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Application of Deep Learning to Detect Ground Deformation in InSAR Data

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Satellite interferometric synthetic aperture radar (InSAR) can be used for measuring surface deformation for a variety of applications. Recent satellite missions, such as Sentinel-1, produce a large amount of data, meaning that visual inspection is impractical. Here we use deep learning, which has proved successful at object detection, to overcome this problem. Initially we present the use of convolutional neural networks (CNNs) for detecting rapid deformation events, which we test on a global dataset of over 30,000 wrapped interferograms at 900 volcanoes. We compare two potential training datasets: data augmentation applied to archive examples and synthetic models. Both are able to detect true positive results, but the data augmentation approach has a false positive rate of 0.205% and the synthetic approach has a false positive rate of 0.036%. Then, I will present an enhanced technique for measuring slow, sustained deformation over a range of scales from volcanic unrest to urban sources of deformation such as coalfields. By rewrapping cumulative time series, the detection performance is improved when the deformation rate is slow, as more fringes are generated without altering the signal to noise ratio. We adapt the method to use persistent scatterer InSAR data, which is sparse in nature, by using spatial interpolation methods such as modified matrix completion Finally, future perspectives for machine learning applications on InSAR data will be discussed.