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3-D synthetic aperture radar interferometry phase unwrapping using extended Kalman filters

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Abstract. Synthetic Aperture Radar Interferometry (InSAR) observations allow researchers to map elevations, analyze surface deformation, and even detect ground water level changes from satellites orbiting the Earth. The InSAR phase measurements are inherently wrapped between 0 and 2π. For most physical interpretation methods the phase measurements have to be unwrapped to reveal the full scale of the observations. The unwrapping of multi-dimensional phase data is still a field of active research and here we present an algorithm using an Extended Kalman Filter (EKF).

The current implementation of our EKF algorithm utilizes a piecewise linear approximation in space and a simple model in the third dimension (e.g. time). The algorithm starts from wrapped, unfiltered interferograms and filters and unwraps the results at the same time solving for a common topography or deformation rate, starting from the highest quality point in the coherent area and proceeding to unwrap highest quality neighbors. The highest quality neighbors are determined according to the Fisher's Distance, which is a phase quality measure similar to the more commonly used phase derivative variance, but also includes the interferogram coherence. In this presentation we demonstrate the effectiveness of our algorithm for the applications of DEM generation and deformation rate analysis using real data.

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