

Prediction and Modeling of the San Francisco Bay area transients using Interferometric Synthetic Aperture Radar

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Abstract

Interferometry relies on the constructive and destructive interference of electromagnetic waves from sources at two or more vantage points at different times. For InSAR, the interference pattern is constructed from two complex-valued synthetic aperture radar images, and interferometry is the study of the phase difference between two images which can be inverted to give surface topography and ground displacements. Synthetic aperture radar (SAR) data were collected over the San Francisco Bay Area by the European Space Agency (ESA) using the ERS-1 and ERS-2 spacecraft from 1992 to 2000 in 46 epochs. The data are time series of surface displacements for different latitude-longitude values. Two sections: The Santa Clara Valley and the Loma Preita region have been chosen for specific analysis due to the proven transient phenomena observed in both the regions. Identification of seasonal variations, DC offsets and separating them from tectonically caused variations is done using functional analysis and principal component analysis. Frequency related components are separated, frequency content evaluated using Empirical Mode Decomposition and the seasonal modes assessed. Modeling of the Loma Preita section is initiated via Kalman Filtering using a 2 fault model, one reverse and one strike slip near the SAF zone. Green's functions are calculated using Okada's technique and random walk probabilistic parameters determined. The slip histories on faults thus found via the Network Inversion Filter are dependent only on tectonics and results may be checked with those from the previous tools.

Key words: InSAR, San Francisco Bay Area, Loma Preita, Santa Clara, Principal Component Analysis, Empirical Mode Decomposition, Hilbert Spectrum, Kalman Filtering, Network Inversion Filter.