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A new algorithm to correct DInSAR maps with GPS data

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In this poster we describe the rationale at the base of a new algorithm developed to constrain DInSAR maps with GPS measurements.
DInSAR data are always affected by several misleading features. Some of them (white noise, atmospheric artefacts) need to be managed statistically in terms of data uncertainty; some other (offset, ramps, flat earth, local discontinuities) are due to inadequate reference points, inaccurate orbit modelling, unwrapping errors and can be analytically modelled. However, when DInSAR data are used to measure low-gradient, regional velocity fields, as those resulting from interseismic strain accumulation or from post-seismic strain release, the issue of attributing a ramp-like signal to a tectonic deformation can be difficult.
GPS, on the contrary, is referred to a global reference frame (ITRF) and is an absolute measure, though rotational (Euler) poles or average values have to be removed when studying a local phenomenon.
In this work we present an algorithm to correct a DInSAR map with GPS measurements, modelling the differences in terms of an analytical equation (in the simplest case describing an offset and a tilt) by means of a weighted least square linear inversion.
Mandatory inputs to the algorithm are a DInSAR raster map and GPS data provided in a standard SINEX format. As a first step, GPS data and the relative uncertainties are projected into the radar line-of-sight, using the SAR satellite state vectors.
At every GPS stations the value of the DInSAR map is calculated with a local Kriging interpolation; if the Kriging parameters are not supplied, an additional DInSAR map containing only noise is required to build the full variance/covariance matrix.
The mismatch between GPS and DInSAR is analytically modelled with a weighted linear inversion of the differences, where the weights are based on the data uncertainty. The GPS variance/covariance matrix is contained in the SINEX file while for DInSAR can be calculated with the supplied additional map. The data uncertainty is also propagated to the model parameters for a quantitative assessment of the solution.
The results are produced in a GIS format and the processing information are stored as alphanumeric attributes.
This algorithm can be used to correct either a DInSAR displacement map or a mean velocity map from a time-series (e.g. Small BAselines Subset, Permanent Scatterers) processing. We show the results of C-, X- and L-band corrected DInSAR maps for the 2009 L'Aquila earthquake, with a short discussion on the consequent advantages in the geophysical modelling.