Geophysical Research Abstracts
Vol. 19, EGU2017-18333, 2017
EGU General Assembly 2017
© Author(s) 2017. CC Attribution 3.0 License.

Seeing the unseen: Complete volcano deformation fields by recursive filtering of satellite radar interferograms

Pablo J. Gonzalez
University of Liverpool, COMET & LEO. Department of Earth, Ocean and Ecological Sciences, Liverpool, United Kingdom (pjgonzal@liverpool.ac.uk)

Automatic interferometric processing of satellite radar data has emerged as a solution to the increasing amount of acquired SAR data. Automatic SAR and InSAR processing ranges from focusing raw echoes to the computation of displacement time series using large stacks of co-registered radar images. However, this type of interferometric processing approach demands the pre-described or adaptive selection of multiple processing parameters. One of the interferometric processing steps that much strongly influences the final results (displacement maps) is the interferometric phase filtering. There are a large number of phase filtering methods, however the “so-called” Goldstein filtering method is the most popular [Goldstein and Werner, 1998; Baran et al., 2003]. The Goldstein filter needs basically two parameters, the size of the window filter and a parameter to indicate the filter smoothing intensity. The modified Goldstein method removes the need to select the smoothing parameter based on the local interferometric coherence level, but still requires to specify the dimension of the filtering window. An optimal filtered phase quality usually requires careful selection of those parameters. Therefore, there is an strong need to develop automatic filtering methods to adapt for automatic processing, while maximizing filtered phase quality.

Here, in this paper, I present a recursive adaptive phase filtering algorithm for accurate estimation of differential interferometric ground deformation and local coherence measurements. The proposed filter is based upon the modified Goldstein filter [Baran et al., 2003]. This filtering method improves the quality of the interferograms by performing a recursive iteration using variable (cascade) kernel sizes, and improving the coherence estimation by locally defringing the interferometric phase. The method has been tested using simulations and real cases relevant to the characteristics of the Sentinel-1 mission. Here, I present real examples from C-band interferograms showing strong and weak deformation gradients, with moderate baselines (∼100-200 m) and variable temporal baselines of 70 and 190 days over variable vegetated volcanoes (Mt. Etna, Hawaii and Nyragongo-Nyamulagira). The differential phase of those examples show intense localized volcano deformation and also vast areas of small differential phase variation.

The proposed method outperforms the classical Goldstein and modified Goldstein filters by preserving subtle phase variations where the deformation fringe rate is high, and effectively suppressing phase noise in smoothly phase variation regions. Finally, this method also has the additional advantage of not requiring input parameters, except for the maximum filtering kernel size.

References:
Baran, I., Stewart, M.P., Kampes, B.M., Perski, Z., Lilly, P., (2003) A modification to the Goldstein radar interferogram filter. IEEE Transactions on Geoscience and Remote Sensing, vol. 41, No. 9., doi:10.1109/TGRS.2003.817212
Goldstein, R.M., Werner, C.L. (1998) Radar interferogram filtering for geophysical applications, Geophysical Research Letters, vol. 25, No. 21, 4035-4038, doi:10.1029/1998GL900033