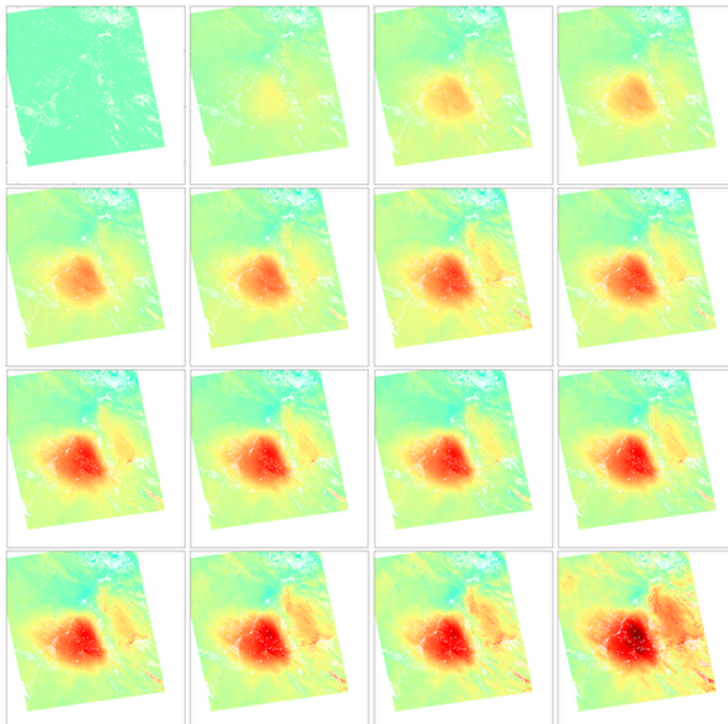
MCANDIS Manual

Version 1.0 Beta



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Introduction

MCANDIS is an acronym for **M**atlab **C**ode for **A**tmospheric **N**oise **D**epression through **I**terative **S**tacking, a method for mitigating the atmospheric noise in InSAR analysis proposed by Tymofyeyeva and Fialko (2015). The basic idea of this method is similar to stacking, which assumes that the atmospheric perturbations are random in time, so the atmospheric noises can be reduced by stacking many interferograms. MCANDIS is a Matlab version of this algorithm.

Usage

Throughout the manual, strings following “>>” are the Matlab command line inputs.

Step1. File format conversion. Here we assume that the unwrapped phase of the respective interferogram is stored in a ‘.grd’ file under the folder *yyyymmdd_yyyymmdd*.

>> getparm_candis

This is the command to get the default parameters. To change the parameters, use

>>setparm_candis(‘paraname’,’value’)

```
        aps_weather_model: 'aps_wm.mat'
            baseline_info: 'baseline.dat'
                     cmax: 150
                     cmin: -150
         coordinates_type: 'geographic'
correction_aps_weather_model: 0
             dates_to_use: 'dates.dat'
                dem_error: 'n'
                 dem_file: 'hgt.mat'
      deramp_mask_polygon: 'mask_polygon.txt'
                 dir_intf: []
                    gamma: 0.1000
            incident_file: 'inc.mat'
                intf_list: 'dates.run'
                   max_bp: 300
                   max_bt: 150
              max_t_stack: 90
                   min_bp: 0
                   min_bt: 0
              nsbas_ratio: 0.6000
               nstack_min: 2
                num_cores: 2
            num_iteration: 3
              num_patches: 4
               output_grd: 'n'
           preproc_deramp: 'n'
              radar_range: 864000
          reference_point: []
                   region: [1x4 double]
       remove_deformation: 'n'
           sbas_intf_list: 'dates.run'
               sbas_steps: [0 3]
                sbas_type: 'SBAS'
                   smooth: 0
              unwrap_file: 'unwrap_ll.grd'
             value_spline: 1
                  vel_out: 'n'
               wavelength: 0.0555
                 xy_units: 'degrees'
```

Note: Not all values are used in current version. Values for *dates_to_use*, *baseline_info*, *intf_list* control the corresponding interferograms and dates to be in the analysis.

Intf_list has the following format:

```
20171129_20171205
20171129_20171211
20171129_20171217
20171129_20171223
20171129_20171229
20171129_20180104
20171129_20180110
20171129_20180116
20171205_20171211
20171205_20171217
20171205_20171223
20171205_20171229
```

```
20171205_20180104
20171205_20180110
……
```

baseline.info has the following format:

```
20171117 0.000000
20171123 -89.486652
20171129 -49.232243
20171205 54.598754
20171211 -66.503363
20171217 42.139214
20171223 -73.408680
20171229 54.177646
20180104 -20.656153
20180110 -39.399964
20180116 -3.951561
20180122 -81.434048
20180128 1.628209
20180203 -39.598809
20180209 -43.269076
20180215 -24.318034
20180221 -50.392505
20180227 -39.515193
```

The first column is the date of SAR acquisitions, and second column is the corresponding perpendicular baseline relative to a given acquisition.

coordinates_type --- either 'geographic' or 'radar'

Tips*: dates_to_use* is generally the same as the first column of *baseline.info*. However, one may want to discard some interferograms containing certain unwanted acquisitions for the time series and/or velocity analysis. (e.g. You processed a large dataset, but later you only would like to analyze the time series after certain date. This parameter would easily let you select the corresponding interferograms.)

Step2. Do the Common-Scene-Stacking (CSS) and time series analysis with SBAS. There are two options here.

For the case where the deformation is expected to be more or less linear with time (e.g. interseismic deformation), I recommend use

\>> *candis_css_linear(0,3)*

because the tectonic deformation would cancel out when doing symmetric stacking. Here the values 0 and 3 in the parentheses control the start and end iterations. 0 stands for starting with the raw data and do a SBAS before the CSS. 3 means doing the CSS would stop after 3 iterations.

Parameters may affect the results in this step include:

max_t_stack ---- *number of days each side (backward and forward) to look for interferograms for stacking*

smooth ---- *non-negative value controlling the temporal smoothing of SBAS (0 for no smooth)*

Tips: *Larger max_t_stack finds more interferograms to stack for a given date, and thus yields more accurate estimate of the APS. However, seasonal variations and/or other long-term processes may break down the assumption that the atmospheric noises are RANDOM in time. For Sentinel-1 acquisitions with 12-day repeat, 60 days each side would have 10 interferograms to stack.*

For the case where the deformation is highly nonlinear during the stacking time window (e.g. early postseismic deformation, slow slip), try with

>> *candis_css_nonlinear(0,3)*

Parameters may affect the results in this step include:

max_t_stack ---- *number of days each side (backward and forward) to look for interferograms for stacking*

smooth ---- *non-negative value controlling the temporal smoothing of SBAS (0 for no smooth)*

value_spline --- float value in [0-1] controlling the degree of smoothing in the spline function fitting of the pseudo-deformation. Smaller a value of value_spline produces smoother pseudo-deformation. (0.7-0.8 is a good value; 1 for not using the spline fitting). Note taht Curve Fitting Toolbox is needed for this function.

Tips: *For both linear and nonlinear stacking, SBAS can be run in parallel. This is controlled by the parameter num_patches and num_cores.*

Reference:

Wang, K., and Y. Fialko, Observations and modeling ofcoseismic and postseismicdeformation due to the 2015 Mw7.8 Gorkha (Nepal) earthquake. Journal of Geophysical Research:Solid Earth, 123, 761–779, 2018

Tymofyeyeva, E. and Y. Fialko, Mitigation of atmospheric phase delays in InSAR data, with application to the Eastern California Shear Zone, J. Geophys. Res., 120, 5952-5963, 2015