervised deep learning method that combines deep learning with semi-supervised learning is proposed for hyperspectral image classification. With extensive experiments on several real-world hyperspectral image datasets, we demonstrate that the proposed methods significantly outperform the state-of-the-art.