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InSAR phase unwrapping using Graph neural networks

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Advancements in processing strategies of time series interferometric synthetic aperture radar (InSAR) has resulted in improved deformation monitoring and DEM generation. Both of the applications use phase unwrapping, which involves finding and adding the unknown correct number of phase cycles to the wrapped phase. It is an inverse process of recovering the absolute phase from the wrapped phase, and the objective is to remove the 2π-multiple ambiguity. Ideally, it could be achieved by addition or subtraction of 2π at each pixel depending on the phase difference between the neighboring pixels. The problem appears effortless but brings challenges due to noise and inconsistencies. The conventional methods require improvements in terms of accurately estimating the unknown number of phase cycles and dealing with phase jumps. Recently, deep learning methods have been used extensively in the domain of remote sensing to solve complex image processing problems such as object detection and localization, image classification, etc. Since all the pixels in a stack of interferograms are not used in unwrapping, and the pixels used are scattered irregularly, modeling the unwrapping problem as an image classification problem is infeasible. In this work, we deploy Graph Neural Networks (GNNs), a class of deep learning methods designed to infer information from input graphs to solve the unwrapping problem. Phase unwrapping can be posed as a node classification problem using GNN, where each pixel is treated as a node. The method is aimed to exploit the capability of GNNs in correctly predicting the phase count of each pixel. The proposed work aims to improve the computational efficiency and accuracy of the unwrapping process, resulting in reliable estimation of displacement.