

Classification of Large-Scale High-Resolution SAR Images With Deep Transfer Learning

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Abstract:

The classification of large-scale high-resolution synthetic aperture radar (SAR) land cover images acquired by satellites is a challenging task, facing several difficulties such as semantic annotation with expertise, changing data characteristics due to varying imaging parameters or regional target area differences, and complex scattering mechanisms being different from optical imaging. Given a large-scale SAR land cover data set collected from TerraSAR-X images with a hierarchical three-level annotation of 150 categories and comprising more than 100 000 patches, three main challenges in automatically interpreting SAR images of highly imbalanced classes, geographic diversity, and label noise are addressed. In this letter, a deep transfer learning method is proposed based on a similarly annotated optical land cover data set (NWPU-RESISC45). Besides, a top-2 smooth loss function with cost-sensitive parameters was introduced to tackle the label noise and imbalanced classes' problems. The proposed method shows high efficiency in transferring information from a similarly annotated remote sensing data set, a robust performance on highly imbalanced classes, and is alleviating the overfitting problem caused by label noise. What is more, the learned deep model has a good generalization for other SAR-specific tasks, such as MSTAR target recognition with a state-of-the-art classification accuracy of 99.46%.

Keywords: High-resolution (HR) synthetic aperture radar (SAR) images, label noise, land cover classification, TerraSAR-X (TSX), transfer learning