Assessment of 3D unwrapping methods in InSAR time series analysis for engineering applications

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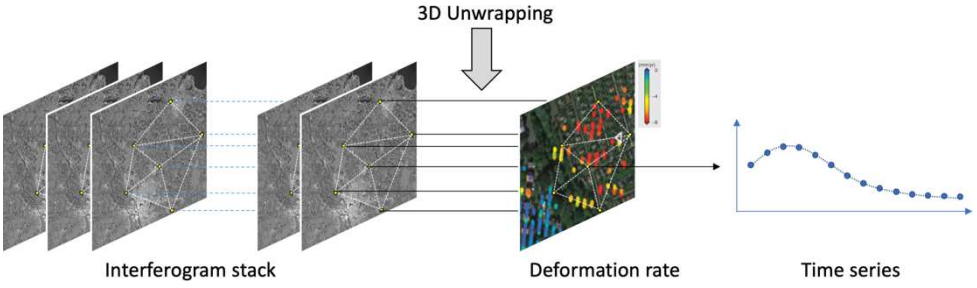
Synthetic Aperture Radar Interferometry (InSAR) is a proven technique for geodetic deformation measurements through phase difference between repeated satellite acquisitions. Since 2014, the launch of the Copernicus Sentinel-1 mission allows a routine time series analysis of deformation in all parts of the world for different applications, e.g., monitoring railways and roads or urban subsidence/uplift. However, InSAR measurement of deformation relies on a careful unwrapping of phase differences in space and time. There are several methods developed in the past years for the 3D unwrapping of phase in a stack of InSAR measurements. However, assessment of their applicability to different kinds of deformation is yet to be investigated.

This thesis will evaluate various 3D phase unwrapping methods for several case studies, including urban subsidence/uplift and road and railway monitoring. The preprocessing of the InSAR data and interferogram generation is performed prior to the beginning. The thesis focuses mainly on utilizing several 3D unwrapping methods available in the software and analyzing their performances. For the successful completion of this thesis, a good knowledge of Matlab programming is required. Basic familiarity with Linux and the command line will be an advantage but can also be learned during the thesis. In this thesis, the student will learn the basics of InSAR as a powerful tool for geodetic measurements and work with the data in practice.

This thesis will be supervised by Dr.-Ing. Mahmud Haghshenas Haghighi.

Figure 1: schematic diagram showing 3D unwrapping of a stack of interferograms to obtain deformation rate and time series. The figure contains modified Copernicus Sentinel data and image from GoogleEarth™.



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