Plug-In of CSL InSAR Suite (CIS) Functionalities into the SentiNel Application Platform (SNAP) Software

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Abstract:

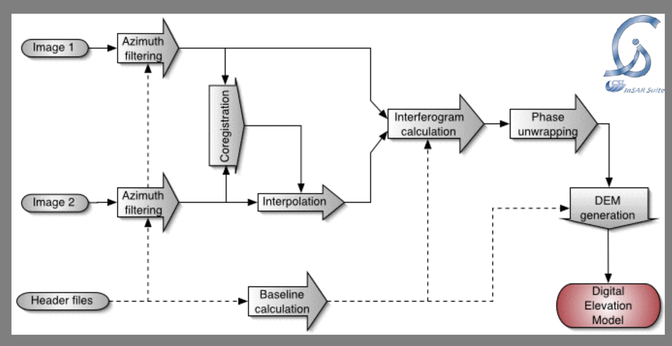
With more than 500 000 registered users, the open-access SentiNel Application Platform – SNAP has become the standard tool for processing remote sensing data. It was originally tailored to Sentinel 1-3 images, but now accommodates data from most common satellite images, including non-ESA missions (e.g., ICEYE, NOVASAR). SNAP integrates classical operators of remote sensing, including data reading, co-registration, calibration, raster algebra, and so forth. SNAP is available upon golden-open-access policy, allowing direct access to the source code. Moreover, SNAP supports the inclusion of plugins with a cookbook for developers.

This abstract reports the work of the progressive inclusion of the CSL InSAR Suite software modules into the SNAP open-source software, as plugins. To fulfill this objective, we are using the Standalone Tool Adapter of SNAP to include external command-line functionalities. The objective of the tool adapter is to create the paths that will link the external application to the SNAP software. We started the migration using a series of simple to complex tasks in different programming languages (C/C++, Python, and Matlab).

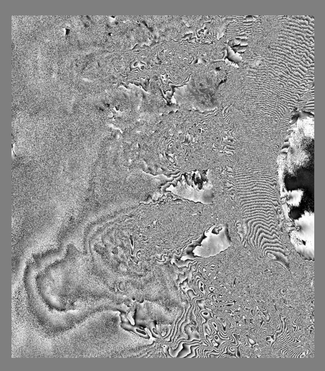
CIS plugins in SNAP will be accessible from a new dedicated menu in the user interface. Currently, we integrated the coherence tracking and multiple aperture interferometry into the SNAP software. Additional tools will be included in future developments.

CSL InSAR Suite:

The CSL Signal Processing Laboratory, has 30 years of expertise in Synthetic Aperture Radar (SAR) advanced image processing, in a suite called CIS (CSL InSAR Suite). CIS is a command-line software written in C, dedicated to the processing of synthetic aperture radar data, allowing the production of analysis-ready outputs such as displacement maps, flood extend, or fire monitoring. Advanced methods are also included, making CIS distinct from other competing SAR suites.



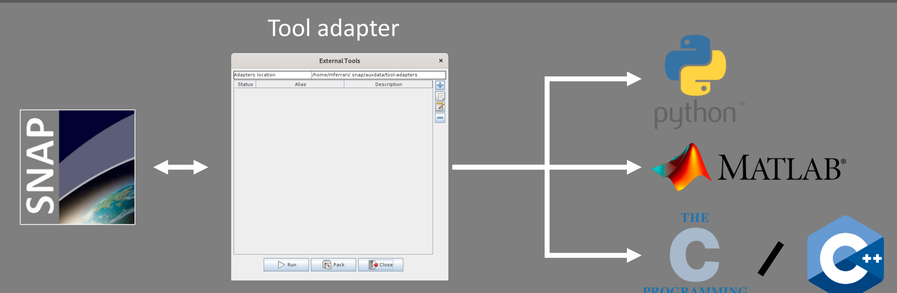
This set of techniques comprises SAR focusing, SAR interferometry (InSAR), differential interferometry (DInSAR), coherence tracking, SAR polarimetry and polarimetric interferometry (PolSAR & PolInSAR), split-band interferometry (SBInSAR), Spectral Coherence, Multiple Aperture Interferometry (MAI), Burst Overlapping Interferometry (BOI), Coherent Speckle Tracking, and TOPSAR interferometry.



Integration of Plugins into SNAP:

The SentiNel Application Platform (SNAP) offers a collaborative wiki in order to facilitate the work with different teams of developers. This collaborative platform has an exhaustive documentation about various subjects such as the development of SNAP engine extension, the creation of new data readers, how to use SNA in your python programs, and so forth.

The inclusion of plugins into SNAP works using the Standalone Tool Adapter (STA). The STA works as a bridge linking your installed programs on your computer and SNAP. Using the STA, you can create a dedicated menu inside SNAP, and a friendly interface to use your external software. In the end, the STA is a way to include a complex program inside a software that can be more familiar to use by other users.

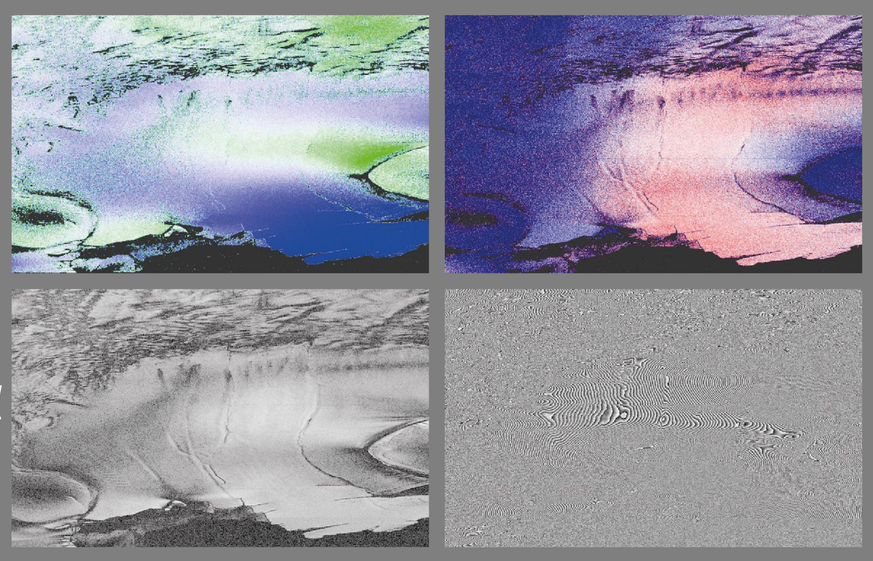


Case #1: Coherent Speckle Tracking

Coherence tracking is a technique that is both able to retrieve bidimensional displacement maps at coarse resolution and also recorrelate 2 signals to produce an interferogram for precise estimation of slant-range displacements. Results are particularly spectacular where surface is moving fast.

The idea of coherence tracking is that large surface displacement will create artificial coherence loss. This is mostly due because the coregistration of SAR images is geographically robust, i.e. that coregistered pixels are pointing to the exact same location in the two images, without considering the scene moving. This is even more true with coregistration based on precise orbits estimates.

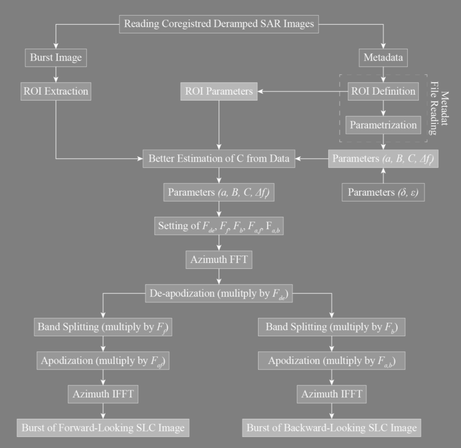
With coherence tracking, we try to find where scatterers moved by performing fine coregistration using maximization of the coherence. Four main products are generated:



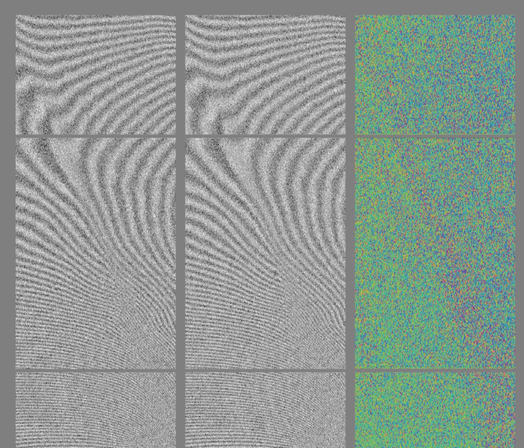
Case #2: Multiple Aperture Interferometry

By subtracting the phase of 2 SAR images taken from different dates and slightly different points of view, we can make an interferogram and extract surface displacements. Nevertheless, these InSAR-based estimated displacements are limited to the across-track direction. Using azimuthal split-band processing, it is possible to retrieve 2D displacements from a single SAR pair (Bechor, 2006).

Multiple Aperture Radar allows the determination of azimuth displacements from the phase difference between reconstructed forward- and backward-looking signals. We choose to split the Doppler band into two separated subbands with their bandwidth as large as possible, maximizing sensitivity and azimuthal resolution. Forward- and backward-looking interferograms look similar, but their subtraction lets appear the azimuthal displacement.



MAI Workflow



Fwd- and Back-looking Interferograms, and MAI Phase

Conclusion and Future Work:

In this project, we managed to bridge some developments from the CSL InSAR Suite (CIS) inside the SentiNel Application Platform (SNAP). After analyzing the different possibilities offered by SNAP, we decided to use the Standalone Tool Adapter in order to include CIS as a plugin with a dedicated menu. While two case studies are presented here, different Python, Matlab, C, and C++ developments are already transferred into SNAP.

Additional work is required in order to facilitate the dissemination of CIS to other users. First, we will work on the availability of downloadable bundled binaries from the SNAP plugins menu. Then, we will adapt some CIS codes to the BEAM-DIMAP format, with the goal of better integrating processing pipelines using both SNAP and CIS. Finally, we will provide resources for training and installation guidelines to interested users.

Acklowledgments:

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