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Automatic Interferogram Selection for SBAS-InSAR Based on Deep Convolutional Neural Networks

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The small baseline subset of spaceborne interferometric synthetic aperture radar (SBAS-InSAR) technology has become a classical method for monitoring slow deformations through time series analysis with an accuracy in the centimeter or even millimeter range. Additionally, the process of calculating interferograms itself directly affects the accuracy of the SBAS-InSAR measurements, whereby the selection of high-quality interferogram pairs is crucial for SBAS data processing. Especially in the era of big data, the demand for an automatic and effective selection method of high-quality interferograms in SBAS-InSAR technology is growing. However, there are some methods including simulated annealing (SA) searching strategy, the graph theory (GT) and others. Until now, the most effective approach of high-quality interferogram selection still relies on the traditional manual method. Due to the high degree of human interaction and a large risk of repetitive work, this traditional manual method increases the instability and inconsistency of the deformation calculation.
Considering that the different qualities of interference pairs show different color characteristics, the DCNN method is adopted in this study. The ResNet50 model (one of DCNN models) has the advantages of representing a standard network structure and easy programming. The idea is based on the fact that interferograms less contaminated by different noise sources display smaller color phase changes within a certain phase range. Hence, training sets containing almost 3000 interferograms obtained from land subsidences in several subregions of Shenzhen in China with varying contaminations of noise were established. Up next, the ResNet50–DCNN model was set up, the respective parameters were determined through analysis of the data sets trained, and traditional interferogram selection methods were used to evaluate the performance. For simulation experiments and the evaluation and validation of real data, phase unwrapping interferograms obtained by the time-spatial baseline threshold method are used to classify high and low quality interferograms based on the ResNet50 model. The quantity of high quality interferograms extracted by the ResNet50–DCNN method is above 90% for the simulation experiment and above 87% concerning the real data experiment, which reflects the accuracy and reliability of the proposed method. A comparison of the overall surface subsidence rates and the deformation information of local PS points reveals little difference between the land subsidence rates obtained by the ResNet50–DCNN method and the actual simulations or the manual method. The proposed advanced method provides an automatized and fast interferogram selection

process for high quality data, which contributes significantly to the application of SBAS-InSAR engineering. For future research, we will expand the training samples and study DCNN models to further improve the general accuracy for a wider applicability of this method.