A Python package for InSAR time series analysis

PySAR Documentation

Version 1.3.0

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2018 March

0 Introduction

PySAR is an open-source Python package for InSAR (Interferometric Synthetic Aperture Radar) time series analysis. It reads stack of interferograms (coregistered and unwrapped) and produces three-dimensional (2D in space and 1D in time) ground displacement. It includes a routine time series analysis (pysarApp.py) and some independent toolboxes. PySAR is built on the initial work done by Scott Baker. Alfredo Terrero developed the code to prepare HDF-EOS5 time-series product for web viewer.

PySAR is available on GitHub: https://yunjunz.github.io/PySAR/

When using this software please reference Yunjun et al. [2018]:
Yunjun Z., H. Fattahi, F. Amelung, (2018), PySAR – A Python Package for Generic InSAR Time Series Analysis based on Full Rank Network. (In prep.)

We also encourage users to cite the individual paper for the steps used in your processing. Details are included in the help of each individual script and summed up in the Bibliography chapter.

This manual provides a brief description to running PySAR, but does not explain all the processing. For technical details, please regards to the cited paper, or code. A detailed API description is attached at the end with index. This is for the developers who would like to develop your own processing routine, or other code where PySAR serves as a platform or toolbox. Contributions are welcomed and can be submitted to our Github repository.

Contents

1 Welcome to PySAR!

PySAR is a open-source Python package for InSAR (Interferometric Synthetic Aperture Radar) time series analysis. It reads stack of interferograms (coregistered and unwrapped) in ROI_PAC, Gamma and ISCE format, and produces three dimensional (2D in space and 1D in time) ground displacement. It includes a routine time series analysis (pysarApp.py) and some independent toolboxs. PySAR is built on the initial work done by `Scott Baker`. `Alfredo Terrero` developed the code to prepare UNAVCO InSAR product for `time series web viewer`.

We recommend using `Anaconda` to install the python environment and the prerequisite packages. You will need:
- `Python2.7`

- Numpy
- Scipy
- h5py
- Matplotlib
- Basemap (optional, for plotting in geo coordinate)
- pykml (optional, for Google Earth KMZ file output)
- joblib (optional, for parallel processing)
- `PyAPS` (optional, for tropospheric correction using weather re-analysis models, i.e. ERA-Interim, NARR, MERRA)

Here is a example on Mac OSX using csh/tcsh:
Add the following in ∼/.cshrc file and source it.

```
############################ Python ###############################
setenv PYTHON2DIR  ~/python/anaconda2
setenv PATH        ${PYTHON2DIR}/bin:${PATH}
```

Install Xcode with command line tools, follow instructions `here`.

Then run the following in your terminal:

```
cd ~/python
wget https://repo.continuum.io/archive/Anaconda2-4.4.0-MacOSX-x86_64.sh
chmod +x Anaconda2-4.4.0-MacOSX-x86_64.sh
./Anaconda2-4.2.0-MacOSX-x86_64.sh -b -p $PYTHON2DIR
$PYTHON2DIR/bin/conda config --add channels conda-forge
$PYTHON2DIR/bin/conda install basemap joblib pykml --yes
```

For PyAPS installation, please refer to `PyAPS's Wiki at Caltech`

1.2 PySAR

Download the latest released version at https://github.com/yunjunz/PySAR/releases, or use the command below.

```
cd ~/python
wget https://github.com/yunjunz/PySAR/archive/v1.2.0.tar.gz
tar -zxvf v1.2.0.tar.gz
```

or download the development version using git:

```
cd ~/python
git clone https://github.com/yunjunz/PySAR.git
```

To use the package, you need to setup the environment. Depending on your shell, you may use commands below to setup pysar, by adding the following to your source file. They are for:
1. To make pysar importable in python, by adding the path to PySAR directory to your $PYTHONPATH
2. To make utility scripts available in command line, by adding ${PYSAR_HOME}/pysar and ${PYSAR_HO↩ME}/shellscripts to your $path.
For bash user, add to your .bashrc file:

```
if [ -z ${PYTHONPATH+x} ]; then export PYTHONPATH=""; fi
export PYSAR_HOME=~/python/PySAR        #for released version, "~/python/PySAR-1.2.0"
export PYTHONPATH=${PYSAR_HOME}:${PYTHONPATH}
export PATH=${PYSAR_HOME}/pysar:${PYSAR_HOME}/shellscripts:${PATH}
```

For csh/tcsh user, add to your .cshrc file:

```
if ( ! $?PYTHONPATH ) then
    setenv PYTHONPATH ""
endif
setenv PYSAR_HOME  ~/python/PySAR       #for released version, "~/python/PySAR-1.2.0"
setenv PYTHONPATH  ${PYSAR_HOME}:${PYTHONPATH}
setenv PATH        ${PYSAR_HOME}/pysar:${PYSAR_HOME}/shellscripts:${PATH}
```

The current version is compatible with ROI_PAC and Gamma products. PySAR reads unwrapped interefrograms (at the same coordinate system: radar or geo) and the baseline files for each interefrogram. You need to give the path to where the interferograms are and PySAR takes care of the rest!
Run pysarApp.py -h see the processing options.
Run pysarApp.py -g to generate a default template file and see the detailed settings.

Download the test data: Download Link and unzip it.
Create a custom template file:

```
cd ~/KujuAlosAT422F650/PYSAR
vi KujuAlosAT422F650_template.txt
```

Include the following pysar options in your template:

```
##------------------------------------------------------------------ Data Loading ------------------------------
# RADAR COORD ROIPAC PRODUCTS
pysar.unwrapFiles     = ~/KujuAlosAT422F650/ROIPAC/RADAR/filt_*.unw
pysar.corFiles        = ~/KujuAlosAT422F650/ROIPAC/RADAR/filt_*.cor
pysar.geomap          = ~/KujuAlosAT422F650/ROIPAC/RADAR/geomap*.trans
pysar.dem.radarCoord = ~/KujuAlosAT422F650/ROIPAC/RADAR/radar*.hgt
pysar.dem.geoCoord    = ~/KujuAlosAT422F650/ROIPAC/RADAR/*.dem

pysar.reference.lalo       = 33.0655, 131.2076
pysar.deramp               = plane
```

Save your template file and run PySAR as:

```
pysarApp.py KujuAlosAT422F650_template.txt
```

Inside pysarApp.py, it reads the unwrapped interferograms, refernces all of them to the same coherent pixel (a seed point point), calculates the phase closure and estimates the unwrapping errors (if it has been asked for), inverts the interferograms, calculates a parameter called "temporal_coherence" which can be used to evaluate the quality of inversion, removes ramps or surface from time-series epochs, corrects dem errors, corrects local oscilator drift (for Envisat only), corrects stratified tropospheric delay (using pyaps and using phase-elevation approach), ... and finally estimates the velocity.
Use view.py to view any pysar output.
Use tsviewer.py to plot the time-series for each point (relative to the refernce point and epoch!).

PySAR is a toolbox with a lot of individual utility scripts, highly modulized in python. Check its documentaion or simple run it with -h to see its usage, you could build your own customized processing recipe!

- Manual: PDF, HTML
- Wiki: Check our Github Wiki to see the example data, paper references, file naming convention and more.

Join our google group https://groups.google.com/forum/#!forum/py-sar to ask questions, get notice of latest features pushed to you!

2 _Sidebar

Wiki

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- DEM
- Bibliography

Output

- Google Earth
- UNAVCO
- Web Viewer

3 Attributes

PySAR mainly use attribute name from ROI_PAC, with some additional attributes generated by PySAR itself.

If using ROI_PAC as InSAR processor, both "baseline parameter RSC" file (i.e. *100416-100901_baseline.rsc*) and basic metadata file (i.e. *filt_100416-100901-sim_HDR_4rlks_c10.unw.rsc*) will be imported into PySAR. The following attributes for each interferogram are required in order to run PySAR:
+ FILE_LENGTH = number of rows
+ WIDTH = number of columns
+ X/Y_STEP = Ground resolution in degree in Longitude/latitude direction, for geocoded product
+ X/Y_FIRST = Longitude/latitude in degree of the first pixel - Upper left corner, for geocoded product

- LAT/LON_REF1/2/3/4 = Latitude/longitude at corner 1/2/3/4 (degree), used in save_unavco, PyAPS (DEM file in radar coord), not accurate; number named in order of first line near/far range, last line near/far range
  + WAVELENGTH = Radar wavelength (m)
  + RANGE_PIXEL_SIZE = Slant range pixel size (search for pixel_ratio to convert to ground size, in m), used in dem_error, incidence_angle, multilook, transect.
  + EARTH_RADIUS = Best fitting spheroid radius (m), used in dem_error, incidence_angle, convert2mat
  + CENTER_LINE_UTC = Time at middle of interferogram (seconds), used in tropo correction using PyAPS
  + HEIGHT = Height of satellite (m), used in dem_error, incidence_angle, convert2mat
  + STARTING_RANGE = Distance from satellite to first ground pixel (m), used in incidence_angle calculation
  + DATE12 = (date1)-(date2), master - slave date of interferogram in 6 digit number
  + PLATFORM = satellite/sensor name, used in Local Oscillator Drift correction for Envisat
  + ORBIT_DIRECTION = ascending, or descending
  + P_BASELINE_TOP_HDR = Perpendicular baseline at top (first line) of interferogram (m), used in _network, _pysar_utilities
  + P_BASELINE_BOTTOM_HDR = Perpendicular baseline at bottom (last line) of interferogram (m), used in _network, _pysar_utilities
  + ALOOKS/RLOOKS = multilook number in azimuth/range direction, used in weighted network inversion.

- ANTENNA_SIDE = -1 for right looking radar, used in save_unavco

- AZIMUTH_PIXEL_SIZE = Azimuth pixel size at orbital altitude (multiply by Re/(Re+h) for ground size (m), where Re is the local earth radius), used in baseline_error/trop and multilook.
  + HEADING = Spacecraft heading at peg point (degree), used in asc_desc, los2enu
  + LOOK_REF1/2 = Look angle at corner 1/2 (degree), not accurate (optional)
  + PRF = Pulse repetition frequency (Hz), used in save_unavco
  + H_BASELINE_RATE_HDR = Rate of change of horizontal baseline as a function of line number (linear term), used in _pysar_utilities
  + H_BASELINE_TOP_HDR = Horizontal baseline separation at the top of the interferogram calculated from orbital parameters, used in _pysar_utilities
  + V_BASELINE_RATE_HDR = Linear term for vertical baseline change, used in _pysar_utilities
  + V_BASELINE_TOP_HDR = Vertical baseline separation at top of the interferogram, used in _pysar_utilities

- FILE_TYPE = file type, velocity, timeseries, interferograms, etc.; for non-HDF5 file, it's the file extension name.
  + FILE_PATH = absolute file path
  + INSAR_PROCESSOR = InSAR processor, roipac, gamma, isce, etc.
  + PROCESSOR = processing software, i.e. isce, roipac, gamma

- DATA_TYPE = data type, i.e. float32, int16, etc., for isce product read using GDAL

- P_BASELINE_TIMESERIES = timeseries of perpendicular baseline

- P_BASELINE_TOP_TIMESERIES = timeseries of perpendicular baseline at top of interferogram

- P_BASELINE_BOTTOM_TIMESERIES = timeseries of perpendicular baseline at bottom of interferogram
- UNIT = data unit, i.e. m, m/yr, radian, and 1 for file without unit, such as coherence
- date1 = start time of dataset
- date2 = end time of dataset
- drop_date =
- drop_ifgram = yes or no, drop this interferogram or not for unwrapIfgram.h5, coherence.h5 etc.
- ref_date = reference date
- ref_x/y/lat/lon = column/row/latitude/longitude of reference point
- subest_x0/y0/x1/y1 = start/end column/row number of subset in the original coverage

Pritchard et al., (2014), Open-source software for geodetic imaging: ROI_PAC for InSAR and pixel trakcing, pp 44-48. PDF

4 Bibliography

Berardino, P., G. Fornaro, R. Lanari, and E. Sansosti (2002), A new algorithm for surface deformation monitoring based on small baseline differential SAR interferograms, *Geoscience and Remote Sensing, IEEE Transactions on*, 40(11), 2375-2383, doi:10.1109/TGRS.2002.803792.
Doin, M. P., C. Lasserre, G. Peltzer, O. Cavalié, and C. Doubre (2009), Corrections of stratified tropospheric delays in SAR interferometry: Validation with global atmospheric models, *Journal of Applied Geophysics*, 69(1), 35-50, doi:10.1016/j.jappgeo.2009.03.010.
Fattahi, H., and F. Amelung (2013), DEM Error Correction in InSAR Time Series, *Geoscience and Remote Sensing, IEEE Transactions on,* 51(7), 4249-4259, doi:10.1109/TGRS.2012.2227761.
Fattahi, H., and F. Amelung (2014), InSAR uncertainty due to orbital errors, *Geophysical Journal International*, 199(1), 549-560, doi:10.1093/gji/ggu276.
Fattahi, H., and F. Amelung (2015), InSAR bias and uncertainty due to the systematic and stochastic tropospheric delay, *Journal of Geophysical Research: Solid Earth* (120), doi:10.1002/2015JB012419.
Jolivet, R., R. Grandin, C. Lasserre, M. P. Doin, and G. Peltzer (2011), Systematic InSAR tropospheric phase delay corrections from global meteorological reanalysis data, *Geophysical Research Letters*, 38(17), L17311, doi:10.↩
1029/2011GL048757.

Tizzani, P., P. Berardino, F. Casu, P. Euillades, M. Manzo, G. P. Ricciardi, G. Zeni, and R. Lanari (2007), Surface deformation of Long Valley caldera and Mono Basin, California, investigated with the SBAS-InSAR approach, *Remote Sensing of Environment*, 108(3), 277-289, doi:10.1016/j.rse.2006.11.015.

5 Coordinate

There are two coordination systems in PySAR: **radar coordinate** and **geo coordinate**. Geo coordinate is defined in WGS84 coordination for horizontal direction, and determined by the following ROI_PAC attributes in latitude and longitude. The following shows examples from *AlosAT422F650/geo_velocity.h5*:

```
X_FIRST    131.02409876
Y_FIRST    33.63756779
X_STEP     0.00033333
Y_STEP     -0.00033333
X_UNIT     degrees
Y_UNIT     degrees
```

X/Y_FIRST are the longitude/latitude value of the first (upper left corner) pixel's upper left corner, as shown below:

6 Corrected DEM

PySAR estimates DEM residual in time series domain using Fattahi and Amelung's method (2013, TGRS), and output a estimated DEM residual value for each pixel into file demRadar/demGeo_error.h5. It can be used to generate a new, corrected DEM after masking and proper decamping, using the command below.

```
mask.py demRadar_error.h5 -m maskTempCoh.h5
add.py demRadar_error_masked.h5 demRadar.h5 demRadar_cor.h5
```

To better under this correction approach, please keep in mind:
1. InSAR measures relative range distance, so does this step. Thus, this estimated DEM residual is with respect to the reference pixel, which has zero value.

1. Fattahi and Amelung (2013, TGRS) method estimate phase components correlated with perpendicular baseline history, which should mainly be DEM residual; it also contains the correlated part from temporal deformation or orbit error, if they are correlated, or partial correlated with perpendicular baseline history.

Fattahi, H., and F. Amelung (2013), DEM Error Correction in InSAR Time Series, *Geoscience and Remote Sensing, IEEE Transactions on,* 51(7), 4249-4259, doi:10.1109/TGRS.2012.2227761.

7 Documentation-Generation

We use Doxygen to generate the API documentation automatically.

Install Doxygen following link.

8 Example

Here is some demo dataset for testing, just download and unzip it, and run the command below:

```
cd $PROJECT_NAME/PYSAR
pysarApp.py $PROJECT_NAME_template.txt
```

- **Kuju Volcano with ALOS Asc Track 422 Frame 650** - Link to Download Data

  cd KujuAlosAT422F650/PYSAR pysarApp.py KujuAlosAT422F650_template.txt

  pysarApp.py reads this custom template and update the corresponding options in the default full template file **_pysarApp_template.txt_** (generated automatically by PySAR whenever you run pysarApp.py; if it already exists, the existing one will be used). Then it runs through the whole processing chain step by step. You can modify the parameters, method for tropospheric delay correction etc. by changing the option value in pysarApp_template.txt, and re-run pysarApp.py to update your processing; and re-do this on and on until you are happy with your result. If no pysarApp_template.txt found, you can generate it with default values using the command below, all options are documented inside the file:

  ```
  pysarApp.py -g
  ```

  To re-run the program:

```
pysarApp.py
```

Check the auto plotted figures in **PYSAR/PIC** folder, and modify the plotting parameters to adjust your plotting, and re-run the plotting script to update your plotting result, a modified version is attached in the example data link above:

```
./plot_pysarApp.sh
```

By default, it's using ROI_PAC product in radar coordinate in ROIPAC/RADAR folder; if you want to try Py↩
SAR with geo coordinate ROI_PAC product in ROIPAC/GEO folder, edit "Data Loading" part in template file: comment out the "RADAR COORD ROIPAC PRODUCTS" part and un-comment "GEO COORD ROIPAC PRODUCTS" part, and re-run pysarApp.py

Yunjun, Z., Amelung F., Aoki Y., (2016). Poster: A time series InSAR survey of volcanic deformation in Kyushu, SW Japan with JERS and ALOS data (G51B-1113). AGU Fall Meeting 2016, Dec 12-16, 2016, San Francisco, CA, USA. PDF

9 File-Descriptions

PySAR use HDF5 file internally. It loads ROI_PAC file into .h5 file in the beginning and has the capability to output to UNAVCO hdf5 file, .grd file, ROI_PAC file and Google Earth KMZ file.

There are 3 types of HDF5 file structures used in PySAR:
- multi_group (**Ngroup-1dset-1atr**) = multiple groups with one dataset and one attribute dict per group
i.e. interferograms, coherence, wrapped, snaphu_connect_component

- multi_dataset (**1group-Ndset-1atr**) = one group with multiple dataset and one attribute dict per group
  i.e. timeseries, geometry
- single_dataset (**1group-1dset-1atr**) = one group with one dataset and one attribute dict per group
  i.e. velocity, dem, rmse, temporal_coherence, mask

- coherence.h5 = spatial coherence files loaded from ROI_PAC, generated in load_data step
- snaphuConnectComponent.h5 = multi_group type, mask of connect component files from SNAPHU phase unwrapping, loaded from ROI_PAC, generated in load_data step
- wrapIfgram.h5 = wrapped interferograms loaded from ROI_PAC, generated in load_data step
- unwrapIfgram.h5 = unwrapped interferograms loaded from ROI_PAC, generated in load_data step

- timeseries.h5 = multi_dataset type, time series displacement, generated in network inversion step
  - geometryRadar/Geo.h5 = multi_dataset type, geometry file for dataset, including the following info:
  /geometry/latitude/ #for geometryRadar.h5 only, from ISCE/Doris lookup table
  /geometry/longitude/ #for geometryRadar.h5 only, from ISCE/Doris lookup table
  /geometry/rangeCoord/ #for geometryGeo.h5 only, from ROI_PAC/Gamma lookup table
  /geometry/azimuthCoord/ #for geometryGeo.h5 only, from ROI_PAC/Gamma lookup table
  /geometry/height/
  /geometry/incidenceAngle/
  /geometry/headingAngle/
  /geometry/slantRangeDistance/

- averageSpatialCoherence.h5 = temporal mean of all spatial coherence, generated from coherence.h5 in data loading step
- demGeo.h5 = DEM in geo coordinate, loaded from pysar.dem.geoCoord
- demRadar.h5 = DEM in radar coordinate, loaded from pysar.dem.radarCoord
- mask.h5 = mask of non-zero amplitude pixels, generated from .unw file list in data loading step
- maskTempCoh.h5 = mask of high temporal coherent pixels, generated from temporalCoherence.h5 with threshold (default=0.7)
- temporalCoherence.h5 = temporal coherence, generated from the inversion of network of interferograms to timeseries
- velocity.h5 = Line-Of-Sight (LOS) velocity, generated in time series inversion step
  - velocityRmse.h5 = root-mean-square deviation of Mean LOS velocity estimation
- velocityStd.h5 = standard deviation of Mean LOS velocity estimation

- geomap_∗rlks.trans = ROI_PAC file, with inverse mapping transformation from radar to geo coordinates, check more `ROI_PAC File Descriptions`, copied in load_data step
  - radar_∗rlks.hgt = ROI_PAC DEM file in radar coordinate, check more `ROI_PAC File Descriptions`, copied in load_data step

- geo_∗ = transformed from radar coord to geo coord using geocode.py
  - Modified_∗ = network modification using modify_network.py
  - subset_∗ = subset/crop in space using subset.py
  - Seeded_∗ = referencing/seeding in space using seed_data.py

- ∗_demErr = DEM error correction in time series domain
  - ∗Ex = processed with some date(s) dropped
  - ∗_ECMWF/MERRA/NARR = tropospheric correction using PyAPS, name is the weather re-analysis data used to estimate the tropospheric phase delay
  - ∗_plane/quadratic/... = phase ramp removal
  - ∗_refDate = referencing in time

10 Gamma-File-Decription

Basically, in GAMMA, we can name the file in any "nickname" if we want. But, there are also some common habits to name different type of files to make non-GAMMA guys readable, which is very similar like other softwares but not absolutely same.Here will introduce some common names of GAMMA-based files from SLC step to Unwrapping step.
ps: GAMMA software has several modules: MSP, ISP, DIFF&GEO, IPTA. MSP for focusing, ISP for interferometry, DIFF&GEO for DInSAR and gecoding, IPTA mainly for TS-InSAR (conventional PS and SBAS).
∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗MSP∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗
(skipped here)
∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗ISP∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗
∗.slc (same thing as roi_pac)
∗.slc.par (parameters' file about orbit, width, length, time, ... But parameters in ∗.par file is far less than ∗.rsc file)
∗.mli (magnitude image of SLC after doing multilook)
∗.mli.par (same thing like ∗.slc.par, but width and length are changed due to multi-looking)
∗.rslc (co-registrated SLC, for TS-InSAR, usually coregistrated to one master image)
∗.rslc.par (parameter file of ∗.rslc, absolutely same as ∗.slc.par)

∗.rmli (co-registrated magnitude images of multi-looked SLC)
∗.rmli.par (parameter file of ...)
∗.off (offset file of co-registration, include fitted polynomial parameters, length, width, ...)
∗.offs (COMPLEX file, offset value in each chosen points, real and imaginary parts for Range and Azimuth offset)
∗.snr (std of co-registration in each point, which will be used to mask some points based on a threshold)
∗.offset (text file of ∗.offs)
∗.coffs (COMPLEX file, culled offset of ∗.offs)
∗.coffsets (text type of ∗.coffs)
∗.base (baseline file)
∗.base.perp (perpendicular baseline file)
∗.cc (coherence map)
∗.int (original interferometry file, include every signal, flatten phase, DEM, Def, APS,...)
∗.flt ("flatten" interferogram, after removing flatten signals from ∗.int)
∗.smcc (coherence map based on filtered interferogram)
∗.sm_flt (filtered ∗.flt interferogram)
∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗∗DIFF & GEOCODE∗∗
∗.diff (interferogram that has removed flatten signals and topography signals)
∗.flag (masked file based on coherence map, 0 and 1, only used for Branch-cut unwrapping)
∗.mask.ras (masked file for MCF unwrapping, also masked based on coherence)
∗.unw (unwrapped interferogram, usually unwrapped from ∗.diff , data type order is different from that of ROI_PAC's .unw file)
The same thing as ISP, all files based on filtering will include "sm", e.g., *sm.diff, ∗.sm.unw, but the final part of suffix will not change.*
∗.htg (digital elevation model in radar coordinates)
.dem (..... in UTM coordinates)
∗.dem.par (parameters of ∗.dem file, which is in UTM coordinates, same as ∗.dem.rsc in ROI_PAC)
∗.utm_to_rdc (lookup table: from utm to radar coordinates)

11 Google-Earth

PySAR use pyKML module to output files into Google Earth .kmz format using script save_kml.py. Check its usage by typing "save_kml.py -h" in your terminal. Below is an screenshot of the velocity of Kuju example using the command:

```
save_kml.py geo_velocity_masked.h5 -c jet_r -u cm --ylim -2.5 0.5 --cbar-height 2000
```

- Download KMZ file

12 Home

Github Page: https://yunjunz.github.io/PySAR/
Google Group: https://groups.google.com/forum/#!forum/py-sar
Workshop 2017: PDF

Documentation: PDF

13 SAR-Sensor-Parameter

Here is summary of SAR sensor parameters commonly used in InSAR.

JERS-1 (Japan Earth Resources Satellite, nickname of Fuyo-1). Data available from 1992 - 1998.
Information from: ESA EO portal

Center frequency	1.275 GHz (L-band, 23.5 cm wavelength)
Bandwidth	15 MHz
Observation Mode	StripMap
Spatial resolution	18 m (range) x 18 m (azimuth, 3 looks)
Swath width	75 km
Pulse width	35 µs
PRF	1505.8 - 1606.0 Hz
Antenna	Array of 1024 microstrip radiation elements
- Polarization	HH
- Look angle	35.21°
- Antenna gain	>33.5 dB
- Signal to ambiguity ratio	>14 dB

14 UNAVCO-InSAR-Archive

Use the following commands to convert PySAR product into UNAVCO InSAR Archive format. All files should be geocoded in the same coordinations and resolution.

```
add_attribute.py timeseries.h5 add_attribute.txt
save_unavco.py timeseries.h5 -i incidence_angle.h5 -d dem.h5 -c temporal_coherence.h5 -m mask.h5
```

Create an text file (i.e. *add_attribute.txt*) with the following attributes and manual modify them for your dataset.

```
##### UNAVCO Required Metadata
mission                = ALOS                  # ERS,ENV,S1,RS1,RS2,CSK,TSX,JERS,ALOS,ALOS2
beam_mode              = SM                    # S2,IW
beam_swath             = 7
relative_orbit         = 422
processing_software    = ROI_PAC
processing_type        = LOS_TIMESERIES
#first_date            =                       # grab by script
#last_date             =                       # grab by script
#scene_footprint       =                       # grab by script
#history               =                       # grab by script
frame                  = 650                   # first frame number, need in file name

##### UNAVCO Recommended Metadata
atmos_correct_method       = ERA-Interim
post_processing_method     = PySAR
processing_dem             = GSI_DEHM_10m
unwrap_method              = SNAPHU
#flight_direction          =                   # grab by script
#look_direction            =                   # grab by script
#polarization              =
#prf                       =                   # grab by script
#wavelength                =                   # grab by script
#master_platform           =             #For INTERFEROGRAM products
#master_absolute_orbit     =             #For INTERFEROGRAM products
#master_doppler            =             #For INTERFEROGRAM products
#slave_platform            =             #For INTERFEROGRAM products
#slave_absolute_orbit      =             #For INTERFEROGRAM products
#slave_doppler             =             #For INTERFEROGRAM products
#percent_unwrapped         =
#average_coherence         =
#max_coherence             =
#percent_atmos_corrected =
#baseline_perp           =

##### INSARMAPS Metadata
reference    = 'Yunjun, Z., Amelung F., Aoki Y., (2016). Poster: A time series InSAR survey of volcanic deform
referencePdf = 'https://yunjunzhang.files.wordpress.com/2015/01/yunjun_2016_agu.pdf'
unavcoUrl    = ''
```

Baker, S., (2015), Product Format Specification of UNAVCO InSAR Product Archive DOC

15 Web-Viewer

You could check the InSAR time-series products processed by University of Miami Geodesy Lab through its web viewer below:

Time series displacement of Kuju volcano from ALOS dataset (Track 422, Frame 650)

16 Namespace Index

16.1 Packages

Here are the packages with brief descriptions (if available):

17 Hierarchical Index

17.1 Class Hierarchy

This inheritance list is sorted roughly, but not completely, alphabetically:

18 Class Index

18.1 Class List

Here are the classes, structs, unions and interfaces with brief descriptions:

19 File Index

19.1 File List

Here is a list of all files with brief descriptions:

20 Namespace Documentation

20.1 animation Namespace Reference

Functions

- def updatefig (args)

Variables

- string work_dir = '/Users/yunjunz/insarlab/Galapagos/AlcedoEnvA2T061/PIC'
- list fileList = [ ]
- list titleList = [ ]
- list imgs = [ ]
- img = mpimg.imread(fname)
- fig = plt.figure(figsize=[10, 5.4])
- ax = fig.add_axes([0.05, 0.05, 0.9, 0.8])
- int i = -2
- im = ax.imshow(imgs[i], animated=True)
- ttl = ax.text(200, -150, titleList[i], ha='left', fontsize=32)
- ani = animation.FuncAnimation(fig, updatefig, interval=1000, blit=True)
- savefigDict = dict()
- string outName = 'timeseries_animation.gif'
- writer
- dpi
- savefig_kwargs

20.1.1 Function Documentation

20.1.1.1 updatefig()

```
def animation.updatefig (
              args )
```

20.1.2 Variable Documentation

20.1.2.1 ani

```
ani = animation.FuncAnimation(fig, updatefig, interval=1000, blit=True)
```

20.1.2.2 ax

```
ax = fig.add_axes([0.05, 0.05, 0.9, 0.8])
```

20.1.2.3 dpi

```
dpi
```

20.1.2.4 fig

```
fig = plt.figure(figsize=[10, 5.4])
```

20.1.2.5 fileList

```
list fileList = [ ]
```

20.1.2.6 i

```
int i = -2
```

20.1.2.7 im

```
im = ax.imshow(imgs[i], animated=True)
```

20.1.2.8 img

```
img = mpimg.imread(fname)
```

20.1.2.9 imgs

```
list imgs = []
```

20.1.2.10 outName

```
outName = 'timeseries_animation.gif'
```

20.1.2.11 savefig_kwargs

```
savefig_kwargs
```

20.1.2.12 savefigDict

```
savefigDict = dict()
```

20.1.2.13 titleList

```
list titleList = []
```

20.1.2.14 ttl

```
ttl = ax.text(200, -150, titleList[i], ha='left', fontsize=32)
```

20.1.2.15 work_dir

```
string work_dir = '/Users/yunjunz/insarlab/Galapagos/AlcedoEnvA2T061/PIC'
```

20.1.2.16 writer

```
writer
```

20.2 delayTimeseries Namespace Reference

Classes

- class timeseries

Functions

- def write_to_h5 (dataset, outName, groupName, h5withAttributes)
- def nearest_valid (xr, yr, data_flat, rows, cols)

20.2.1 Function Documentation

20.2.1.1 nearest_valid()

```
def delayTimeseries.nearest_valid (
              xr,
              yr,
              data_flat,
              rows,
              cols )
```

20.2.1.2 write_to_h5()

```
def delayTimeseries.write_to_h5 (
              dataset,
              outName,
              groupName,
              h5withAttributes )
```

20.3 dloadUtil Namespace Reference

Functions

- def download_modis (inps)
- def download_atmosphereModel (inps)
- def daterange (start_date, end_date)
- def get_date (f)
- def pwv2zwd (pwv)
- def zwd2swd (zwd, theta)
- def read_modis (file)

20.3.1 Function Documentation

20.3.1.1 daterange()

```
def dloadUtil.daterange (
              start_date,
              end_date )
```

20.3.1.2 download_atmosphereModel()

```
def dloadUtil.download_atmosphereModel (
              inps )
```

20.3.1.3 download_modis()

```
def dloadUtil.download_modis (
              inps )
```

20.3.1.4 get_date()

```
def dloadUtil.get_date (
              f )
```

20.3.1.5 pwv2zwd()

```
def dloadUtil.pwv2zwd (
              pwv )
```

20.3.1.6 read_modis()

```
def dloadUtil.read_modis (
              file )
```

20.3.1.7 zwd2swd()

```
def dloadUtil.zwd2swd (
              zwd,
              theta )
```

20.4 get_modis_v3 Namespace Reference

Functions

- def usage ()
- def main ()

Variables

- out
- start_time_main
- time_elapsed

20.4.1 Function Documentation

20.4.1.1 main()

```
def get_modis_v3.main ( )
```

20.4.1.2 usage()

```
def get_modis_v3.usage ( )
```

20.4.2 Variable Documentation

20.4.2.1 out

```
out
```

20.4.2.2 start_time_main

```
start_time_main
```

20.4.2.3 time_elapsed

```
time_elapsed
```

20.5 plot_tropcor_phase_elevation Namespace Reference

Variables

- workDir
- demFile
- timeseriesFile
- timeseriesFile2
- maskFile
- tropHgtFile
- ecmwfFile
- epoch
- dem
- dem_atr
- data
- atr
- data2
- atr2
- tropHgt
- atr3
- ecmwf
- atr4
- mask
- msk_atr
- ndx
- dataList
- fig
- axes
- nrows
- ncols
- sharex
- True
- sharey
- figsize
- i
- ms
- bbox_inches
- dpi

20.5.1 Variable Documentation

20.5.1.1 atr

```
atr
```

20.5.1.2 atr2

```
atr2
```

20.5.1.3 atr3

atr3

20.5.1.4 atr4

atr4

20.5.1.5 axes

axes

20.5.1.6 bbox_inches

bbox_inches

20.5.1.7 data

data

20.5.1.8 data2

data2

20.5.1.9 dataList

dataList

20.5.1.10 dem

dem

20.5.1.11 dem_atr

dem_atr

20.5.1.12 demFile

`demFile`

20.5.1.13 dpi

`dpi`

20.5.1.14 ecmwf

`ecmwf`

20.5.1.15 ecmwfFile

`ecmwfFile`

20.5.1.16 epoch

`epoch`

20.5.1.17 fig

`fig`

20.5.1.18 figsize

`figsize`

20.5.1.19 i

`i`

20.5.1.20 mask

`mask`

20.5.1.21 maskFile

`maskFile`

20.5.1.22 ms

`ms`

20.5.1.23 msk_atr

`msk_atr`

20.5.1.24 ncols

`ncols`

20.5.1.25 ndx

`ndx`

20.5.1.26 nrows

`nrows`

20.5.1.27 sharex

`sharex`

20.5.1.28 sharey

`sharey`

20.5.1.29 timeseriesFile

`timeseriesFile`

20.5.1.30 timeseriesFile2

```
timeseriesFile2
```

20.5.1.31 tropHgt

```
tropHgt
```

20.5.1.32 tropHgtFile

```
tropHgtFile
```

20.5.1.33 True

```
True
```

20.5.1.34 workDir

```
workDir
```

20.6 pysar Namespace Reference

Namespaces

- _datetime
- _gmt
- _network
- _plot
- _pysar_utilities
- _readfile
- _remove_surface
- _sensor
- _variance
- _writefile
- add
- add_attribute
- add_attribute_insarmaps
- asc_desc
- baseline_error
- baseline_trop
- coord_glob2radar
- coord_radar2glob
- correct_dem
- correlation_with_dem

- temporal_derivative
- temporal_filter
- timeseries2velocity
- timeseries_rms
- transect
- transect_legacy
- tropcor_phase_elevation
- tropcor_pyaps
- tsviewer
- unwrap_error
- view

Variables

- bool miami_path = True
- int parallel_num = 8
- float figsize_single_min = 6.0
- float figsize_single_max = 12.0
- list figsize_multi = [15.0, 8.0]

20.6.1 Variable Documentation

20.6.1.1 figsize_multi

```
list figsize_multi = [15.0, 8.0]
```

20.6.1.2 figsize_single_max

```
float figsize_single_max = 12.0
```

20.6.1.3 figsize_single_min

```
float figsize_single_min = 6.0
```

20.6.1.4 miami_path

```
bool miami_path = True
```

20.6.1.5 parallel_num

```
int parallel_num = 8
```

20.7 pysar._datetime Namespace Reference

Classes

- class progress_bar

  Simple progress bar######################.

Functions

- def yyyymmdd2years (dates)
- def yymmdd2yyyymmdd (date)
- def yyyymmdd (dates)
- def yymmdd (dates)
- def ifgram_date_list (ifgramFile, fmt='YYYYMMDD')
- def read_date_list (date_list_file)
- def date_index (dateList)
- def date_list2tbase (dateList)
- def date_list2vector (dateList)
- def auto_adjust_xaxis_date (ax, datevector, fontSize=12, every_year=1)
- def list_ifgram2date12 (ifgram_list)
- def closest_weather_product_time (sar_acquisition_time, grib_source='ECMWF')

20.7.1 Function Documentation

20.7.1.1 auto_adjust_xaxis_date()

```
def pysar._datetime.auto_adjust_xaxis_date (
              ax,
              datevector,
              fontSize = 12,
              every_year = 1 )
```

```
Adjust X axis
Input:
    ax : matplotlib figure axes object
    datevector : list of float, date in years
                 i.e. [2007.013698630137, 2007.521917808219, 2007.6463470319634]
Output:
    ax  - matplotlib figure axes object
    dss - datetime.date object, xmin
    dee - datetime.date object, xmax
```

20.7.1.2 closest_weather_product_time()

```
def pysar._datetime.closest_weather_product_time (
              sar_acquisition_time,
              grib_source = 'ECMWF' )
```

```
Find closest available time of weather product from SAR acquisition time
Inputs:
    sar_acquisition_time - string, SAR data acquisition time in seconds
    grib_source - string, Grib Source of weather reanalysis product
Output:
    grib_hr - string, time of closest available weather product
Example:
    '06:00' = closest_weather_product_time(atr['CENTER_LINE_UTC'], 'ECMWF')
    '12'    = closest_weather_product_time(atr['CENTER_LINE_UTC'], 'NARR')
```

20.7.1.3 date_index()

```
def pysar._datetime.date_index (
              dateList )
```

20.7.1.4 date_list2tbase()

```
def pysar._datetime.date_list2tbase (
              dateList )
```

```
Get temporal Baseline in days with respect to the 1st date
Input: dateList - list of string, date in YYYYMMDD or YYMMDD format
Output:
    tbase    - list of int, temporal baseline in days
    dateDict - dict with key   - string, date in YYYYMMDD format
                         value - int, temporal baseline in days
```

20.7.1.5 date_list2vector()

```
def pysar._datetime.date_list2vector (
              dateList )
```

```
Get time in datetime format: datetime.datetime(2006, 5, 26, 0, 0)
Input: dateList - list of string, date in YYYYMMDD or YYMMDD format
Outputs:
    dates      - list of datetime.datetime objects, i.e. datetime.datetime(2010, 10, 20, 0, 0)
    datevector - list of float, years, i.e. 2010.8020547945205
```

20.7.1.6 ifgram_date_list()

```
def pysar._datetime.ifgram_date_list (
              ifgramFile,
              fmt = 'YYYYMMDD' )
```

```
Read Date List from Interferogram file
    for timeseries file, use h5file['timeseries'].keys() directly
Inputs:
    ifgramFile - string, name/path of interferograms file
    fmt        - string, output date format, choices=['YYYYMMDD','YYMMDD']
Output:
    date_list  - list of string, date included in ifgramFile in YYYYMMDD or YYMMDD format
```

20.7.1.7 list_ifgram2date12()

```
def pysar._datetime.list_ifgram2date12 (
              ifgram_list )
```

```
Convert ifgram list into date12 list
Input:
    ifgram_list  - list of string in *YYMMDD-YYMMDD* or *YYMMDD_YYMMDD* format
Output:
    date12_list  - list of string in YYMMDD-YYMMDD format
Example:
    h5 = h5py.File('unwrapIfgram.h5','r')
    ifgram_list = sorted(h5['interferograms'].keys())
    date12_list = ptime.list_ifgram2date12(ifgram_list)
```

20.7.1.8 read_date_list()

```
def pysar._datetime.read_date_list (
              date_list_file )
```

```
Read Date List from txt file
```

20.7.1.9 yymmdd()

```
def pysar._datetime.yymmdd (
              dates )
```

20.7.1.10 yymmdd2yyyymmdd()

```
def pysar._datetime.yymmdd2yyyymmdd (
              date )
```

20.7.1.11 yyyymmdd()

```
def pysar._datetime.yyyymmdd (
              dates )
```

20.7.1.12 yyyymmdd2years()

```
def pysar._datetime.yyyymmdd2years (
              dates )
```

20.8 pysar._gmt Namespace Reference

Functions

- def write_gmt_simple (lons, lats, z, fname, title='default', name='z', scale=1.0, offset=0, units='meters')

20.8.1 Function Documentation

20.8.1.1 write_gmt_simple()

```
def pysar._gmt.write_gmt_simple (
              lons,
              lats,
              z,
              fname,
              title = 'default',
              name = 'z',
              scale = 1.0,
              offset = 0,
              units = 'meters' )
```

```
Writes a simple GMT grd file with one array.

.. Args:

    * lons     -> 1D Array of lon values
    * lats     -> 1D Array of lat values
    * z        -> 2D slice to be saved
    * fname    -> Output file name

.. Kwargs:

    * title    -> Title for the grd file
    * name     -> Name of the field in the grd file
    * scale    -> Scale value in the grd file
    * offset   -> Offset value in the grd file

.. Returns:

    * None
```

20.9 pysar._network Namespace Reference

Functions

- def read_pairs_list (date12ListFile, dateList=[ ])
- def write_pairs_list (pairs, dateList, outName)
- def read_igram_pairs (igramFile)
- def read_baseline_file (baselineFile, exDateList=[ ])
- def date12_list2index (date12_list, date_list=[ ])
- def get_date12_list (File, check_drop_ifgram=False)
- def igram_perp_baseline_list (File)
- def azimuth_bandwidth (sensor)
- def range_bandwidth (sensor)
- def wavelength (sensor)
- def incidence_angle (sensor, inc_angle=None)
- def signal2noise_ratio (sensor)
- def critical_perp_baseline (sensor, inc_angle=None, print_msg=False)
- def calculate_doppler_overlap (dop_a, dop_b, bandwidth_az)
- def simulate_coherence (date12_list, baselineFile='bl_list.txt', sensor='Env', inc_angle=22.8, decor_↩ time=200.0, coh_resid=0.2, display=False)
- def threshold_doppler_overlap (date12_list, date_list, dop_list, bandwidth_az, dop_overlap_min=0.15)
- def threshold_perp_baseline (date12_list, date_list, pbase_list, pbase_max, pbase_min=0.0)
- def threshold_temporal_baseline (date12_list, btemp_max, keep_seasonal=True, btemp_min=0.0)
- def coherence_matrix (date12_list, coh_list, diagValue=np.nan)
- def threshold_coherence_based_mst (date12_list, coh_list)
- def pair_sort (pairs)
- def pair_merge (pairs1, pairs2)
- def select_pairs_all (date_list)
- def select_pairs_sequential (date_list, increment_num=2)
- def select_pairs_hierarchical (date_list, pbase_list, temp_perp_list)
- def select_pairs_delaunay (date_list, pbase_list, norm=True)
- def select_pairs_mst (date_list, pbase_list)
- def select_pairs_star (date_list, m_date=None, pbase_list=[ ])
- def select_master_date (date_list, pbase_list=[ ])
- def select_master_interferogram (date12_list, date_list, pbase_list, m_date=None)
- def plot_network (ax, date12_list, date_list, pbase_list, plot_dict={}, date12_list_drop=[ ], print_msg=True)
- def plot_perp_baseline_hist (ax, date8_list, pbase_list, plot_dict={}, date8_list_drop=[ ])
- def plot_coherence_matrix (ax, date12_list, coherence_list, date12_list_drop=[ ], plot_dict={})
- def mode (thelist)
- def plot_coherence_history (ax, date12_list, coherence_list, plot_dict={})
- def auto_adjust_yaxis (ax, dataList, fontSize=12, ymin=None, ymax=None)

Variables

- string BASELINE_LIST_FILE
- string IFGRAM_LIST_FILE

20.9.1 Function Documentation

20.9.1.1 auto_adjust_yaxis()

```
def pysar._network.auto_adjust_yaxis (
              ax,
              dataList,
              fontSize = 12,
              ymin = None,
              ymax = None )
```

```
Adjust Y axis
Input:
    ax       : matplot figure axes object
    dataList : list of float, value in y axis
    fontSize : float, font size
    ymin     : float, lower y axis limit
    ymax     : float, upper y axis limit
Output:
    ax
```

20.9.1.2 azimuth_bandwidth()

```
def pysar._network.azimuth_bandwidth (
              sensor )
```

```
Find the hardwired azimuth bandwidth in hertz for the given satellite
```

20.9.1.3 calculate_doppler_overlap()

```
def pysar._network.calculate_doppler_overlap (
              dop_a,
              dop_b,
              bandwidth_az )
```

```
Calculate Overlap Percentage of Doppler frequency in azimuth direction
Inputs:
    dop_a/b      : np.array of 3 floats, doppler frequency
    bandwidth_az : float, azimuth bandwidth
Output:
    dop_overlap  : float, doppler frequency overlap between a & b.
```

20.9.1.4 coherence_matrix()

```
def pysar._network.coherence_matrix (
              date12_list,
              coh_list,
              diagValue = np.nan )
```

```
Return coherence matrix based on input date12 list and its coherence
Inputs:
    date12_list - list of string in YYMMDD-YYMMDD format
    coh_list    - list of float, average coherence for each interferograms
Output:
    coh_matrix  - 2D np.array with dimension length = date num
                  np.nan value for interferograms non-existed.
                  1.0 for diagonal elements
```

20.9.1.5 critical_perp_baseline()

```
def pysar._network.critical_perp_baseline (
              sensor,
              inc_angle = None,
              print_msg = False )
```

```
Critical Perpendicular Baseline for each satellite
```

20.9.1.6 date12_list2index()

```
def pysar._network.date12_list2index (
              date12_list,
              date_list = [] )
```

```
Convert list of date12 string into list of index
```

20.9.1.7 get_date12_list()

```
def pysar._network.get_date12_list (
              File,
              check_drop_ifgram = False )
```

```
Read Date12 info from input file: Pairs.list or multi-group hdf5 file
Inputs:
    File - string, path/name of input multi-group hdf5 file or text file
    check_drop_ifgram - bool, check the "drop_ifgram" attribute or not for multi-group hdf5 file
Output:
    date12_list - list of string in YYMMDD-YYMMDD format
Example:
    date12List = get_date12_list('unwrapIfgram.h5')
    date12List = get_date12_list('unwrapIfgram.h5', check_drop_ifgram=True)
    date12List = get_date12_list('Pairs.list')
```

20.9.1.8 igram_perp_baseline_list()

```
def pysar._network.igram_perp_baseline_list (
              File )
```

```
Get perpendicular baseline list from input multi_group hdf5 file
```

20.9.1.9 incidence_angle()

```
def pysar._network.incidence_angle (
              sensor,
              inc_angle = None )
```

20.9.1.10 mode()

```
def pysar._network.mode (
              thelist )
```

```
Find Mode (most common) item in the list
Borrowded from pysar._pysar_utilities
```

20.9.1.11 pair_merge()

```
def pysar._network.pair_merge (
              pairs1,
              pairs2 )
```

20.9.1.12 pair_sort()

```
def pysar._network.pair_sort (
              pairs )
```

20.9.1.13 plot_coherence_history()

```
def pysar._network.plot_coherence_history (
              ax,
              date12_list,
              coherence_list,
              plot_dict = {} )
```

```
Plot min/max Coherence of all interferograms for each date
```

20.9.1.14 plot_coherence_matrix()

```
def pysar._network.plot_coherence_matrix (
              ax,
              date12_list,
              coherence_list,
              date12_list_drop = [],
              plot_dict = {} )
```

```
Plot Coherence Matrix of input network

if date12_list_drop is not empty, plot KEPT pairs in the upper triangle and
                                       ALL  pairs in the lower triangle.
```

20.9.1.15 plot_network()

```
def pysar._network.plot_network (
              ax,
              date12_list,
              date_list,
              pbase_list,
              plot_dict = {},
              date12_list_drop = [],
              print_msg = True )
```

```
Plot Temporal-Perp baseline Network
Inputs
    ax : matplotlib axes object
    date12_list : list of string for date12 in YYMMDD-YYMMDD format
    date_list   : list of string, for date in YYYYMMDD/YYMMDD format
    pbase_list  : list of float, perp baseline, len=number of acquisition
    plot_dict   : dictionary with the following items:
                  fontsize
                  linewidth
                  markercolor
                  markersize

                  coherence_list : list of float, coherence value of each interferogram, len = number of ifgra
                  disp_min/max :  float, min/max range of the color display based on coherence_list
                  colormap : string, colormap name
                  coh_thres : float, coherence of where to cut the colormap for display
                  disp_title : bool, show figure title or not, default: True
                  disp_drop: bool, show dropped interferograms or not, default: True
Output
    ax : matplotlib axes object
```

20.9.1.16 plot_perp_baseline_hist()

```
def pysar._network.plot_perp_baseline_hist (
              ax,
              date8_list,
              pbase_list,
              plot_dict = {},
              date8_list_drop = [] )
```

```
Plot Perpendicular Spatial Baseline History
Inputs
    ax : matplotlib axes object
    date8_list : list of string, date in YYYYMMDD format
    pbase_list : list of float, perp baseline
    plot_dict : dictionary with the following items:
                fontsize
                linewidth
                markercolor
                markersize
                disp_title : bool, show figure title or not, default: True
                every_year : int, number of years for the major tick on xaxis
    date8_list_drop : list of string, date dropped in YYYYMMDD format
                      e.g. ['20080711', '20081011']
Output:
    ax : matplotlib axes object
```

20.9.1.17 range_bandwidth()

```
def pysar._network.range_bandwidth (
              sensor )
```

20.9.1.18 read_baseline_file()

```
def pysar._network.read_baseline_file (
              baselineFile,
              exDateList = [] )
```

```
Read bl_list.txt without dates listed in exDateList
# Date  Bperp    dop0/PRF  dop1/PRF   dop2/PRF      PRF    slcDir
070106     0.0   0.03      0.0000000  0.00000000000 2155.2 /scratch/KyushuT422F650AlosA/SLC/070106/
070709  2631.9   0.07      0.0000000  0.00000000000 2155.2 /scratch/KyushuT422F650AlosA/SLC/070709/
070824  2787.3   0.07      0.0000000  0.00000000000 2155.2 /scratch/KyushuT422F650AlosA/SLC/070824/
...

Examples:
    date8List, perpBaseList, dopList, prfList, slcDirList = read_baseline_file(baselineFile)
    date8List, perpBaseList, dopList, prfList, slcDirList = read_baseline_file(baselineFile,['080520','100726'
    date8List, perpBaseList = read_baseline_file(baselineFile)[0:2]
```

20.9.1.19 read_igram_pairs()

```
def pysar._network.read_igram_pairs (
              igramFile )
```

```
Read pairs index from hdf5 file
```

20.9.1.20 read_pairs_list()

```
def pysar._network.read_pairs_list (
              date12ListFile,
              dateList = [] )
```

```
Read Pairs List file like below:
070311-070426
070311-070611
...
```

20.9.1.21 select_master_date()

```
def pysar._network.select_master_date (
              date_list,
              pbase_list = [] )
```

```
Select super master date based on input temporal and/or perpendicular baseline info.
Return master date in YYYYMMDD format.
```

20.9.1.22 select_master_interferogram()

```
def pysar._network.select_master_interferogram (
              date12_list,
              date_list,
              pbase_list,
              m_date = None )
```

```
Select reference interferogram based on input temp/perp baseline info
If master_date is specified, select its closest slave_date, which is newer than master_date;
    otherwise, choose the closest pair among all pairs as master interferogram.
Example:
    master_date12   = pnet.select_master_ifgram(date12_list, date_list, pbase_list)
    '080211-080326' = pnet.select_master_ifgram(date12_list, date_list, pbase_list, m_date='080211')
```

20.9.1.23 select_pairs_all()

```
def pysar._network.select_pairs_all (
              date_list )
```

```
Select All Possible Pairs/Interferograms
Input : date_list   - list of date in YYMMDD/YYYYMMDD format
Output: date12_list - list date12 in YYMMDD-YYMMDD format
Reference:
    Berardino, P., G. Fornaro, R. Lanari, and E. Sansosti (2002), A new algorithm for surface deformation moni
    based on small baseline differential SAR interferograms, IEEE TGRS, 40(11), 2375-2383.
```

20.9.1.24 select_pairs_delaunay()

```
def pysar._network.select_pairs_delaunay (
              date_list,
              pbase_list,
              norm = True )
```

```
Select Pairs using Delaunay Triangulation based on temporal/perpendicular baselines
Inputs:
    date_list  : list of date in YYMMDD/YYYYMMDD format
    pbase_list : list of float, perpendicular spatial baseline
    norm       : normalize temporal baseline to perpendicular baseline
Key points
    1. Define a ratio between perpendicular and temporal baseline axis units (Pepe and Lanari, 2006, TGRS).
    2. Pairs with too large perpendicular / temporal baseline or Doppler centroid difference should be removec
       after this, using a threshold, to avoid strong decorrelations (Zebker and Villasenor, 1992, TGRS).
Reference:
    Pepe, A., and R. Lanari (2006), On the extension of the minimum cost flow algorithm for phase unwrapping
    of multitemporal differential SAR interferograms, IEEE TGRS, 44(9), 2374-2383.
    Zebker, H. A., and J. Villasenor (1992), Decorrelation in interferometric radar echoes, IEEE TGRS, 30(5),
```

20.9.1.25 select_pairs_hierarchical()

```
def pysar._network.select_pairs_hierarchical (
              date_list,
              pbase_list,
              temp_perp_list )
```

```
Select Pairs in a hierarchical way using list of temporal and perpendicular baseline thresholds
    For each temporal/perpendicular combination, select all possible pairs; and then merge all combination res
    together for the final output (Zhao, 2015).
Inputs:
    date_list  : list of date in YYMMDD/YYYYMMDD format
    pbase_list : list of float, perpendicular spatial baseline
    temp_perp_list : list of list of 2 floats, for list of temporal/perp baseline, e.g.
                     [[32.0, 800.0], [48.0, 600.0], [64.0, 200.0]]
Examples:
    pairs = select_pairs_hierarchical(date_list, pbase_list, [[32.0, 800.0], [48.0, 600.0], [64.0, 200.0]])
Reference:
    Zhao, W., (2015), Small deformation detected from InSAR time-series and their applications in geophysics,
    dissertation, Univ. of Miami, Section 6.3.
```

20.9.1.26 select_pairs_mst()

```
def pysar._network.select_pairs_mst (
              date_list,
              pbase_list )
```

```
Select Pairs using Minimum Spanning Tree technique
    Connection Cost is calculated using the baseline distance in perp and scaled temporal baseline (Pepe and L
    2006, TGRS) plane.
Inputs:
    date_list  : list of date in YYMMDD/YYYYMMDD format
    pbase_list : list of float, perpendicular spatial baseline
References:
    Pepe, A., and R. Lanari (2006), On the extension of the minimum cost flow algorithm for phase unwrapping
    of multitemporal differential SAR interferograms, IEEE TGRS, 44(9), 2374-2383.
    Perissin D., Wang T. (2012), Repeat-pass SAR interferometry with partially coherent targets. IEEE TGRS. 27
```

20.9.1.27 select_pairs_sequential()

```
def pysar._network.select_pairs_sequential (
              date_list,
              increment_num = 2 )
```

```
Select Pairs in a Sequential way:
    For each acquisition, find its increment_num nearest acquisitions in the past time.
Inputs:
    date_list  : list of date in YYMMDD/YYYYMMDD format
Reference:
    Fattahi, H., and F. Amelung (2013), DEM Error Correction in InSAR Time Series, IEEE TGRS, 51(7), 4249-4259
```

20.9.1.28 select_pairs_star()

```
def pysar._network.select_pairs_star (
              date_list,
              m_date = None,
              pbase_list = [] )
```

```
Select Star-like network/interferograms/pairs, it's a single master network, similar to PS approach.
Usage:
    m_date : master date, choose it based on the following cretiria:
             1) near the center in temporal and spatial baseline
             2) prefer winter season than summer season for less temporal decorrelation
Reference:
    Ferretti, A., C. Prati, and F. Rocca (2001), Permanent scatterers in SAR interferometry, IEEE TGRS, 39(1),
```

20.9.1.29 signal2noise_ratio()

```
def pysar._network.signal2noise_ratio (
              sensor )
```

```
Fine the Signal to Noise Ratio in dB for the given satellite
Reference:
    ERS - Zebker et al., 1994, TGRS
    Envisat - Guarnieri, A.M., 2013. Introduction to RADAR. POLIMI DEI, Milano.
    JERS - https://directory.eoportal.org/web/eoportal/satellite-missions/j/jers-1
    Sentinel-1 - https://sentinels.copernicus.eu/web/sentinel/user-guides/sentinel-1-sar/acquisition-modes/int
```

20.9.1.30 simulate_coherence()

```
def pysar._network.simulate_coherence (
              date12_list,
              baselineFile = 'bl_list.txt',
              sensor = 'Env',
              inc_angle = 22.8,
              decor_time = 200.0,
              coh_resid = 0.2,
              display = False )
```

```
Simulate coherence for a given set of interferograms
Inputs:
    date12_list  - list of string in YYMMDD-YYMMDD format, indicating pairs configuration
    baselineFile - string, path of baseline list text file
    sensor       - string, SAR sensor
    inc_angle    - float, incidence angle
    decor_time   - float / 2D np.array in size of (1, pixel_num)
                   decorrelation rate in days, time for coherence to drop to 1/e of its initial value
    coh_resid    - float / 2D np.array in size of (1, pixel_num)
                   long-term coherence, minimum attainable coherence value
    display      - bool, display result as matrix or not
Output:
    cohs         - 2D np.array in size of (ifgram_num, pixel_num)
Example:
    date12_list = pnet.get_date12_list('ifgram_list.txt')
    cohs = simulate_coherences(date12_list, 'bl_list.txt', sensor='Tsx')

References:
    Zebker, H. A., & Villasenor, J. (1992). Decorrelation in interferometric radar echoes.
        IEEE-TGRS, 30(5), 950-959.
    Hanssen, R. F. (2001). Radar interferometry: data interpretation and error analysis
        (Vol. 2). Dordrecht, Netherlands: Kluwer Academic Pub.
    Morishita, Y., & Hanssen, R. F. (2015). Temporal decorrelation in L-, C-, and X-band satellite
        radar interferometry for pasture on drained peat soils. IEEE-TGRS, 53(2), 1096-1104.
    Parizzi, A., Cong, X., & Eineder, M. (2009). First Results from Multifrequency Interferometry.
        A comparison of different decorrelation time constants at L, C, and X Band. ESA Scientific
        Publications(SP-677), 1-5.
```

20.9.1.31 threshold_coherence_based_mst()

```
def pysar._network.threshold_coherence_based_mst (
              date12_list,
              coh_list )
```

```
Return a minimum spanning tree of network based on the coherence inverse.
Inputs:
    date12_list - list of string in YYMMDD-YYMMDD format
    coh_list    - list of float, average coherence for each interferogram
Output:
    mst_date12_list - list of string in YYMMDD-YYMMDD format, for MST network of interferograms
```

20.9.1.32 threshold_doppler_overlap()

```
def pysar._network.threshold_doppler_overlap (
              date12_list,
              date_list,
              dop_list,
              bandwidth_az,
              dop_overlap_min = 0.15 )
```

```
Remove pairs/interoferogram with doppler overlap larger than critical value
Inputs:
    date12_list : list of string, for date12 in YYMMDD-YYMMDD format
    date_list   : list of string, for date in YYMMDD/YYYYMMDD format, optional
    dop_list    : list of list of 3 float, for centroid Doppler frequency
    bandwidth_az    : float, bandwidth in azimuth direction
    dop_overlap_min : float, minimum overlap of azimuth Doppler frequency
Outputs:
    date12_list : list of string, for date12 in YYMMDD-YYMMDD format
```

20.9.1.33 threshold_perp_baseline()

```
def pysar._network.threshold_perp_baseline (
              date12_list,
              date_list,
              pbase_list,
              pbase_max,
              pbase_min = 0.0 )
```

```
Remove pairs/interoferogram out of [pbase_min, pbase_max]
Inputs:
    date12_list : list of string for date12 in YYMMDD-YYMMDD format
    date_list   : list of string for date in YYMMDD/YYYYMMDD format, optional
    pbase_list  : list of float for perpendicular spatial baseline
    pbase_max   : float, maximum perpendicular baseline
    pbase_min   : float, minimum perpendicular baseline
Output:
    date12_list_out : list of string for date12 in YYMMDD-YYMMDD format
Example:
    date12_list = threshold_perp_baseline(date12_list, date_list, pbase_list, 500)
```

20.9.1.34 threshold_temporal_baseline()

```
def pysar._network.threshold_temporal_baseline (
              date12_list,
              btemp_max,
              keep_seasonal = True,
              btemp_min = 0.0 )
```

```
Remove pairs/interferograms out of min/max/seasonal temporal baseline limits
Inputs:
    date12_list : list of string for date12 in YYMMDD-YYMMDD format
    btemp_max   : float, maximum temporal baseline
    btemp_min   : float, minimum temporal baseline
    keep_seasonal : keep interferograms with seasonal temporal baseline
Output:
    date12_list_out : list of string for date12 in YYMMDD-YYMMDD format
Example:
    date12_list = threshold_temporal_baseline(date12_list, 200)
    date12_list = threshold_temporal_baseline(date12_list, 200, False)
```

20.9.1.35 wavelength()

```
def pysar._network.wavelength (
              sensor )
```

20.9.1.36 write_pairs_list()

```
def pysar._network.write_pairs_list (
              pairs,
              dateList,
              outName )
```

Write pairs list file.

20.9.2 Variable Documentation

20.9.2.1 BASELINE_LIST_FILE

```
string BASELINE_LIST_FILE
```

Initial value:

```
= '''
# Date  Bperp    dop0/PRF  dop1/PRF   dop2/PRF   PRF    slcDir
070106     0.0   0.03      0.0000000  0.000000   2155.2 /KyushuT422F650AlosA/SLC/070106/
070709  2631.9   0.07      0.0000000  0.000000   2155.2 /KyushuT422F650AlosA/SLC/070709/
070824  2787.3   0.07      0.0000000  0.000000   2155.2 /KyushuT422F650AlosA/SLC/070824/
...
'''
```

20.9.2.2 IFGRAM_LIST_FILE

```
string IFGRAM_LIST_FILE
```

Initial value:

```
= '''
060713-070113
060828-070113
060828-070831
...
'''
```

20.10 pysar._plot Namespace Reference

Functions

- def plot_bar_std (ax, date_list, std_list, fig_name=None, ref_date=None)

20.10.1 Function Documentation

20.10.1.1 plot_bar_std()

```
def pysar._plot.plot_bar_std (
              ax,
              date_list,
              std_list,
              fig_name = None,
              ref_date = None )
```

```
Plot Residual Standard Deviation into a Bar figure
Inputs
    ax        - matplotlib axes object
    date_list - list of string, date in YYYYMMDD or YYMMDD format
    std_list  - list of float, residual standard deviation
    fig_name  - string, output figure name
    ref_date  - string, reference date in YYYYMMDD or YYMMDD format
Output:
    ax - matplotlib axes object
```

20.11 pysar._pysar_utilities Namespace Reference

Functions

- def touch (fname_list, times=None)
- def get_lookup_file (filePattern=None, abspath=False, print_msg=True)
- def get_geometry_file (dset, coordType=None, filePattern=None, abspath=False, print_msg=True)
- def check_loaded_dataset (work_dir='./', inps=None, print_msg=True)
- def is_file_exist (file_list, abspath=True)
- def four_corners (atr)
- def circle_index (atr, circle_par)
- def update_template_file (template_file, extra_dict)
- def get_residual_std (timeseries_resid_file, mask_file='maskTempCoh.h5', ramp_type='quadratic')
- def timeseries_std (inFile, maskFile='maskTempCoh.h5', outFile=None)
- def get_residual_rms (timeseries_resid_file, mask_file='maskTempCoh.h5', ramp_type='quadratic')
- def timeseries_rms (inFile, maskFile='maskTempCoh.h5', outFile=None, dimension=2)
- def timeseries_coherence (inFile, maskFile='maskTempCoh.h5', outFile=None)
- def normalize_timeseries (ts_mat, nanValue=0)
- def normalize_timeseries_old (ts_mat, nanValue=0)
- def update_file (outFile, inFile=None, overwrite=False, check_readable=True)
- def update_attribute_or_not (atr_new, atr_orig, update=False)
- def add_attribute (File, atr_new=dict())
- def check_parallel (file_num=1, print_msg=True)
- def perp_baseline_timeseries (atr, dimension=1)
- def range_distance (atr, dimension=2)
- def incidence_angle (atr, dimension=2, print_msg=True)
- def which (program)
- def check_drop_ifgram (h5, print_msg=True)
- def nonzero_mask (File, outFile='mask.h5')
- def spatial_average (File, maskFile=None, box=None, saveList=False, checkAoi=True)
- def temporal_average (File, outFile=None)

- def get_file_list (fileList, abspath=False, coord=None)
- def check_file_size (fname_list, mode_width=None, mode_length=None)
- def mode (thelist)
- def range_ground_resolution (atr, print_msg=False)
- def azimuth_ground_resolution (atr)
- def get_lookup_row_col (y, x, lut_y, lut_x, y_factor=10, x_factor=10, geoCoord=False)

    Use geomap∗.trans file for precious (pixel-level) coord conversion.
- def glob2radar (lat, lon, lookupFile=None, atr_rdr=dict(), print_msg=True)
- def radar2glob (az, rg, lookupFile=None, atr_rdr=dict(), print_msg=True)
- def check_variable_name (path)
- def hillshade (data, scale)
- def date_list (h5file)
- def design_matrix (ifgramFile=None, date12_list=[ ], referenceDate=None, zero_first=True)
- def timeseries_inversion_FGLS (h5flat, h5timeseries)
- def timeseries_inversion_L1 (h5flat, h5timeseries)
- def perp_baseline_ifgram2timeseries (ifgramFile, ifgram_list=[ ])
- def dBh_dBv_timeseries (ifgramFile)
- def Bh_Bv_timeseries (ifgramFile)
- def get_file_stack (File, maskFile=None)
- def stacking (File)
- def yymmdd2YYYYMMDD (date)
- def yyyymmdd (dates)
- def yymmdd (dates)
- def make_triangle (dates12, igram1, igram2, igram3)
- def get_triangles (h5file)
- def generate_curls (curlfile, h5file, Triangles, curls)

20.11.1 Function Documentation

20.11.1.1 add_attribute()

```
def pysar._pysar_utilities.add_attribute (
              File,
              atr_new = dict() )
```

```
Add/update input attribute into File
Inputs:
    File - string, path/name of file
    atr_new - dict, attributes to be added/updated
              if value is None, delete the item from input File attributes
Output:
    File - string, path/name of updated file
```

20.11.1.2 azimuth_ground_resolution()

```
def pysar._pysar_utilities.azimuth_ground_resolution (
              atr )
```

```
Get azimuth resolution on the ground in meters, from ROI_PAC attributes, for file in radar coord
```

20.11.1.3 Bh_Bv_timeseries()

```
def pysar._pysar_utilities.Bh_Bv_timeseries (
              ifgramFile )
```

20.11.1.4 check_drop_ifgram()

```
def pysar._pysar_utilities.check_drop_ifgram (
              h5,
              print_msg = True )
```

```
Update ifgram_list based on ’drop_ifgram’ attribute
Input:
    h5          - HDF5 file object
Output:
    dsListOut  - list of string, group name with drop_ifgram = ’yes’
Example:
    h5 = h5py.File(’unwrapIfgram.h5’,’r’)
    ifgram_list = ut.check_drop_ifgram(h5)
```

20.11.1.5 check_file_size()

```
def pysar._pysar_utilities.check_file_size (
              fname_list,
              mode_width = None,
              mode_length = None )
```

```
Check file size in the list of files, and drop those not in the same size with majority.
```

20.11.1.6 check_loaded_dataset()

```
def pysar._pysar_utilities.check_loaded_dataset (
              work_dir = './',
              inps = None,
              print_msg = True )
```

```
Check the result of loading data for the following two rules:
    1. file existance
    2. file attribute readability

If inps is valid/not_empty: return updated inps;
Otherwise, return True/False if all recommended file are loaded and readably or not

Inputs:
    work_dir : string, PySAR working directory
    inps     : Namespace, optional, variable for pysarApp.py. Not needed for check loading result.
Outputs:
    load_complete  : bool, complete loading or not
    ifgram_file    : string, file name/path of unwrapped interferograms
    coherence_file : string, file name/path of spatial coherence
    dem_file_radar : string, file name/path of DEM file in radara coord (for interferograms in radar coord)
    dem_file_geo   : string, file name/path of DEM file in geo coord
    lookup_file    : string, file name/path of lookup table file (for interferograms in radar coord)
Example:
    from pysar.pysarApp import check_loaded_dataset
    True = check_loaded_dataset($SCRATCHDIR+’/SinabungT495F50AlosA/PYSAR’) #if True, PROCESS, SLC folder coul
    inps = check_loaded_dataset(inps.work_dir, inps)
```

20.11.1.7 check_parallel()

```
def pysar._pysar_utilities.check_parallel (
              file_num = 1,
              print_msg = True )
```

```
Check parallel option based on pysar setting, file num and installed module
Examples:
    num_cores, inps.parallel, Parallel, delayed = ut.check_parallel(len(inps.file))
    num_cores, inps.parallel, Parallel, delayed = ut.check_parallel(1000)
```

20.11.1.8 check_variable_name()

```
def pysar._pysar_utilities.check_variable_name (
              path )
```

20.11.1.9 circle_index()

```
def pysar._pysar_utilities.circle_index (
              atr,
              circle_par )
```

```
Return Index of Elements within a Circle centered at input pixel
Inputs: atr : dictionary
            containging the following attributes:
            WIDT
            FILE_LENGTH
        circle_par : string in the format of 'y,x,radius'
            i.e. '200,300,20'          for radar coord
                 '31.0214,130.5699,20' for geo   coord
Output: idx : 2D np.array in bool type
            mask matrix for those pixel falling into the circle defined by circle_par
Examples: idx_mat = ut.circle_index(atr, '200,300,20')
          idx_mat = ut.circle_index(atr, '31.0214,130.5699,20')
```

20.11.1.10 date_list()

```
def pysar._pysar_utilities.date_list (
              h5file )
```

20.11.1.11 dBh_dBv_timeseries()

```
def pysar._pysar_utilities.dBh_dBv_timeseries (
              ifgramFile )
```

20.11.1.12 design_matrix()

```
def pysar._pysar_utilities.design_matrix (
              ifgramFile = None,
              date12_list = [],
              referenceDate = None,
              zero_first = True )
```

```
Make the design matrix for the inversion based on date12_list.
Reference:
    Berardino, P., Fornaro, G., Lanari, R., & Sansosti, E. (2002).
    A new algorithm for surface deformation monitoring based on small
    baseline differential SAR interferograms. IEEE TGRS, 40(11), 2375-2383.

Input:
    ifgramFile  - string, name/path of interferograms file
    date12_list - list of string, date12 used in calculation in YYMMDD-YYMMDD format
                  use all date12 from ifgramFile if input is empty
Outputs:
    A - 2D np.array in size of (ifgram_num, date_num-1)
        representing date combination for each interferogram (-1 for master, 1 for slave, 0 for others)
    B - 2D np.array in size of (ifgram_num, date_num-1)
        representing temporal baseline timeseries between master and slave date for each interferogram
```

20.11.1.13 four_corners()

```
def pysar._pysar_utilities.four_corners (
              atr )
```

```
Return 4 corners lat/lon
```

20.11.1.14 generate_curls()

```
def pysar._pysar_utilities.generate_curls (
              curlfile,
              h5file,
              Triangles,
              curls )
```

20.11.1.15 get_file_list()

```
def pysar._pysar_utilities.get_file_list (
              fileList,
              abspath = False,
              coord = None )
```

```
Get all existed files matching the input list of file pattern
Inputs:
    fileList - string or list of string, input file/directory pattern
    abspath  - bool, return absolute path or not
    coord    - string, return files with specific coordinate type: geo or radar
               if none, skip the checking and return all files
Output:
    fileListOut - list of string, existed file path/name, [] if not existed
Example:
    fileList = get_file_list(['*velocity*.h5','timeseries*.h5'])
    fileList = get_file_list('timeseries*.h5')
```

20.11.1.16 get_file_stack()

```
def pysar._pysar_utilities.get_file_stack (
              File,
              maskFile = None )
```

```
Get stack file of input File and return the stack 2D matrix
Input:   File/maskFile - string
Output:  stack - 2D np.array matrix
```

20.11.1.17 get_geometry_file()

```
def pysar._pysar_utilities.get_geometry_file (
              dset,
              coordType = None,
              filePattern = None,
              abspath = False,
              print_msg = True )
```

```
Find geometry file containing input specific dataset
```

20.11.1.18 get_lookup_file()

```
def pysar._pysar_utilities.get_lookup_file (
              filePattern = None,
              abspath = False,
              print_msg = True )
```

```
Find lookup table file with/without input file pattern
```

20.11.1.19 get_lookup_row_col()

```
def pysar._pysar_utilities.get_lookup_row_col (
              y,
              x,
              lut_y,
              lut_x,
              y_factor = 10,
              x_factor = 10,
              geoCoord = False )
```

Use geomap∗.trans file for precious (pixel-level) coord conversion.

```
Get row/col number in y/x value matrix from input y/x
Use overlap mean value between y and x buffer;
To support point outside of value pool/matrix, could use np.polyfit to fit a line
for y and x value buffer and return the intersection point row/col
```

20.11.1.20 get_residual_rms()

```
def pysar._pysar_utilities.get_residual_rms (
              timeseries_resid_file,
              mask_file = 'maskTempCoh.h5',
              ramp_type = 'quadratic' )
```

```
Calculate deramped Root Mean Square in space for each epoch of input timeseries file.
Inputs:
    timeseries_resid_file - string, timeseries HDF5 file, e.g. timeseries_ECMWF_demErrInvResid.h5
    mask_file - string, mask file, e.g. maskTempCoh.h5
    ramp_type - string, ramp type, e.g. plane, quadratic, no for do not remove ramp
outputs:
    rms_list  - list of float, Root Mean Square of deramped input timeseries file
    date_list - list of string in YYYYMMDD format, corresponding dates
Example:
    import pysar._pysar_utilities as ut
    rms_list, date_list = ut.get_residual_rms('timeseriesResidual.h5', 'maskTempCoh.h5')
```

20.11.1.21 get_residual_std()

```
def pysar._pysar_utilities.get_residual_std (
              timeseries_resid_file,
              mask_file = 'maskTempCoh.h5',
              ramp_type = 'quadratic' )
```

```
Calculate deramped standard deviation in space for each epoch of input timeseries file.
Inputs:
    timeseries_resid_file - string, timeseries HDF5 file, e.g. timeseries_ECMWF_demErrInvResid.h5
    mask_file - string, mask file, e.g. maskTempCoh.h5
    ramp_type - string, ramp type, e.g. plane, quadratic, no for do not remove ramp
outputs:
    std_list  - list of float, standard deviation of deramped input timeseries file
    date_list - list of string in YYYYMMDD format, corresponding dates
Example:
    import pysar._pysar_utilities as ut
    std_list, date_list = ut.get_residual_std('timeseries_ECMWF_demErrInvResid.h5', 'maskTempCoh.h5')
```

20.11.1.22 get_triangles()

```
def pysar._pysar_utilities.get_triangles (
              h5file )
```

20.11.1.23 glob2radar()

```
def pysar._pysar_utilities.glob2radar (
              lat,
              lon,
              lookupFile = None,
              atr_rdr = dict(),
              print_msg = True )
```

```
Convert geo coordinates into radar coordinates.
Inputs:
    lat/lon    - np.array, float, latitude/longitude
    lookupFile - string, trans/look up file
    atr_rdr    - dict, attributes of file in radar coord, optional but recommended.
Output:
    az/rg     - np.array, float, range/azimuth pixel number
    az/rg_res - float, residul/uncertainty of coordinate conversion
```

20.11.1.24 hillshade()

```
def pysar._pysar_utilities.hillshade (
              data,
              scale )
```

```
from scott baker, ptisk library
```

20.11.1.25 incidence_angle()

```
def pysar._pysar_utilities.incidence_angle (
              atr,
              dimension = 2,
              print_msg = True )
```

```
Calculate 2D matrix of incidence angle from ROI_PAC attributes, very accurate.
Input:
    dictionary - ROI_PAC attributes including the following items:
                 STARTING_RANGE
                 RANGE_PIXEL_SIZE
                 EARTH_RADIUS
                 HEIGHT
                 FILE_LENGTH
                 WIDTH
    dimension - int,
                2 for 2d matrix
                1 for 1d array
                0 for one center value
Output: 2D np.array - incidence angle in degree for each pixel
```

20.11.1.26 is_file_exist()

```
def pysar._pysar_utilities.is_file_exist (
              file_list,
              abspath = True )
```

```
Check if any file in the file list 1) exists and 2) readable
Inputs:
    file_list : list of string, file name with/without wildcards
    abspath   : bool, return absolute file name/path or not
Output:
    file_path : string, found file name/path; None if not.
```

20.11.1.27 make_triangle()

```
def pysar._pysar_utilities.make_triangle (
              dates12,
              igram1,
              igram2,
              igram3 )
```

20.11.1.28 mode()

```
def pysar._pysar_utilities.mode (
              thelist )
```

```
Find Mode (most common) item in the list
```

20.11.1.29 nonzero_mask()

```
def pysar._pysar_utilities.nonzero_mask (
              File,
              outFile = 'mask.h5' )
```

```
Generate mask file for non-zero value of input multi-group hdf5 file
```

20.11.1.30 normalize_timeseries()

```
def pysar._pysar_utilities.normalize_timeseries (
              ts_mat,
              nanValue = 0 )
```

```
Normalize timeseries of 2D matrix in time domain
```

20.11.1.31 normalize_timeseries_old()

```
def pysar._pysar_utilities.normalize_timeseries_old (
              ts_mat,
              nanValue = 0 )
```

20.11.1.32 perp_baseline_ifgram2timeseries()

```
def pysar._pysar_utilities.perp_baseline_ifgram2timeseries (
              ifgramFile,
              ifgram_list = [] )
```

```
Calculate perpendicular baseline timeseries from input interferograms file
Input:
    ifgramFile - string, file name/path of interferograms file
    ifgram_list - list of string, group name that is used for calculation
                  use all if it’s empty
Outputs:
    pbase        - 1D np.array, P_BASELINE_TIMESERIES
    pbase_top    - 1D np.array, P_BASELINE_TOP_TIMESERIES
    pbase_bottom - 1D np.array, P_BASELINE_BOTTOM_TIMESERIES
```

20.11.1.33 perp_baseline_timeseries()

```
def pysar._pysar_utilities.perp_baseline_timeseries (
              atr,
              dimension = 1 )
```

```
Calculate perpendicular baseline for each acquisition within timeseries
Inputs:
    atr - dict, including the following PySAR attribute
          FILE_LENGTH
          P_BASELINE_TIMESERIES
          P_BASELINE_TOP_TIMESERIES (optional)
          P_BASELINE_BOTTOM_TIMESERIES (optional)
    dimension - int, choices = [0, 1]
                0 for constant P_BASELINE in azimuth direction
                1 for linear P_BASELINE in azimuth direction, for radar coord only
Output:
    pbase - np.array, with shape = [date_num, 1] or [date_num, length]
```

20.11.1.34 radar2glob()

```
def pysar._pysar_utilities.radar2glob (
              az,
              rg,
              lookupFile = None,
              atr_rdr = dict(),
              print_msg = True )
```

```
Convert radar coordinates into geo coordinates
Inputs:
    rg/az      - np.array, int, range/azimuth pixel number
    lookupFile - string, trans/look up file
    atr_rdr    - dict, attributes of file in radar coord, optional but recommended.
Output:
    lon/lat    - np.array, float, longitude/latitude of input point (rg,az); nan if not found.
    latlon_res - float, residul/uncertainty of coordinate conversion
```

20.11.1.35 range_distance()

```
def pysar._pysar_utilities.range_distance (
              atr,
              dimension = 2 )
```

```
Calculate range distance from input attribute dict
Inputs:
    atr - dict, including the following ROI_PAC attributes:
          STARTING_RANGE
          RANGE_PIXEL_SIZE
          FILE_LENGTH
          WIDTH
    dimension - int, choices = [0,1,2]
                2 for 2d matrix, vary in range direction, constant in az direction, for radar coord only
                1 for 1d matrix, in range direction, for radar coord file
                0 for center value
Output: np.array (0, 1 or 2 D) - range distance between antenna and ground target in meters
```

20.11.1.36 range_ground_resolution()

```
def pysar._pysar_utilities.range_ground_resolution (
              atr,
              print_msg = False )
```

```
Get range resolution on the ground in meters, from ROI_PAC attributes, for file in radar coord
```

20.11.1.37 spatial_average()

```
def pysar._pysar_utilities.spatial_average (
              File,
              maskFile = None,
              box = None,
              saveList = False,
              checkAoi = True )
```

```
Read/Calculate Spatial Average of input file.

If input file is text file, read it directly;
If input file is data matrix file:
    If corresponding text file exists with the same mask file/AOI info, read it directly;
    Otherwise, calculate it from data file.

    Only non-nan pixel is considered.
Input:
    File     : string, path of input file
    maskFile : string, path of mask file, e.g. maskTempCoh.h5
    box      : 4-tuple defining the left, upper, right, and lower pixel coordinate
    saveList : bool, save (list of) mean value into text file
Output:
    mean_list : list for float, average value in space for each epoch of input file
    date_list : list of string for date info
                date12_list, e.g. 101120-110220, for interferograms/coherence
                date8_list, e.g. 20101120, for timeseries
                file name, e.g. velocity.h5, for all the other file types
Example:
    mean_list = spatial_average('coherence.h5')[0]
    ref_list  = spatial_average('unwrapIfgram.h5', box=(100,200,101,201))[0]
    mean_list, date12_list = spatial_average('coherence.h5', 'maskTempCoh.h5', saveList=True)

    stack = ut.get_file_stack('unwrapIfgram.h5', 'mask.h5')
    mask = ~np.isnan(stack)
    ref_list = ut.spatial_average('unwrapIfgram.h5', mask, (100,200,101,201))
```

20.11.1.38 stacking()

```
def pysar._pysar_utilities.stacking (
              File )
```

```
Stack multi-temporal dataset into one equivalent to temporal sum
For interferograms, the averaged velocity is calculated.
```

20.11.1.39 temporal_average()

```
def pysar._pysar_utilities.temporal_average (
              File,
              outFile = None )
```

```
Calculate temporal average.
```

20.11.1.40 timeseries_coherence()

```
def pysar._pysar_utilities.timeseries_coherence (
              inFile,
              maskFile = 'maskTempCoh.h5',
              outFile = None )
```

```
Calculate spatial average coherence for each epoch of input time series file
Inputs:
    inFile   - string, timeseries HDF5 file
    maskFile - string, mask file
    outFile  - string, output text file
Example:
    txtFile = timeseries_coherence('timeseries_ECMWF_demErrInvResid_quadratic.h5')
```

20.11.1.41 timeseries_inversion_FGLS()

```
def pysar._pysar_utilities.timeseries_inversion_FGLS (
              h5flat,
              h5timeseries )
```

```
Implementation of the SBAS algorithm.

Usage:
timeseries_inversion(h5flat,h5timeseries)
  h5flat: hdf5 file with the interferograms
  h5timeseries: hdf5 file with the output from the inversion
##################################################
```

20.11.1.42 timeseries_inversion_L1()

```
def pysar._pysar_utilities.timeseries_inversion_L1 (
              h5flat,
              h5timeseries )
```

20.11.1.43 timeseries_rms()

```
def pysar._pysar_utilities.timeseries_rms (
              inFile,
              maskFile = 'maskTempCoh.h5',
              outFile = None,
              dimension = 2 )
```

```
Calculate the Root Mean Square for each epoch of input timeseries file
and output result to a text file.
```

20.11.1.44 timeseries_std()

```
def pysar._pysar_utilities.timeseries_std (
              inFile,
              maskFile = 'maskTempCoh.h5',
              outFile = None )
```

```
Calculate the standard deviation for each epoch of input timeseries file
and output result to a text file.
```

20.11.1.45 touch()

```
def pysar._pysar_utilities.touch (
              fname_list,
              times = None )
```

```
python equivalent function to Unix utily - touch
It sets the modification and access times of files to the current time of day.
If the file doesn’t exist, it is created with default permissions.
Inputs/Output:
    fname_list - string / list of string
```

20.11.1.46 update_attribute_or_not()

```
def pysar._pysar_utilities.update_attribute_or_not (
              atr_new,
              atr_orig,
              update = False )
```

```
Compare new attributes with exsiting ones
```

20.11.1.47 update_file()

```
def pysar._pysar_utilities.update_file (
              outFile,
              inFile = None,
              overwrite = False,
              check_readable = True )
```

```
Check whether to update outFile/outDir or not.
return True if any of the following meets:
    1. if overwrite option set to True
    2. outFile is empty, e.g. None, []
    3. outFile is not existed
    4. outFile is not readable by readfile.read_attribute() when check_readable=True
    5. outFile is older than inFile, if inFile is not None
Otherwise, return False.

If inFile=None and outFile exists and readable, return False

Inputs:
    inFile - string or list of string, input file(s)/directories
Output:
    True/False - bool, whether to update output file or not
Example:
    if ut.update_file('timeseries_ECMWF_demErr.h5', 'timeseries_ECMWF.h5'):
    if ut.update_file('exclude_date.txt', ['timeseries_ECMWF_demErrInvResid.h5','maskTempCoh.h5','pysar_templa
                      check_readable=False):
```

20.11.1.48 update_template_file()

```
def pysar._pysar_utilities.update_template_file (
              template_file,
              extra_dict )
```

```
Update option value in template_file with value from input extra_dict
```

20.11.1.49 which()

```
def pysar._pysar_utilities.which (
              program )
```

```
Test if executable exists
```

20.11.1.50 yymmdd()

```
def pysar._pysar_utilities.yymmdd (
              dates )
```

20.11.1.51 yymmdd2YYYYMMDD()

```
def pysar._pysar_utilities.yymmdd2YYYYMMDD (
              date )
```

20.11.1.52 yyyymmdd()

```
def pysar._pysar_utilities.yyyymmdd (
              dates )
```

20.12 pysar._readfile Namespace Reference

Functions

- def read (File, box=None, epoch=None, print_msg=True)
- def read_attribute (File, epoch=None)
- def check_variable_name (path)
- def is_plot_attribute (attribute)
- def read_template (File, delimiter='=')
- def read_roipac_rsc (File)
- def read_gamma_par (fname, delimiter=':', skiprows=3, convert2roipac=True)
- def read_isce_xml (File)
- def attribute_gamma2roipac (par_dict_in)
- def attribute_isce2roipac (metaDict, dates=[ ], baselineDict={})
- def attribute_envi2roipac (metaDict)
- def read_float32 (File, box=None, byte_order='l')
- def read_real_float64 (fname, box=None, byte_order='l')
- def read_complex_float32 (fname, box=None, byte_order='l', cpx=False)
- def read_real_float32 (fname, box=None, byte_order='l')
- def read_complex_int16 (File, box=None, byte_order='l', cpx=False)
- def read_real_int16 (File, box=None, byte_order='l')
- def read_bool (File, box=None)
- def read_GPS_USGS (File)
- def read_multiple (File, box='')

Variables

- list multi_group_hdf5_file = ['interferograms','coherence','wrapped','snaphu_connect_component']
- list multi_dataset_hdf5_file = ['timeseries','geometry']
- list single_dataset_hdf5_file = ['dem','mask','rmse','temporal_coherence', 'velocity']
- list geometry_dataset

20.12.1 Function Documentation

20.12.1.1 attribute_envi2roipac()

```
def pysar._readfile.attribute_envi2roipac (
              metaDict )
```

```
Convert ISCE xml attribute into ROI_PAC format
```

20.12.1.2 attribute_gamma2roipac()

```
def pysar._readfile.attribute_gamma2roipac (
              par_dict_in )
```

```
Convert Gamma par attribute into ROI_PAC format
```

20.12.1.3 attribute_isce2roipac()

```
def pysar._readfile.attribute_isce2roipac (
              metaDict,
              dates = [],
              baselineDict = {} )
```

```
Convert ISCE xml attribute into ROI_PAC format
```

20.12.1.4 check_variable_name()

```
def pysar._readfile.check_variable_name (
              path )
```

20.12.1.5 is_plot_attribute()

```
def pysar._readfile.is_plot_attribute (
              attribute )
```

20.12.1.6 read()

```
def pysar._readfile.read (
              File,
              box = None,
              epoch = None,
              print_msg = True )
```

```
Read one dataset and its attributes from input file.

Read one dataset, i.e. interferogram, coherence, velocity, dem ...
return 0 if failed.

Inputs:
    File  : str, path of file to read
            PySAR   file: interferograms, timeseries, velocity, etc.
            ROI_PAC file: .unw .cor .hgt .dem .trans
            Gamma   file: .mli .slc
            Image   file: .jpeg .jpg .png .ras .bmp
    box   : 4-tuple of int, area to read, defined in (x0, y0, x1, y1) in pixel coordinate
    epoch : string, epoch to read, for multi-dataset files
            for .trans file:
            '' - return both dataset
            rg, range   - for geomap_*.trans file
            az, azimuth - for geomap_*.trans file

Outputs:
    data : 2-D matrix in numpy.array format, return None if failed
    atr  : dictionary, attributes of data, return None if failed

Examples:
    data, atr = read('velocity.h5')
    data, atr = read('100120-110214.unw', box=(100,1100, 500, 2500))
    data, atr = read('timeseries.h5', epoch='20101120')
    data, atr = read('timeseries.h5', box=(100,1100, 500, 2500), epoch='20101120')
    az,   atr = read('geomap*.trans', epoch='azimuth')
    rg,az,atr = read('geomap*.trans')
```

20.12.1.7 read_attribute()

```
def pysar._readfile.read_attribute (
              File,
              epoch = None )
```

```
Read attributes of input file into a dictionary
Input  : string, file name and epoch (optional)
Output : dictionary, attributes dictionary
```

20.12.1.8 read_bool()

```
def pysar._readfile.read_bool (
              File,
              box = None )
```

```
Read binary file with flags, 1-byte values with flags set in bits
For ROI_PAC .flg, *_snap_connect.byt file.
```

20.12.1.9 read_complex_float32()

```
def pysar._readfile.read_complex_float32 (
              fname,
              box = None,
              byte_order = 'l',
              cpx = False )
```

```
Read complex float 32 data matrix, i.e. roi_pac int or slc data.
old name: read_complex64()

ROI_PAC file: .slc, .int, .amp

Data is sotred as:
real, imaginary, real, imaginary, ...
real, imaginary, real, imaginary, ...
...

Inputs:
    fname      : str, input file name
    box        : 4-tuple defining (left, upper, right, lower) pixel coordinate.
    byte_order : str, optional, order of reading byte in the file
    cpx        : flag for output format,
                 0 for amplitude and phase [by default],
                 non-0 : for real and imagery
Output:
    data : 2D np.array in complex float32
Example:
    amp, phase, atr = read_complex_float32('geo_070603-070721_0048_00018.int')
    data, atr       = read_complex_float32('150707.slc', 1)
```

20.12.1.10 read_complex_int16()

```
def pysar._readfile.read_complex_int16 (
              File,
              box = None,
              byte_order = 'l',
              cpx = False )
```

```
Read complex int 16 data matrix, i.e. GAMMA SCOMPLEX file (.slc)

Gamma file: .slc

Inputs:
   file: complex data matrix (cpx_int16)
   box: 4-tuple defining the left, upper, right, and lower pixel coordinate.
Example:
   data,rsc = read_complex_int16('100102.slc')
   data,rsc = read_complex_int16('100102.slc',(100,1200,500,1500))
```

20.12.1.11 read_float32()

```
def pysar._readfile.read_float32 (
              File,
              box = None,
              byte_order = 'l' )
```

```
Reads roi_pac data (RMG format, interleaved line by line)
should rename it to read_rmg_float32()

ROI_PAC file: .unw, .cor, .hgt, .trans, .msk

RMG format (named after JPL radar pionner Richard M. Goldstein): made
up of real*4 numbers in two arrays side-by-side. The two arrays often
show the magnitude of the radar image and the phase, although not always
(sometimes the phase is the correlation). The length and width of each
array are given as lines in the metadata (.rsc) file. Thus the total
width width of the binary file is (2*width) and length is (length), data
are stored as:
magnitude, magnitude, magnitude, ...,phase, phase, phase, ...
magnitude, magnitude, magnitude, ...,phase, phase, phase, ...
......

   box  : 4-tuple defining the left, upper, right, and lower pixel coordinate.
Example:
   a,p,r = read_float32('100102-100403.unw')
   a,p,r = read_float32('100102-100403.unw',(100,1200,500,1500))
```

20.12.1.12 read_gamma_par()

```
def pysar._readfile.read_gamma_par (
              fname,
              delimiter = ':',
              skiprows = 3,
              convert2roipac = True )
```

```
Read GAMMA .par/.off file into a python dictionary structure.
Parameters: fname : file, str, or path.
                File path of .par, .off file.
            delimiter : str, optional
                String used to separate values.
            skiprows : int, optional
                Skip the first skiprows lines.
Returns:    par_dict : dict
                Attributes dictionary
```

20.12.1.13 read_GPS_USGS()

```
def pysar._readfile.read_GPS_USGS (
              File )
```

20.12.1.14 read_isce_xml()

```
def pysar._readfile.read_isce_xml (
              File )
```

```
Read ISCE .xml file input a python dictionary structure.
```

20.12.1.15 read_multiple()

```
def pysar._readfile.read_multiple (
              File,
              box = '' )
```

```
Read multi-temporal 2D datasets into a 3-D data stack
Inputs:
    File  : input file, interferograms,coherence, timeseries, ...
    box   : 4-tuple defining the left, upper, right, and lower pixel coordinate [optional]
Examples:
    stack = stacking('timeseries.h5',(100,1200,500,1500))
```

20.12.1.16 read_real_float32()

```
def pysar._readfile.read_real_float32 (
              fname,
              box = None,
              byte_order = 'l' )
```

```
Read real float 32 data matrix, i.e. GAMMA .mli file
Parameters: fname      : str, path, filename to be read
            byte_order : str, optional, order of reading byte in the file
Returns: data : 2D np.array, data matrix
         atr  : dict, attribute dictionary
Usage: data, atr = read_real_float32('20070603.mli')
       data, atr = read_real_float32('diff_filt_130118-130129_4rlks.unw')
```

20.12.1.17 read_real_float64()

```
def pysar._readfile.read_real_float64 (
              fname,
              box = None,
              byte_order = 'l' )
```

```
Read real float64/double data matrix, i.e. isce lat/lon.rdr
```

20.12.1.18 read_real_int16()

```
def pysar._readfile.read_real_int16 (
              File,
              box = None,
              byte_order = 'l' )
```

20.12.1.19 read_roipac_rsc()

```
def pysar._readfile.read_roipac_rsc (
              File )
```

```
Read ROI_PAC .rsc file into a python dictionary structure.
```

20.12.1.20 read_template()

```
def pysar._readfile.read_template (
              File,
              delimiter = '=' )
```

```
Reads the template file into a python dictionary structure.
Input : string, full path to the template file
Output: dictionary, pysar template content
Example:
    tmpl = read_template(KyushuT424F610_640AlosA.template)
    tmpl = read_template(R1_54014_ST5_L0_F898.000.pi, ':')
```

20.12.2 Variable Documentation

20.12.2.1 geometry_dataset

```
list geometry_dataset
```

Initial value:

```
= ['rangeCoord','azimuthCoord','latitude','longitude','height',\
                 'incidenceAngle','headingAngle','slantRangeDistance','waterMask','shadowMask']
```

20.12.2.2 multi_dataset_hdf5_file

```
list multi_dataset_hdf5_file = ['timeseries','geometry']
```

20.12.2.3 multi_group_hdf5_file

```
list multi_group_hdf5_file = ['interferograms','coherence','wrapped','snaphu_connect_component']
```

20.12.2.4 single_dataset_hdf5_file

```
list single_dataset_hdf5_file = ['dem','mask','rmse','temporal_coherence', 'velocity']
```

20.13 pysar._remove_surface Namespace Reference

Functions

- def remove_data_surface (data, mask, surf_type='plane')
- def remove_data_multiple_surface (data, mask, surf_type, ysub)
- def remove_surface (File, surf_type, maskFile=None, outFile=None, ysub=None)

20.13.1 Function Documentation

20.13.1.1 remove_data_multiple_surface()

```
def pysar._remove_surface.remove_data_multiple_surface (
              data,
              mask,
              surf_type,
              ysub )
```

20.13.1.2 remove_data_surface()

```
def pysar._remove_surface.remove_data_surface (
              data,
              mask,
              surf_type = 'plane' )
```

```
Remove surface from input data matrix based on pixel marked by mask
```

20.13.1.3 remove_surface()

```
def pysar._remove_surface.remove_surface (
              File,
              surf_type,
              maskFile = None,
              outFile = None,
              ysub = None )
```

20.14 pysar._sensor Namespace Reference

Classes

- class JERS

  Program is part of PySAR v1.0 # Copyright(c) 2016, Yunjun Zhang # Author: Yunjun Zhang #.

20.15 pysar._variance Namespace Reference

Functions

- def get_lat_lon (atr)
- def sample_data (lat, lon, mask=None, num_sample=500)
- def get_distance (lat, lon, i)
- def structure_function (data, lat, lon, step=5e3, min_pair_num=100e3, print_msg=True)
- def bin_variance (distance, variance, step=5e3, min_pair_num=100e3, print_msg=True)

20.15.1 Function Documentation

20.15.1.1 bin_variance()

```
def pysar._variance.bin_variance (
              distance,
              variance,
              step = 5e3,
              min_pair_num = 100e3,
              print_msg = True )
```

20.15.1.2 get_distance()

```
def pysar._variance.get_distance (
              lat,
              lon,
              i )
```

```
Return the distance of all points in lat/lon from its ith point
```

20.15.1.3 get_lat_lon()

```
def pysar._variance.get_lat_lon (
              atr )
```

```
Get lat/lon of all pixels
```

20.15.1.4 sample_data()

```
def pysar._variance.sample_data (
              lat,
              lon,
              mask = None,
              num_sample = 500 )
```

20.15.1.5 structure_function()

```
def pysar._variance.structure_function (
              data,
              lat,
              lon,
              step = 5e3,
              min_pair_num = 100e3,
              print_msg = True )
```

20.16 pysar._writefile Namespace Reference

Functions

- def write (args)
- def write_roipac_rsc (atr, outname, sorting=True)
- def write_float32 (args)
- def write_complex64 (data, outname)
- def write_real_int16 (data, outname)
- def write_dem (data, outname)
- def write_real_float32 (data, outname)
- def write_complex_int16 (data, outname)

20.16.1 Function Documentation

20.16.1.1 write()

```
def pysar._writefile.write (
              args )
```

```
Write one dataset, i.e. interferogram, coherence, velocity, dem ...
    Return 0 if failed.

Usage:
    write(data,atr,outname)
    write(rg,az,atr,outname)

Inputs:
    data : 2D data matrix
    atr  : attribute object
    outname : output file name

Output:
    output file name

Examples:
    write(data,atr,'velocity.h5')
    write(data,atr,'temporal_coherence.h5')
    write(data,atr,'100120-110214.unw')
    write(data,atr,'strm1.dem')
    write(data,atr,'100120.mli')
    write(rg,az,atr,'geomap_4lks.trans')
```

20.16.1.2 write_complex64()

```
def pysar._writefile.write_complex64 (
              data,
              outname )
```

```
Writes roi_pac .int data
```

20.16.1.3 write_complex_int16()

```
def pysar._writefile.write_complex_int16 (
              data,
              outname )
```

```
Write gamma scomplex data, i.e. .slc file.
    data is complex 2-D matrix
    real, imagery, real, ...
```

20.16.1.4 write_dem()

```
def pysar._writefile.write_dem (
              data,
              outname )
```

20.16.1.5 write_float32()

```
def pysar._writefile.write_float32 (
              args )
```

```
Write ROI_PAC rmg format with float32 precision
Format of the binary file is same as roi_pac unw, cor, or hgt data.
      should rename to write_rmg_float32()

Exmaple:
        write_float32(phase, outname)
        write_float32(amp, phase, outname)
```

20.16.1.6 write_real_float32()

```
def pysar._writefile.write_real_float32 (
              data,
              outname )
```

```
write gamma float data, i.e. .mli file.
```

20.16.1.7 write_real_int16()

```
def pysar._writefile.write_real_int16 (
              data,
              outname )
```

20.16.1.8 write_roipac_rsc()

```
def pysar._writefile.write_roipac_rsc (
              atr,
              outname,
              sorting = True )
```

```
Write attribute dict into ROI_PAC .rsc file
Inputs:
    atr     - dict, attributes dictionary
    outname - rsc file name, to which attribute is writen
    sorting - bool, sort attributes in alphabetic order while writing
Output:
    outname
```

20.17 pysar.add Namespace Reference

Functions

- def add_matrix (data1, data2)
- def add_files (fname_list, fname_out=None)
- def cmdLineParse ()
- def main (argv)

Variables

- string EXAMPLE

20.17.1 Function Documentation

20.17.1.1 add_files()

```
def pysar.add.add_files (
              fname_list,
              fname_out = None )
```

```
Generate sum of all input files
Inputs:
    fname_list - list of string, path/name of input files to be added
    fname_out  - string, optional, path/name of output file
Output:
    fname_out  - string, path/name of output file
Example:
    'mask_all.h5' = add_file(['mask_1.h5','mask_2.h5','mask_3.h5'], 'mask_all.h5')
```

20.17.1.2 add_matrix()

```
def pysar.add.add_matrix (
              data1,
              data2 )
```

```
Sum of 2 input matrix
```

20.17.1.3 cmdLineParse()

```
def pysar.add.cmdLineParse ( )
```

20.17.1.4 main()

```
def pysar.add.main (
              argv )
```

20.17.2 Variable Documentation

20.17.2.1 EXAMPLE

```
string EXAMPLE
```

Initial value:

```
= '''example:
  add.py  mask_1.h5 mask_2.h5 mask_3.h5           -o mask_all.h5
  add.py  081008_100220.unw    100220_110417.unw  -o 081008_110417.unw
  add.py  timeseries_ECMWF.h5  ECMWF.h5           -o  timeseries.h5
'''
```

20.18 pysar.add_attribute Namespace Reference

Functions

- def usage ()
- def main (argv)

20.18.1 Function Documentation

20.18.1.1 main()

```
def pysar.add_attribute.main (
                argv )
```

20.18.1.2 usage()

```
def pysar.add_attribute.usage ( )
```

20.19 pysar.add_attribute_insarmaps Namespace Reference

Classes

- class InsarDatabaseController
- class InsarDatasetController

Functions

- def build_parser ()
- def main (argv)

20.19.1 Function Documentation

20.19.1.1 build_parser()

```
def pysar.add_attribute_insarmaps.build_parser ( )
```

20.19.1.2 main()

```
def pysar.add_attribute_insarmaps.main (
              argv )
```

20.20 pysar.asc_desc Namespace Reference

Functions

- def get_overlap_lalo (atr1, atr2)
- def cmdLineParse ()
- def main (argv)

Variables

- REFERENCE
- EXAMPLE

20.20.1 Function Documentation

20.20.1.1 cmdLineParse()

```
def pysar.asc_desc.cmdLineParse ( )
```

20.20.1.2 get_overlap_lalo()

```
def pysar.asc_desc.get_overlap_lalo (
              atr1,
              atr2 )
```

```
Find overlap area in lat/lon of two geocoded files
Inputs:
    atr1/2 - dict, attribute dictionary of two input files in geo coord
Outputs:
    W/E/S/N - float, West/East/South/North in deg
```

20.20.1.3 main()

```
def pysar.asc_desc.main (
              argv )
```

20.20.2 Variable Documentation

20.20.2.1 EXAMPLE

```
EXAMPLE
```

20.20.2.2 REFERENCE

```
REFERENCE
```

20.21 pysar.baseline_error Namespace Reference

Functions

- def to_percent (y, position)
- def usage ()
- def main (argv)

20.21.1 Function Documentation

20.21.1.1 main()

```
def pysar.baseline_error.main (
              argv )
```

20.21.1.2 to_percent()

```
def pysar.baseline_error.to_percent (
              y,
              position )
```

20.21.1.3 usage()

```
def pysar.baseline_error.usage ( )
```

20.22 pysar.baseline_trop Namespace Reference

Functions

- def to_percent (y, position)
- def usage ()
- def main (argv)

20.22.1 Function Documentation

20.22.1.1 main()

```
def pysar.baseline_trop.main (
              argv )
```

20.22.1.2 to_percent()

```
def pysar.baseline_trop.to_percent (
              y,
              position )
```

20.22.1.3 usage()

```
def pysar.baseline_trop.usage ( )
```

20.23 pysar.coord_glob2radar Namespace Reference

Functions

- def usage ()
- def main (argv)

20.23.1 Function Documentation

20.23.1.1 main()

```
def pysar.coord_glob2radar.main (
              argv )
```

20.23.1.2 usage()

```
def pysar.coord_glob2radar.usage ( )
```

20.24 pysar.coord_radar2glob Namespace Reference

Functions

- def usage ()
- def main (argv)

20.24.1 Function Documentation

20.24.1.1 main()

```
def pysar.coord_radar2glob.main (
              argv )
```

20.24.1.2 usage()

```
def pysar.coord_radar2glob.usage ( )
```

20.25 pysar.correct_dem Namespace Reference

Functions

- def usage ()
- def main (argv)

20.25.1 Function Documentation

20.25.1.1 main()

```
def pysar.correct_dem.main (
              argv )
```

20.25.1.2 usage()

```
def pysar.correct_dem.usage ( )
```

20.26 pysar.correlation_with_dem Namespace Reference

Functions

- def usage ()
- def main (argv)

20.26.1 Function Documentation

20.26.1.1 main()

```
def pysar.correlation_with_dem.main (
              argv )
```

20.26.1.2 usage()

```
def pysar.correlation_with_dem.usage ( )
```

20.27 pysar.dem_error Namespace Reference

Functions

- def topographic_residual_inversion (ts0, A0, inps)
- def read_template2inps (template_file, inps=None)
- def check_exclude_date (exDateIn, dateList)
- def cmdLineParse ()
- def main (argv)

Variables

- TEMPLATE
- EXAMPLE
- REFERENCE

20.27.1 Function Documentation

20.27.1.1 check_exclude_date()

```
def pysar.dem_error.check_exclude_date (
              exDateIn,
              dateList )
```

```
Read exclude dates info
Inputs:
    exDateIn - list of string, date in YYMMDD or YYYYMMDD format,
               or text file with date in it
    dateList - list of string, date in YYYYMMDD format
Output:
    exDateOut - list of string, date in YYYYMMDD format
```

20.27.1.2 cmdLineParse()

```
def pysar.dem_error.cmdLineParse ( )
```

20.27.1.3 main()

```
def pysar.dem_error.main (
              argv )
```

20.27.1.4 read_template2inps()

```
def pysar.dem_error.read_template2inps (
              template_file,
              inps = None )
```

```
Read input template file into inps.ex_date
```

20.27.1.5 topographic_residual_inversion()

```
def pysar.dem_error.topographic_residual_inversion (
              ts0,
              A0,
              inps )
```

```
Inputs:
    ts0  - 2D np.array in size of (date_num, pixel_num), original time series displacement
    A0   - 2D np.array in size of (date_num, model_num), design matrix in [A_deltaZ, A_def]
    inps - Namespace with the following settings:
           tbase     - 2D np.array in size of (date_num, 1), temporal baseline
           date_flag - 1D np.array in bool data type, mark the date used in the estimation
           phase_velocity - bool, use phase history or phase velocity for minimization
Outputs:
    deltaZ - 2D np.array in size of (1,        pixel_num), estimated DEM residual
    tsCor  - 2D np.array in size of (date_num, pixel_num), corrected timeseries = tsOrig - topoRes
    tsRes  - 2D np.array in size of (date_num, pixel_num), resudal   timeseries = tsOrig - topoRes - defModel
    stepEst- 2D np.array in size of (step_num, pixel_num), estimated step deformation
Example:
    deltaZ, tsCor, tsRes = topographic_residual_inversion(ts, A, inps)
```

20.27.2 Variable Documentation

20.27.2.1 EXAMPLE

```
EXAMPLE
```

20.27.2.2 REFERENCE

```
REFERENCE
```

20.27.2.3 TEMPLATE

```
TEMPLATE
```

20.28 pysar.diff Namespace Reference

Functions

- def diff_data (data1, data2)
- def diff_file (file1, file2, outName=None, force=False)
- def usage ()
- def cmdLineParse ()
- def main (argv)

20.28.1 Function Documentation

20.28.1.1 cmdLineParse()

```
def pysar.diff.cmdLineParse ( )
```

20.28.1.2 diff_data()

```
def pysar.diff.diff_data (
              data1,
              data2 )
```

```
data1 - data2
```

20.28.1.3 diff_file()

```
def pysar.diff.diff_file (
              file1,
              file2,
              outName = None,
              force = False )
```

```
Subtraction/difference of two input files
```

20.28.1.4 main()

```
def pysar.diff.main (
              argv )
```

20.28.1.5 usage()

```
def pysar.diff.usage ( )
```

20.29 pysar.gamma_view Namespace Reference

Functions

- def usage ()
- def main (argv)

20.29.1 Function Documentation

20.29.1.1 main()

```
def pysar.gamma_view.main (
              argv )
```

20.29.1.2 usage()

```
def pysar.gamma_view.usage ( )
```

20.30 pysar.generate_mask Namespace Reference

Functions

- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.30.1 Function Documentation

20.30.1.1 cmdLineParse()

```
def pysar.generate_mask.cmdLineParse ( )
```

20.30.1.2 main()

```
def pysar.generate_mask.main (
              argv )
```

20.30.2 Variable Documentation

20.30.2.1 EXAMPLE

```
EXAMPLE
```

20.31 pysar.geocode Namespace Reference

Functions

- def geocode_output_filename (fname)
- def update_attribute_geo_lut (atr_rdr, atr_lut, print_msg=True)

  Geocoded with lut in geo coord ##########################.
- def geocode_file_geo_lut (fname, lookup_file, fname_out, inps)
- def interp_weights (xy, uv, d=2)

  Geocoded with lut in radar coord ######################## Reference: `https://stackoverflow.↩ com/questions/20915502/speedup-scipy-griddata-for-` *multiple-interpolations-between-two-irregular-grids.*
- def interpolate (values, vtx, wts, fill_value=np.nan)
- def update_attribute_radar_lut (atr_rdr, inps, lat=None, lon=None, print_msg=True)
- def geocode_file_radar_lut (fname, lookup_file, fname_out=None, inps=None)
- def geocode_file (fname, lookup_file, fname_out, inps)
- def read_template2inps (template_file, inps)
- def cmdLineParse ()
- def main (argv)

Variables

- TEMPLATE
- EXAMPLE

20.31.1 Function Documentation

20.31.1.1 cmdLineParse()

```
def pysar.geocode.cmdLineParse ( )
```

20.31.1.2 geocode_file()

```
def pysar.geocode.geocode_file (
              fname,
              lookup_file,
              fname_out,
              inps )
```

```
Geocode input file with lookup table file
```

20.31.1.3 geocode_file_geo_lut()

```
def pysar.geocode.geocode_file_geo_lut (
              fname,
              lookup_file,
              fname_out,
              inps )
```

```
Geocode file using ROI_PAC/Gamma lookup table file.
Related module: scipy.interpolate.RegularGridInterpolator

Inputs:
    fname      : string, file to be geocoded
    lookup_file    : string, optional, lookup table file genereated by ROIPAC or Gamma
                 i.e. geomap_4rlks.trans           from ROI_PAC
                      sim_150911-150922.UTM_TO_RDC from Gamma
    interp_method     : string, optional, interpolation/resampling method, supporting nearest, linear
    fill_value : value used for points outside of the interpolation domain.
    fname_out  : string, optional, output geocoded filename
Output:
    fname_out  : string, optional, output geocoded filename
```

20.31.1.4 geocode_file_radar_lut()

```
def pysar.geocode.geocode_file_radar_lut (
              fname,
              lookup_file,
              fname_out = None,
              inps = None )
```

```
Geocode file using lookup table file in radar coordinates (isce).
Two solutions:
1) scipy.interpolate.griddata, with a speed up solution from Jaime and Jeff (Stack Overflow)
    https://stackoverflow.com/questions/20915502/speedup-scipy-griddata-for-multiple-interpo
    lations-between-two-irregular-grids
2) matplotlib.tri, interpolation from triangular grid to quad grid, which is much slower than 1).

Inputs:
    fname       : string, file to be geocoded
    lookup_file : string, lookup table file, geometryRadar.h5
    fname_out   : string, optional, output geocoded filename
    inps        : namespace, object with the following items:
                  interp_method : string, interpolation/resampling method, supporting linear
                  fill_value    : value used for points outside of the interpolation domain
Output:
    fname_out  : string, optional, output geocoded filename
```

20.31.1.5 geocode_output_filename()

```
def pysar.geocode.geocode_output_filename (
              fname )
```

20.31.1.6 interp_weights()

```
def pysar.geocode.interp_weights (
              xy,
              uv,
              d = 2 )
```

Geocoded with lut in radar coord ######################## Reference: `https://stackoverflow.com/questions/20915502/speedup-scipy-griddata-for-`multiple-interpolations-between-two-irregular-grids.

```
calculate triangulation and coordinates transformation using qhull.Delaunay
1) Triangulate the irregular grid coordinates xy;
2) For each point in the new grid uv, search which simplex does it lay
3) Calculate barycentric coordinates with respect to the vertices of enclosing simplex
```

20.31.1.7 interpolate()

```
def pysar.geocode.interpolate (
              values,
              vtx,
              wts,
              fill_value = np.nan )
```

```
Interpolate values on new points
```

20.31.1.8 main()

```
def pysar.geocode.main (
              argv )
```

20.31.1.9 read_template2inps()

```
def pysar.geocode.read_template2inps (
              template_file,
              inps )
```

```
Read input template options into Namespace inps
```

20.31.1.10 update_attribute_geo_lut()

```
def pysar.geocode.update_attribute_geo_lut (
              atr_rdr,
              atr_lut,
              print_msg = True )
```

Geocoded with lut in geo coord ##########################.

```
Get attributes in geo coord from atr_rdr dict and atr_lut dict
Inputs:
    atr_rdr : dict, attributes of file in radar coord
    atr_lut : dict, attributes of mapping transformation file
    print_msg : bool, print out message or not
Output:
    atr : dict, attributes of output file in geo coord.
```

20.31.1.11 update_attribute_radar_lut()

```
def pysar.geocode.update_attribute_radar_lut (
              atr_rdr,
              inps,
              lat = None,
              lon = None,
              print_msg = True )
```

```
Get attributes in geo coord from atr_rdr dict and geo_data matrix
Inputs:
    atr_rdr - dict, attribute of file in radar coord
    inps    - Namespace, including items of the following:
              lat0/lon0
              lat_step/lon_step
              lat_num/lon_num
    lat/lon - 2D np.array of lat/lon value
Output:
    atr - dict, attributes of output file in geo coord.
```

20.31.2 Variable Documentation

20.31.2.1 EXAMPLE

```
EXAMPLE
```

20.31.2.2 TEMPLATE

```
TEMPLATE
```

20.32 pysar.hdfeos5_2insarmaps Namespace Reference

Functions

- def get_H5_filename (path)
- def build_parser ()
- def main ()

20.32.1 Function Documentation

20.32.1.1 build_parser()

```
def pysar.hdfeos5_2insarmaps.build_parser ( )
```

20.32.1.2 get_H5_filename()

```
def pysar.hdfeos5_2insarmaps.get_H5_filename (
              path )
```

20.32.1.3 main()

```
def pysar.hdfeos5_2insarmaps.main ( )
```

20.33 pysar.hdfeos5_2json_mbtiles Namespace Reference

Functions

- def get_date (date_string)
- def get_decimal_date (d)
- def region_name_from_project_name (project_name)
- def serialize_dictionary (dictionary, fileName)
- def convert_data (attributes, decimal_dates, timeseries_datasets, dates, json_path, folder_name)
- def make_json_file (chunk_num, points, dates, json_path, folder_name)
- def build_parser ()
- def main ()

Variables

- needed_attributes

20.33.1 Function Documentation

20.33.1.1 build_parser()

```
def pysar.hdfeos5_2json_mbtiles.build_parser ( )
```

20.33.1.2 convert_data()

```
def pysar.hdfeos5_2json_mbtiles.convert_data (
              attributes,
              decimal_dates,
              timeseries_datasets,
              dates,
              json_path,
              folder_name )
```

20.33.1.3 get_date()

```
def pysar.hdfeos5_2json_mbtiles.get_date (
              date_string )
```

20.33.1.4 get_decimal_date()

```
def pysar.hdfeos5_2json_mbtiles.get_decimal_date (
              d )
```

20.33.1.5 main()

```
def pysar.hdfeos5_2json_mbtiles.main ( )
```

20.33.1.6 make_json_file()

```
def pysar.hdfeos5_2json_mbtiles.make_json_file (
              chunk_num,
              points,
              dates,
              json_path,
              folder_name )
```

20.33.1.7 region_name_from_project_name()

```
def pysar.hdfeos5_2json_mbtiles.region_name_from_project_name (
              project_name )
```

20.33.1.8 serialize_dictionary()

```
def pysar.hdfeos5_2json_mbtiles.serialize_dictionary (
              dictionary,
              fileName )
```

20.33.2 Variable Documentation

20.33.2.1 needed_attributes

```
needed_attributes
```

20.34 pysar.ifgram_closure Namespace Reference

Functions

- def usage ()
- def main (argv)

20.34.1 Function Documentation

20.34.1.1 main()

```
def pysar.ifgram_closure.main (
              argv )
```

20.34.1.2 usage()

```
def pysar.ifgram_closure.usage ( )
```

20.35 pysar.ifgram_inversion Namespace Reference

Functions

- def phase_pdf_ds (L, coherence=None, phiNum=1000)
- def phase_variance_ds (L, coherence=None)
- def phase_variance_ps (L, coherence=None)
- def coherence2phase_variance_ds (coherence, L=32, print_msg=False)
- def coherence2fisher_info_index (coherence, L=32, epsilon=1e-4)
- def round_to_1 (x)
- def ceil_to_1 (x)
- def network_inversion_sbas (B, ifgram, tbase_diff, skipZeroPhase=True)
- def network_inversion_wls (A, ifgram, weight, skipZeroPhase=True, Astd=None)
- def temporal_coherence (A, ts, ifgram, weight=None, chunk_size=500)
- def ifgram_inversion_patch (ifgramFile, coherenceFile, meta, box=None)
- def ifgram_inversion (ifgramFile='unwrapIfgram.h5', coherenceFile='coherence.h5', meta=None)
- def write_timeseries_hdf5_file (timeseries, date8_list, atr, timeseriesFile=None)
- def read_template2inps (template_file, inps)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- TEMPLATE
- REFERENCE

20.35.1 Function Documentation

20.35.1.1 ceil_to_1()

```
def pysar.ifgram_inversion.ceil_to_1 (
              x )
```

Return the most significant digit of input number and ceiling it

20.35.1.2 cmdLineParse()

```
def pysar.ifgram_inversion.cmdLineParse ( )
```

20.35.1.3 coherence2fisher_info_index()

```
def pysar.ifgram_inversion.coherence2fisher_info_index (
              coherence,
              L = 32,
              epsilon = 1e-4 )
```

Convert coherence to Fisher information index (Seymour & Cumming, 1994, IGARSS)

20.35.1.4 coherence2phase_variance_ds()

```
def pysar.ifgram_inversion.coherence2phase_variance_ds (
              coherence,
              L = 32,
              print_msg = False )
```

Convert coherence to phase variance based on DS phase PDF (Tough et al., 1995)

20.35.1.5 ifgram_inversion()

```
def pysar.ifgram_inversion.ifgram_inversion (
              ifgramFile = 'unwrapIfgram.h5',
              coherenceFile = 'coherence.h5',
              meta = None )
```

```
Implementation of the SBAS algorithm.
modified from sbas.py written by scott baker, 2012

Inputs:
    ifgramFile    - string, HDF5 file name of the interferograms
    coherenceFile - string, HDF5 file name of the coherence
    meta          - dict, including the following options:
                    weight_function
                    chunk_size - float, max number of data (ifgram_num*row_num*col_num)
                                 to read per loop; to control the memory
Output:
    timeseriesFile - string, HDF5 file name of the output timeseries
    tempCohFile    - string, HDF5 file name of temporal coherence
Example:
    meta = dict()
    meta['weight_function'] = 'variance'
    meta['chunk_size'] = 0.5e9
    meta['timeseriesFile'] = 'timeseries_var.h5'
    meta['tempCohFile'] = 'temporalCoherence_var.h5'
    ifgram_inversion('unwrapIfgram.h5', 'coherence.h5', meta)
```

20.35.1.6 ifgram_inversion_patch()

```
def pysar.ifgram_inversion.ifgram_inversion_patch (
              ifgramFile,
              coherenceFile,
              meta,
              box = None )
```

```
Inputs:
    ifgramFile    - string, interferograms hdf5 file
    coherenceFile - string, coherence hdf5 file
    box           - 4-tuple, left, upper, right, and lower pixel coordinate of area of interest
    meta          - dict, including the following attributes:

                    #Interferograms
                    length/width - int, file size for each interferogram
                    ifgram_list  - list of string, interferogram dataset name
                    date12_list  - list of string, YYMMDD-YYMMDD
                    ref_value    - np.array in size of (ifgram_num, 1)
                                   reference pixel coordinate in row/column number
                    ref_y/x      - int, reference pixel coordinate in row/column number

                    #Time-series
                    date8_list   - list of string in YYYYMMDD
                    tbase_diff   - np.array in size of (date_num-1, 1), differential temporal baseline

                    #Inversion
                    weight_function   - no, fim, var, coh
Outputs:
    ts       - 3D np.array in size of (date_num, row_num, col_num)
    temp_coh - 2D np.array in size of (row_num, col_num)
    tsStd    - 3D np.array in size of (date_num, row_num, col_num)
```

20.35.1.7 main()

```
def pysar.ifgram_inversion.main (
              argv )
```

20.35.1.8 network_inversion_sbas()

```
def pysar.ifgram_inversion.network_inversion_sbas (
              B,
              ifgram,
              tbase_diff,
              skipZeroPhase = True )
```

```
Network inversion based on Small BAseline Subsets (SBAS) algorithm (Berardino et al.,
    2002, IEEE-TGRS). For full rank design matrix, a.k.a., fully connected network, ordinary
    least square (OLS) inversion is applied; otherwise, Singular Value Decomposition (SVD).

Inputs:
    B           - 2D np.array in size of (ifgram_num, date_num-1)
                  design matrix B, which represents temporal baseline timeseries between
                  master and slave date for each interferogram
    ifgram      - 2D np.array in size of (ifgram_num, pixel_num)
                  phase of all interferograms
    tbase_diff - 2D np.array in size of (date_num-1, 1)
                  differential temporal baseline of time-series
    skipZeroPhase - bool, skip ifgram with zero phase value
Output:
    ts      - 2D np.array in size of (date_num-1, pixel_num), phase time series
    tempCoh - 1D np.array in size of (pixel_num), temporal coherence
```

20.35.1.9 network_inversion_wls()

```
def pysar.ifgram_inversion.network_inversion_wls (
              A,
              ifgram,
              weight,
              skipZeroPhase = True,
              Astd = None )
```

```
Network inversion based on Weighted Least Square (WLS) solution.
Inputs:
    A      - 2D np.array in size of (ifgram_num, date_num-1)
             representing date configuration for each interferogram
             (-1 for master, 1 for slave, 0 for others)
    ifgram - np.array in size of (ifgram_num,) or (ifgram_num, 1)
             phase of all interferograms
    weight - np.array in size of (ifgram_num,) or (ifgram_num, 1)
             weight of ifgram
    skipZeroPhase - bool, skip ifgram with zero phase value
    Astd   - 2D np.array in size of (ifgram_num, date_num-1)
             design matrix for STD calculation excluding the reference date
Output:
    ts      - 1D np.array in size of (date_num-1,), phase time series
    tempCoh - float32, temporal coherence
    tsStd   - 1D np.array in size of (date_num-1,), decor noise std time series
```

20.35.1.10 phase_pdf_ds()

```
def pysar.ifgram_inversion.phase_pdf_ds (
              L,
              coherence = None,
              phiNum = 1000 )
```

```
Marginal PDF of interferometric phase for distributed scatterers (DS)
Eq. 66 (Tough et al., 1995) and Eq. 4.2.23 (Hanssen, 2001)
Inputs:
    L         - int, number of independent looks
    coherence - 1D np.array for the range of coherence, with value < 1.0 for valid operation
    phiNum    - int, number of phase sample for the numerical calculation
Output:
    pdf       - 2D np.array, phase pdf in size of (phiNum, len(coherence))
    coherence - 1D np.array for the range of coherence
Example:
    epsilon = 1e-4
    coh = np.linspace(0., 1-epsilon, 1000)
    pdf, coh = phase_pdf_ds(1, coherence=coh)
```

20.35.1.11 phase_variance_ds()

```
def pysar.ifgram_inversion.phase_variance_ds (
              L,
              coherence = None )
```

```
Interferometric phase variance for distributed scatterers (DS)
Eq. 2.1.2 (Box et al., 2015) and Eq. 4.2.27 (Hanssen, 2001)
Inputs:
    L         - int, number of independent looks
    coherence - 1D np.array for the range of coherence, with value < 1.0 for valid operation
    phiNum    - int, number of phase sample for the numerical calculation
Output:
    var       - 1D np.array, phase variance in size of (len(coherence))
    coherence - 1D np.array for the range of coherence
Example:
    epsilon = 1e-4
    coh = np.linspace(0., 1-epsilon, 1000)
    var, coh = phase_variance_ds(1, coherence=coh)
```

20.35.1.12 phase_variance_ps()

```
def pysar.ifgram_inversion.phase_variance_ps (
              L,
              coherence = None )
```

```
the Cramer-Rao bound (CRB) of phase variance
Given by Eq. 25 (Rodriguez and Martin, 1992)and Eq 4.2.32 (Hanssen, 2001)
Valid when coherence is close to 1.
```

20.35.1.13 read_template2inps()

```
def pysar.ifgram_inversion.read_template2inps (
              template_file,
              inps )
```

```
Read input template options into Namespace inps
```

20.35.1.14 round_to_1()

```
def pysar.ifgram_inversion.round_to_1 (
              x )
```

```
Return the most significant digit of input number
```

20.35.1.15 temporal_coherence()

```
def pysar.ifgram_inversion.temporal_coherence (
              A,
              ts,
              ifgram,
              weight = None,
              chunk_size = 500 )
```

```
Calculate temporal coherence based on Tizzani et al. (2007, RSE)
Inputs:
    A      - 2D np.array in size of (ifgram_num, date_num-1)
             representing date configuration for each interferogram
             (-1 for master, 1 for slave, 0 for others)
    ts     - 2D np.array in size of (date_num-1, pixel_num), phase time series
    ifgram - 2D np.array in size of (ifgram_num, pixel_num), observed interferometric phase
    weight - 2D np.array in size of (ifgram_num, pixel_num), weight of ifgram
    chunk_size - int, max number of pixels per loop during the calculation
Output:
    temp_coh - 1D np.array in size of (pixel_num), temporal coherence
```

20.35.1.16 write_timeseries_hdf5_file()

```
def pysar.ifgram_inversion.write_timeseries_hdf5_file (
              timeseries,
              date8_list,
              atr,
              timeseriesFile = None )
```

```
Write to timeseries HDF5 file
Inputs:
    timeseries - 3D np.array in size of (date_num, length, width)
                 cumulative time series phase
    date8_list - list of string in YYYYMMDD format
    atr        - dict, attributes of time-series file, including two parts:
                 1) attributes inherited from interferograms
                 2) attributes of time-series inverted from network of interferograms:
                     P_BASELINE_TIMESERIES
                     P_BASELINE_TOP_TIMESERIES
                     P_BASELINE_BOTTOM_TIMESERIES
                     ref_date
    timeseriesFile - string, file name of output time-series file
Output:
    timeseriesFile - string, file name of output time-series file
```

20.35.2 Variable Documentation

20.35.2.1 EXAMPLE

```
EXAMPLE
```

20.35.2.2 REFERENCE

```
REFERENCE
```

20.35.2.3 TEMPLATE

```
TEMPLATE
```

20.36 pysar.ifgram_reconstruction Namespace Reference

Functions

- def usage ()
- def main (argv)

20.36.1 Function Documentation

20.36.1.1 main()

```
def pysar.ifgram_reconstruction.main (
              argv )
```

20.36.1.2 usage()

```
def pysar.ifgram_reconstruction.usage ( )
```

20.37 pysar.ifgram_simulation Namespace Reference

Functions

- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.37.1 Function Documentation

20.37.1.1 cmdLineParse()

```
def pysar.ifgram_simulation.cmdLineParse ( )
```

20.37.1.2 main()

```
def pysar.ifgram_simulation.main (
              argv )
```

20.37.2 Variable Documentation

20.37.2.1 EXAMPLE

```
EXAMPLE
```

20.38 pysar.image_math Namespace Reference

Functions

- def data_operation (data, operator, operand)
- def file_operation (fname, operator, operand, fname_out=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.38.1 Function Documentation

20.38.1.1 cmdLineParse()

```
def pysar.image_math.cmdLineParse ( )
```

20.38.1.2 data_operation()

```
def pysar.image_math.data_operation (
              data,
              operator,
              operand )
```

```
Mathmatic operation of 2D matrix
```

20.38.1.3 file_operation()

```
def pysar.image_math.file_operation (
              fname,
              operator,
              operand,
              fname_out = None )
```

```
Mathmathic operation of file
```

20.38.1.4 main()

```
def pysar.image_math.main (
              argv )
```

20.38.2 Variable Documentation

20.38.2.1 EXAMPLE

```
EXAMPLE
```

20.39 pysar.incidence_angle Namespace Reference

Functions

- def usage ()
- def main (argv)

20.39.1 Function Documentation

20.39.1.1 main()

```
def pysar.incidence_angle.main (
              argv )
```

20.39.1.2 usage()

```
def pysar.incidence_angle.usage ( )
```

20.40 pysar.info Namespace Reference

Functions

- def print_attributes (atr, sorting=True)
- def print_hdf5_structure (File)

  By andrewcollette at `https://github.com/h5py/h5py/issues/406`*.*
- def print_timseries_date_info (dateList)
- def usage ()
- def main (argv)

20.40.1 Function Documentation

20.40.1.1 main()

```
def pysar.info.main (
              argv )
```

20.40.1.2 print_attributes()

```
def pysar.info.print_attributes (
              atr,
              sorting = True )
```

20.40.1.3 print_hdf5_structure()

```
def pysar.info.print_hdf5_structure (
              File )
```

By andrewcollette at `https://github.com/h5py/h5py/issues/406`.

20.40.1.4 print_timseries_date_info()

```
def pysar.info.print_timseries_date_info (
              dateList )
```

20.40.1.5 usage()

```
def pysar.info.usage ( )
```

20.41 pysar.insar_vs_gps Namespace Reference

Functions

- def readGPSfile (gpsFile, gps_source)
- def nearest (x, tbase, xstep)
- def find_row_column (Lon, Lat, lon, lat, lon_step, lat_step)
- def usage ()
- def main (argv)

20.41.1 Function Documentation

20.41.1.1 find_row_column()

```
def pysar.insar_vs_gps.find_row_column (
              Lon,
              Lat,
              lon,
              lat,
              lon_step,
              lat_step )
```

20.41.1.2 main()

```
def pysar.insar_vs_gps.main (
              argv )
```

20.41.1.3 nearest()

```
def pysar.insar_vs_gps.nearest (
              x,
              tbase,
              xstep )
```

20.41.1.4 readGPSfile()

```
def pysar.insar_vs_gps.readGPSfile (
              gpsFile,
              gps_source )
```

20.41.1.5 usage()

```
def pysar.insar_vs_gps.usage ( )
```

20.42 pysar.insarmaps_query Namespace Reference

Classes

- class BasicHTTP

Functions

- def buildURL (args)
- def build_parser ()
- def main ()

20.42.1 Function Documentation

20.42.1.1 build_parser()

```
def pysar.insarmaps_query.build_parser ( )
```

20.42.1.2 buildURL()

```
def pysar.insarmaps_query.buildURL (
              args )
```

20.42.1.3 main()

```
def pysar.insarmaps_query.main ( )
```

20.43 pysar.json_mbtiles2insarmaps Namespace Reference

Functions

- def get_unavco_name (json_path)
- def upload_insarmaps_metadata (fileName)
- def upload_json (folder_path)
- def build_parser ()
- def main ()

Variables

- dbUsername
- dbPassword
- dbHost

20.43.1 Function Documentation

20.43.1.1 build_parser()

```
def pysar.json_mbtiles2insarmaps.build_parser ( )
```

20.43.1.2 get_unavco_name()

```
def pysar.json_mbtiles2insarmaps.get_unavco_name (
              json_path )
```

20.43.1.3 main()

```
def pysar.json_mbtiles2insarmaps.main ( )
```

20.43.1.4 upload_insarmaps_metadata()

```
def pysar.json_mbtiles2insarmaps.upload_insarmaps_metadata (
              fileName )
```

20.43.1.5 upload_json()

```
def pysar.json_mbtiles2insarmaps.upload_json (
              folder_path )
```

20.43.2 Variable Documentation

20.43.2.1 dbHost

```
dbHost
```

20.43.2.2 dbPassword

```
dbPassword
```

20.43.2.3 dbUsername

```
dbUsername
```

20.44 pysar.l1 Namespace Reference

Functions

- def l1mosek (P, q)
- def l1mosek2 (P, q)
- def l1 (P, q)
- def l1blas (P, q)

Variables

- __MOSEK
- task
- x

20.44.1 Function Documentation

20.44.1.1 l1()

```
def pysar.l1.l1 (
              P,
              q )
```

```
Returns the solution u of the ell-1 approximation problem

    (primal) minimize ||P*u - q||_1

    (dual)   maximize    q'*w
             subject to  P'*w = 0
                         ||w||_infty <= 1.
```

20.44.1.2 l1blas()

```
def pysar.l1.l1blas (
              P,
              q )
```

```
Returns the solution u of the ell-1 approximation problem

    (primal) minimize ||P*u - q||_1

    (dual)   maximize    q'*w
             subject to  P'*w = 0
                         ||w||_infty <= 1.
```

20.44.1.3 l1mosek()

```
def pysar.l1.l1mosek (
              P,
              q )
```

```
minimize    e'*v

subject to  P*u - v <=  q
           -P*u - v <= -q
```

20.44.1.4 l1mosek2()

```
def pysar.l1.l1mosek2 (
              P,
              q )
```

```
minimize    e'*s + e'*t

subject to  P*u - q = s - t
            s, t >= 0
```

20.44.2 Variable Documentation

20.44.2.1 __MOSEK

```
__MOSEK  [private]
```

20.44.2.2 task

```
task
```

20.44.2.3 x

```
x
```

20.45 pysar.load_data Namespace Reference

Functions

- def project_name2sensor (projectName)

  Sub Functions ####################################.
- def auto_path_miami (inps, template={})
- def mode (thelist)
- def check_file_size (fileList, mode_width=None, mode_length=None)
- def check_existed_hdf5_file (inFiles, hdf5File)
- def load_multi_group_hdf5 (fileType, fileList, outfile='unwrapIfgram.h5', exDict=dict())
- def load_geometry_hdf5 (fileType, fileList, outfile=None, exDict=dict())
- def load_single_dataset_hdf5 (file_type, infile, outfile=None, exDict=dict())
- def copy_file (targetFile, destDir)
- def load_file (fileList, inps_dict=dict(), outfile=None, file_type=None)
- def load_data_from_template (inps)
- def cmdLineParse ()
- def main (argv)

  Main Function #################################.

Variables

- sensorList
- EXAMPLE

  Usage #################################.
- TEMPLATE

20.45.1 Function Documentation

20.45.1.1 auto_path_miami()

```
def pysar.load_data.auto_path_miami (
              inps,
              template = {} )
```

```
Auto File Path Setting for Geodesy Lab - University of Miami
```

20.45.1.2 check_existed_hdf5_file()

```
def pysar.load_data.check_existed_hdf5_file (
              inFiles,
              hdf5File )
```

```
Check file list with existed hdf5 file
Return list of files that are not included in the existed readable hdf5 file.
If all included, return None.
```

20.45.1.3 check_file_size()

```
def pysar.load_data.check_file_size (
              fileList,
              mode_width = None,
              mode_length = None )
```

```
Update file list and drop those not in the same size with majority.
```

20.45.1.4 cmdLineParse()

```
def pysar.load_data.cmdLineParse ( )
```

20.45.1.5 copy_file()

```
def pysar.load_data.copy_file (
              targetFile,
              destDir )
```

```
Copy file and its .rsc/.par/.xml file to destination directory.
```

20.45.1.6 load_data_from_template()

```
def pysar.load_data.load_data_from_template (
              inps )
```

```
Load dataset for PySAR time series using input template
```

20.45.1.7 load_file()

```
def pysar.load_data.load_file (
              fileList,
              inps_dict = dict(),
              outfile = None,
              file_type = None )
```

```
Load input file(s) into one HDF5 file
It supports ROI_PAC files only for now.
Inputs:
    fileList  - string / list of string, path of files to load
    inps_dict - dict, including the following attributes
                PROJECT_NAME   : KujuAlosAT422F650  (extra attribute dictionary to add to output file)
                sensor         : (optional)
                timeseries_dir : directory of time series analysis, e.g. KujuAlosAT422F650/PYSAR
                insarProcessor: InSAR processor, roipac, isce, gamma, doris
    outfile   - string, output file name
    file_type - string, group name for output HDF5 file, interferograms, coherence, dem, etc.
Output:
    outfile - string, output file name
Example:
    unwrapIfgram.h5 = load_file('filt*.unw', inps_dict=vars(inps))
```

20.45.1.8 load_geometry_hdf5()

```
def pysar.load_data.load_geometry_hdf5 (
              fileType,
              fileList,
              outfile = None,
              exDict = dict() )
```

```
Load multiple geometry files into hdf5 file: geometryGeo.h5 or geometryRadar.h5.
File structure:
    /geometry.attrs
    /geometry/latitude          #for geometryRadar.h5 only, from ISCE/Doris lookup table
    /geometry/longitude         #for geometryRadar.h5 only, from ISCE/Doris lookup table
    /geometry/rangeCoord        #for geometryGeo.h5 only, from ROI_PAC/Gamma lookup table
    /geometry/azimuthCoord      #for geometryGeo.h5 only, from ROI_PAC/Gamma lookup table
    /geometry/height
    /geometry/incidenceAngle
    /geometry/headingAngle
    /geometry/slantRangeDistance
    /geometry/shadowMask
    /geometry/waterMask
```

20.45.1.9 load_multi_group_hdf5()

```
def pysar.load_data.load_multi_group_hdf5 (
              fileType,
              fileList,
              outfile = 'unwrapIfgram.h5',
              exDict = dict() )
```

```
Load multiple ROI_PAC files into HDF5 file (Multi-group, one dataset and one attribute dict per group).
Inputs:
    fileType : string, i.e. interferograms, coherence, snaphu_connect_component, etc.
    fileList : list of path, ROI_PAC .unw/.cor/.int/.byt file
    outfile : string, file name/path of the multi-group hdf5 PySAR file
    exDict : dict, extra attribute dictionary
Outputs:
    outfile : output hdf5 file name
    fileList : list of string, files newly added
```

20.45.1.10 load_single_dataset_hdf5()

```
def pysar.load_data.load_single_dataset_hdf5 (
              file_type,
              infile,
              outfile = None,
              exDict = dict() )
```

```
Convert ROI_PAC .dem / .hgt file to hdf5 file
Based on load_dem.py written by Emre Havazli
Inputs:
    file_type : string, group name of hdf5 file, i.e. dem, mask
    infile    : string, input ROI_PAC file name
    outfile   : string, output hdf5 file name
    exDict : dict, extra attributes to output file
Output:
    outfile   : string, output hdf5 file name
```

20.45.1.11 main()

```
def pysar.load_data.main (
              argv )
```

Main Function ##################################.

20.45.1.12 mode()

```
def pysar.load_data.mode (
              thelist )
```

```
Find Mode (most common) item in the list
```

20.45.1.13 project_name2sensor()

```
def pysar.load_data.project_name2sensor (
              projectName )
```

Sub Functions #####################################.

20.45.2 Variable Documentation

20.45.2.1 EXAMPLE

```
EXAMPLE
```

Usage ################################.

20.45.2.2 sensorList

```
sensorList
```

20.45.2.3 TEMPLATE

```
TEMPLATE
```

20.46 pysar.load_dem Namespace Reference

Variables

- demFile
- ext
- amp
- dem
- demRsc
- outName
- h5
- group
- dset
- data
- compression

20.46.1 Variable Documentation

20.46.1.1 amp

```
amp
```

20.46.1.2 compression

```
compression
```

20.46.1.3 data

`data`

20.46.1.4 dem

`dem`

20.46.1.5 demFile

`demFile`

20.46.1.6 demRsc

`demRsc`

20.46.1.7 dset

`dset`

20.46.1.8 ext

`ext`

20.46.1.9 group

`group`

20.46.1.10 h5

`h5`

20.46.1.11 outName

`outName`

20.47 pysar.lod Namespace Reference

Functions

- def correct_lod_file (File, rangeDistFile=None, outFile=None)
- def cmdLineParse ()
- def main (argv)

Variables

- REFERENCE
- EXAMPLE

20.47.1 Function Documentation

20.47.1.1 cmdLineParse()

```
def pysar.lod.cmdLineParse ( )
```

20.47.1.2 correct_lod_file()

```
def pysar.lod.correct_lod_file (
              File,
              rangeDistFile = None,
              outFile = None )
```

20.47.1.3 main()

```
def pysar.lod.main (
              argv )
```

20.47.2 Variable Documentation

20.47.2.1 EXAMPLE

```
EXAMPLE
```

20.47.2.2 REFERENCE

```
REFERENCE
```

20.48 pysar.look_angle Namespace Reference

Functions

- def usage ()
- def main (argv)

20.48.1 Function Documentation

20.48.1.1 main()

```
def pysar.look_angle.main (
              argv )
```

20.48.1.2 usage()

```
def pysar.look_angle.usage ( )
```

20.49 pysar.los2enu Namespace Reference

Functions

- def usage ()
- def main (argv)

20.49.1 Function Documentation

20.49.1.1 main()

```
def pysar.los2enu.main (
              argv )
```

20.49.1.2 usage()

```
def pysar.los2enu.usage ( )
```

20.50 pysar.mask Namespace Reference

Functions

- def mask_matrix (data_mat, mask_mat, fill_value=None)
- def update_mask (mask, inps_dict, print_msg=True)
- def mask_file (File, maskFile, outFile=None, inps_dict=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.50.1 Function Documentation

20.50.1.1 cmdLineParse()

```
def pysar.mask.cmdLineParse ( )
```

20.50.1.2 main()

```
def pysar.mask.main (
              argv )
```

20.50.1.3 mask_file()

```
def pysar.mask.mask_file (
              File,
              maskFile,
              outFile = None,
              inps_dict = None )
```

```
Mask input File with maskFile
Inputs:
    File/maskFile - string,
    inps_dict - dictionary including the following options:
                subset_x/y - list of 2 ints, subset in x/y direction
                thr - float, threshold/minValue to generate mask
Output:
    outFile - string
```

20.50.1.4 mask_matrix()

```
def pysar.mask.mask_matrix (
              data_mat,
              mask_mat,
              fill_value = None )
```

```
mask a 2D matrxi data with mask
```

20.50.1.5 update_mask()

```
def pysar.mask.update_mask (
              mask,
              inps_dict,
              print_msg = True )
```

```
Update mask matrix from input options: subset_x/y and threshold
```

20.50.2 Variable Documentation

20.50.2.1 EXAMPLE

```
EXAMPLE
```

20.51 pysar.match Namespace Reference

Functions

- def corners (atr)
- def nearest (x, X)
- def manual_offset_estimate (matrix1, matrix2)
- def match_two_files (File1, File2, outName=None, manual_match=False, disp_fig=False)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.51.1 Function Documentation

20.51.1.1 cmdLineParse()

```
def pysar.match.cmdLineParse ( )
```

20.51.1.2 corners()

```
def pysar.match.corners (
              atr )
```

```
Get corners coordinate.
```

20.51.1.3 main()

```
def pysar.match.main (
              argv )
```

20.51.1.4 manual_offset_estimate()

```
def pysar.match.manual_offset_estimate (
              matrix1,
              matrix2 )
```

```
Manually estimate offset between two data matrix.
By manually selecting a line from each of them, and estimate the difference.
It usually used when 2 input data matrix have no area in common.
```

20.51.1.5 match_two_files()

```
def pysar.match.match_two_files (
              File1,
              File2,
              outName = None,
              manual_match = False,
              disp_fig = False )
```

```
Match two geocoded files by estimating their offset.
Better for two files with common area overlaping.
```

20.51.1.6 nearest()

```
def pysar.match.nearest (
              x,
              X )
```

```
find nearest neighbour
```

20.51.2 Variable Documentation

20.51.2.1 EXAMPLE

```
EXAMPLE
```

20.52 pysar.modify_network Namespace Reference

Functions

- def nearest_neighbor (x, y, x_array, y_array)

  Sub Function ##############################.
- def reset_pairs (File)
- def manual_select_pairs_to_remove (File)
- def modify_file_date12_list (File, date12_to_rmv, mark_attribute=False, outFile=None)
- def read_template2inps (template_file, inps=None)
- def cmdLineParse ()
- def main (argv)

  Main Function ###############################.

Variables

- EXAMPLE

  Usage #################################.
- TEMPLATE

20.52.1 Function Documentation

20.52.1.1 cmdLineParse()

```
def pysar.modify_network.cmdLineParse ( )
```

20.52.1.2 main()

```
def pysar.modify_network.main (
              argv )
```

Main Function ################################.

20.52.1.3 manual_select_pairs_to_remove()

```
def pysar.modify_network.manual_select_pairs_to_remove (
              File )
```

```
Manually select interferograms to remove
```

20.52.1.4 modify_file_date12_list()

```
def pysar.modify_network.modify_file_date12_list (
              File,
              date12_to_rmv,
              mark_attribute = False,
              outFile = None )
```

```
Update multiple group hdf5 file using date12 to remove
Inputs:
    File          - multi_group HDF5 file, i.e. unwrapIfgram.h5, coherence.h5
    date12_to_rmv - list of string indicating interferograms in YYMMDD-YYMMDD format
    mark_attribute- bool, if True, change 'drop_ifgram' attribute only; otherwise, write
                    resutl to a new file
    outFile       - string, output file name
Output:
    outFile       - string, output file name, if mark_attribute=True, outFile = File
```

20.52.1.5 nearest_neighbor()

```
def pysar.modify_network.nearest_neighbor (
              x,
              y,
              x_array,
              y_array )
```

Sub Function ################################.

```
find nearest neighbour
Input:
    x/y       : float
    x/y_array : numpy.array, temporal/perpendicular spatial baseline
Output:
    idx : int, index of min distance - nearest neighbour
```

20.52.1.6 read_template2inps()

```
def pysar.modify_network.read_template2inps (
              template_file,
              inps = None )
```

```
Read input template options into Namespace inps
```

20.52.1.7 reset_pairs()

```
def pysar.modify_network.reset_pairs (
              File )
```

```
Reset/restore all pairs within the input file by set all drop_ifgram=no
```

20.52.2 Variable Documentation

20.52.2.1 EXAMPLE

```
EXAMPLE
```

Usage ##################################.

20.52.2.2 TEMPLATE

```
TEMPLATE
```

20.53 pysar.multi_transect Namespace Reference

Functions

- def usage ()
- def dms2d (Coord)
- def gps_to_LOS (Ve, Vn, theta, heading)
- def check_st_in_box (x, y, x0, y0, x1, y1, X0, Y0, X1, Y1)
- def check_st_in_box2 (x, y, x0, y0, x1, y1, X0, Y0, X1, Y1)
- def line (x0, y0, x1, y1)
- def dist_point_from_line (m, c, x, y, dx, dy)
- def get_intersect (m, c, x, y)
- def readGPSfile (gpsFile, gps_source)
- def redGPSfile (gpsFile)
- def redGPSfile_cmm4 (gpsFile)
- def nearest (x, tbase, xstep)
- def find_row_column (Lon, Lat, lon, lat, lon_step, lat_step)
- def get_lat_lon (h5file)
- def nanmean (data, args)
- def nanstd (data, args)
- def get_transect (z, x0, y0, x1, y1)
- def get_start_end_point (Xf0, Yf0, Xf1, Yf1, L, dx, dy)
- def point_with_distance_from_line (Xf0, Yf0, Xf1, Yf1, L)
- def point_on_line_with_distance_from_beginning (Xf0, Yf0, Xf1, Yf1, L)
- def read_fault_coords (Fault_coord_file, Dp)
- def main (argv)
- def onclick (event)

Variables

- lat
- lon
- lat_step
- lon_step
- lat_all
- lon_all
- Fault_lon
- Fault_lat
- Num_profiles
- FaultCoords
- Lat0
- Lon0
- Lat1
- Lon1
- Length
- Width
- Yf0
- Xf0
- Yf1
- Xf1
- y0
- x0
- y1
- x1
- fig
- ax
- xc
- yc
- cid
- length

  try: mf=float(Yf1-Yf0)/float((Xf1-Xf0)) # slope of the fault line cf=float(Yf0-mf∗Xf0) # intercept of the fault line df0=dist↩ _point_from_line(mf,cf,x0,y0,1,1) #distance of the profile start point from the Fault line df1=dist_point_from_↩ line(mf,cf,x1,y1,1,1) #distance of the profile end point from the Fault line
- x
- y
- zi
- lat_transect
- lon_transect
- dx
- dy
- DX
- DY
- D
- mf
- cf
- df0_km
- transect
- XX0
- XX1
- YY0
- YY1
- m
- c

- m1
- dp
- X0
- Y0
- X1
- Y1
- transect_lat
- transect_lon
- m_prof_edge
- c_prof_edge
- gpsFile
- insarData
- fileName
- fileExtension
- Stations
- Lat
- Lon
- Ve
- Se
- Vn
- Sn
- idxRef
- IDYref
- IDXref
- stationsList
- h5file_theta
- dset
- theta
- heading
- unitVec
- gpsLOS_ref
- GPS
- GPS_station
- GPSx
- GPSy
- GPS_lat
- GPS_lon
- idx
- IDY
- IDX
- gpsLOS
- NoInSAR
- DistGPS
- GPS_in_bound
- GPS_in_bound_st
- GPSxx
- GPSyy
- gx
- gy
- check_result
- check_result2
- dg
- axes
- nrows
- ms

ax.fill_between(D/1000.0, (avgInSAR-stdInSAR)∗1000, (avgInSAR+stdInSAR)∗1000,where=(avgInSAR+stdInS↩ AR)∗1000>=(avgInSAR-stdInSAR)∗1000,alpha=1, facecolor='Red')

- avgInSAR
- axis
- stdInSAR
- fig2
- axes2
- FaultLine
- figName

  Temporary To plot DEM try: majorLocator = MultipleLocator(5) ax.yaxis.set_major_locator(majorLocator) minor↩ Locator = MultipleLocator(1) ax.yaxis.set_minor_locator(minorLocator)

- mfc
- linewidth
- matFile
- dataset
- color

  ax.plot(D/1000.0, avgInSAR∗1000, 'r-')

- alpha
- fontsize
- lbound

  lower and higher bounds for diplaying the profile

- hbound
- ylim
- xlim

20.53.1 Function Documentation

20.53.1.1 check_st_in_box()

```
def pysar.multi_transect.check_st_in_box (
              x,
              y,
              x0,
              y0,
              x1,
              y1,
              X0,
              Y0,
              X1,
              Y1 )
```

20.53.1.2 check_st_in_box2()

```
def pysar.multi_transect.check_st_in_box2 (
              x,
              y,
              x0,
              y0,
              x1,
              y1,
              X0,
              Y0,
              X1,
              Y1 )
```

20.53.1.3 dist_point_from_line()

```
def pysar.multi_transect.dist_point_from_line (
              m,
              c,
              x,
              y,
              dx,
              dy )
```

20.53.1.4 dms2d()

```
def pysar.multi_transect.dms2d (
              Coord )
```

20.53.1.5 find_row_column()

```
def pysar.multi_transect.find_row_column (
              Lon,
              Lat,
              lon,
              lat,
              lon_step,
              lat_step )
```

20.53.1.6 get_intersect()

```
def pysar.multi_transect.get_intersect (
              m,
              c,
              x,
              y )
```

20.53.1.7 get_lat_lon()

```
def pysar.multi_transect.get_lat_lon (
              h5file )
```

20.53.1.8 get_start_end_point()

```
def pysar.multi_transect.get_start_end_point (
              Xf0,
              Yf0,
              Xf1,
              Yf1,
              L,
              dx,
              dy )
```

20.53.1.9 get_transect()

```
def pysar.multi_transect.get_transect (
              z,
              x0,
              y0,
              x1,
              y1 )
```

20.53.1.10 gps_to_LOS()

```
def pysar.multi_transect.gps_to_LOS (
              Ve,
              Vn,
              theta,
              heading )
```

20.53.1.11 line()

```
def pysar.multi_transect.line (
              x0,
              y0,
              x1,
              y1 )
```

20.53.1.12 main()

```
def pysar.multi_transect.main (
              argv )
```

20.53.1.13 nanmean()

```
def pysar.multi_transect.nanmean (
              data,
              args )
```

20.53.1.14 nanstd()

```
def pysar.multi_transect.nanstd (
              data,
              args )
```

20.53.1.15 nearest()

```
def pysar.multi_transect.nearest (
              x,
              tbase,
              xstep )
```

20.53.1.16 onclick()

```
def pysar.multi_transect.onclick (
              event )
```

20.53.1.17 point_on_line_with_distance_from_beginning()

```
def pysar.multi_transect.point_on_line_with_distance_from_beginning (
              Xf0,
              Yf0,
              Xf1,
              Yf1,
              L )
```

20.53.1.18 point_with_distance_from_line()

```
def pysar.multi_transect.point_with_distance_from_line (
              Xf0,
              Yf0,
              Xf1,
              Yf1,
              L )
```

20.53.1.19 read_fault_coords()

```
def pysar.multi_transect.read_fault_coords (
              Fault_coord_file,
              Dp )
```

20.53.1.20 readGPSfile()

```
def pysar.multi_transect.readGPSfile (
              gpsFile,
              gps_source )
```

20.53.1.21 redGPSfile()

```
def pysar.multi_transect.redGPSfile (
              gpsFile )
```

20.53.1.22 redGPSfile_cmm4()

```
def pysar.multi_transect.redGPSfile_cmm4 (
              gpsFile )
```

20.53.1.23 usage()

```
def pysar.multi_transect.usage ( )
```

20.53.2 Variable Documentation

20.53.2.1 alpha

```
alpha
```

20.53.2.2 avgInSAR

```
avgInSAR
```

20.53.2.3 ax

```
ax
```

20.53.2.4 axes

```
axes
```

20.53.2.5 axes2

```
axes2
```

20.53.2.6 axis

```
axis
```

20.53.2.7 c

```
c
```

20.53.2.8 c_prof_edge

```
c_prof_edge
```

20.53.2.9 cf

```
cf
```

20.53.2.10 check_result

```
check_result
```

20.53.2.11 check_result2

```
check_result2
```

20.53.2.12 cid

```
cid
```

20.53.2.13 color

```
color
```

ax.plot(D/1000.0, avgInSAR∗1000, 'r-')

To plot the Fault location on the profile try:

20.53.2.14 D

D

20.53.2.15 dataset

dataset

20.53.2.16 df0_km

df0_km

20.53.2.17 dg

dg

20.53.2.18 DistGPS

DistGPS

20.53.2.19 dp

dp

20.53.2.20 dset

dset

20.53.2.21 dx

dx

20.53.2.22 DX

DX

20.53.2.23 dy

```
dy
```

20.53.2.24 DY

```
DY
```

20.53.2.25 Fault_lat

```
Fault_lat
```

20.53.2.26 Fault_lon

```
Fault_lon
```

20.53.2.27 FaultCoords

```
FaultCoords
```

20.53.2.28 FaultLine

```
FaultLine
```

20.53.2.29 fig

```
fig
```

20.53.2.30 fig2

```
fig2
```

20.53.2.31 figName

```
figName
```

Temporary To plot DEM try: majorLocator = MultipleLocator(5) ax.yaxis.set_major_locator(majorLocator) minor↩
Locator = MultipleLocator(1) ax.yaxis.set_minor_locator(minorLocator)

20.53.2.32 fileExtension

```
fileExtension
```

20.53.2.33 fileName

```
fileName
```

20.53.2.34 fontsize

```
fontsize
```

20.53.2.35 GPS

```
GPS
```

20.53.2.36 GPS_in_bound

```
GPS_in_bound
```

20.53.2.37 GPS_in_bound_st

```
GPS_in_bound_st
```

20.53.2.38 GPS_lat

```
GPS_lat
```

20.53.2.39 GPS_lon

```
GPS_lon
```

20.53.2.40 GPS_station

```
GPS_station
```

20.53.2.41 gpsFile

```
gpsFile
```

20.53.2.42 gpsLOS

```
gpsLOS
```

20.53.2.43 gpsLOS_ref

```
gpsLOS_ref
```

20.53.2.44 GPSx

```
GPSx
```

20.53.2.45 GPSxx

```
GPSxx
```

20.53.2.46 GPSy

```
GPSy
```

20.53.2.47 GPSyy

```
GPSyy
```

20.53.2.48 gx

gx

20.53.2.49 gy

gy

20.53.2.50 h5file_theta

h5file_theta

20.53.2.51 hbound

hbound

20.53.2.52 heading

heading

20.53.2.53 idx

idx

20.53.2.54 IDX

IDX

20.53.2.55 idxRef

idxRef

20.53.2.56 IDXref

IDXref

20.53.2.57 IDY

```
IDY
```

20.53.2.58 IDYref

```
IDYref
```

20.53.2.59 insarData

```
insarData
```

20.53.2.60 lat

```
lat
```

20.53.2.61 Lat

```
Lat
```

20.53.2.62 Lat0

```
Lat0
```

20.53.2.63 Lat1

```
Lat1
```

20.53.2.64 lat_all

```
lat_all
```

20.53.2.65 lat_step

```
lat_step
```

20.53.2.66 lat_transect

```
lat_transect
```

20.53.2.67 lbound

```
lbound
```

lower and higher bounds for diplaying the profile

20.53.2.68 Length

```
Length
```

20.53.2.69 length

```
length
```

try: mf=float(Yf1-Yf0)/float((Xf1-Xf0)) # slope of the fault line cf=float(Yf0-mf∗Xf0) # intercept of the fault line df0=dist_point_from_line(mf,cf,x0,y0,1,1) #distance of the profile start point from the Fault line df1=dist_point_↩ from_line(mf,cf,x1,y1,1,1) #distance of the profile end point from the Fault line

20.53.2.70 linewidth

```
linewidth
```

20.53.2.71 lon

```
lon
```

20.53.2.72 Lon

```
Lon
```

20.53.2.73 Lon0

```
Lon0
```

20.53.2.74 Lon1

```
Lon1
```

20.53.2.75 lon_all

```
lon_all
```

20.53.2.76 lon_step

```
lon_step
```

20.53.2.77 lon_transect

```
lon_transect
```

20.53.2.78 m

```
m
```

20.53.2.79 m1

```
m1
```

20.53.2.80 m_prof_edge

```
m_prof_edge
```

20.53.2.81 matFile

```
matFile
```

20.53.2.82 mf

```
mf
```

20.53.2.83 mfc

```
mfc
```

20.53.2.84 ms

```
ms
```

ax.fill_between(D/1000.0, (avgInSAR-stdInSAR)*1000, (avgInSAR+stdInSAR)*1000,where=(avgInSAR+stdInS↩
AR)*1000>=(avgInSAR-stdInSAR)*1000,alpha=1, facecolor='Red')

20.53.2.85 NoInSAR

```
NoInSAR
```

20.53.2.86 nrows

```
nrows
```

20.53.2.87 Num_profiles

```
Num_profiles
```

20.53.2.88 Se

```
Se
```

20.53.2.89 Sn

```
Sn
```

20.53.2.90 Stations

```
Stations
```

20.53.2.91 stationsList

```
stationsList
```

20.53.2.92 stdInSAR

```
stdInSAR
```

20.53.2.93 theta

```
theta
```

20.53.2.94 transect

```
transect
```

20.53.2.95 transect_lat

```
transect_lat
```

20.53.2.96 transect_lon

```
transect_lon
```

20.53.2.97 unitVec

```
unitVec
```

20.53.2.98 Ve

```
Ve
```

20.53.2.99 Vn

```
Vn
```

20.53.2.100 Width

`Width`

20.53.2.101 x

`x`

20.53.2.102 x0

`x0`

20.53.2.103 X0

`X0`

20.53.2.104 x1

`x1`

20.53.2.105 X1

`X1`

20.53.2.106 xc

`xc`

20.53.2.107 Xf0

`Xf0`

20.53.2.108 Xf1

`Xf1`

20.53.2.109 xlim

```
xlim
```

20.53.2.110 XX0

```
XX0
```

20.53.2.111 XX1

```
XX1
```

20.53.2.112 y

```
y
```

20.53.2.113 y0

```
y0
```

20.53.2.114 Y0

```
Y0
```

20.53.2.115 y1

```
y1
```

20.53.2.116 Y1

```
Y1
```

20.53.2.117 yc

```
yc
```

20.53.2.118 Yf0

```
Yf0
```

20.53.2.119 Yf1

```
Yf1
```

20.53.2.120 ylim

```
ylim
```

20.53.2.121 YY0

```
YY0
```

20.53.2.122 YY1

```
YY1
```

20.53.2.123 zi

```
zi
```

20.54 pysar.multilook Namespace Reference

Functions

- def multilook_matrix (matrix, lks_y, lks_x)

  Sub Functions ##.
- def multilook_attribute (atr_dict, lks_y, lks_x, print_msg=True)
- def multilook_file (infile, lks_y, lks_x, outfile=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.54.1 Function Documentation

20.54.1.1 cmdLineParse()

```
def pysar.multilook.cmdLineParse ( )
```

20.54.1.2 main()

```
def pysar.multilook.main (
              argv )
```

20.54.1.3 multilook_attribute()

```
def pysar.multilook.multilook_attribute (
              atr_dict,
              lks_y,
              lks_x,
              print_msg = True )
```

20.54.1.4 multilook_file()

```
def pysar.multilook.multilook_file (
              infile,
              lks_y,
              lks_x,
              outfile = None )
```

20.54.1.5 multilook_matrix()

```
def pysar.multilook.multilook_matrix (
              matrix,
              lks_y,
              lks_x )
```

Sub Functions ##.

20.54.2 Variable Documentation

20.54.2.1 EXAMPLE

```
EXAMPLE
```

20.55 pysar.perp_baseline Namespace Reference

Functions

- def usage ()
- def main (argv)

20.55.1 Function Documentation

20.55.1.1 main()

```
def pysar.perp_baseline.main (
              argv )
```

20.55.1.2 usage()

```
def pysar.perp_baseline.usage ( )
```

20.56 pysar.plot_network Namespace Reference

Functions

- def read_template2inps (template_file, inps=None)

  Sub Function ###############################.
- def cmdLineParse ()
- def main (argv)

  Main Function ###############################.

Variables

- BL_LIST

  Sub Function ###############################.
- DATE12_LIST
- EXAMPLE
- TEMPLATE

20.56.1 Function Documentation

20.56.1.1 cmdLineParse()

```
def pysar.plot_network.cmdLineParse ( )
```

20.56.1.2 main()

```
def pysar.plot_network.main (
              argv )
```

Main Function ###############################.

20.56.1.3 read_template2inps()

```
def pysar.plot_network.read_template2inps (
              template_file,
              inps = None )
```

Sub Function ###############################.

```
Read input template options into Namespace inps
```

20.56.2 Variable Documentation

20.56.2.1 BL_LIST

```
BL_LIST
```

Sub Function ###############################.

20.56.2.2 DATE12_LIST

```
DATE12_LIST
```

20.56.2.3 EXAMPLE

```
EXAMPLE
```

20.56.2.4 TEMPLATE

```
TEMPLATE
```

20.57 pysar.prep4timeseries Namespace Reference

Functions

- def createParser ()
- def cmdLineParse (iargs=None)
- def extractIsceMetadata (xmlFile)
- def read_baseline (baselineFile)
- def baselineTimeseries (baselineDir)
- def read_rsc (rscFile)
- def write_rsc (rscDict, rscFile)
- def attribute_isce2roipac (metaDict, dates=[ ], baselineDict={})
- def prepare_stack (inputDir, filePattern, metaDictIn, baselineDict)
- def prepare_geometry (geometryDir, exDict=None)
- def read_template (File, delimiter='=')

  from _read_file.py Need to be removed once we can import _readfile.py
- def check_variable_name (path)
- def main (iargs=None)

Variables

- GDAL2NUMPY_DATATYPE
- EXAMPLE

20.57.1 Function Documentation

20.57.1.1 attribute_isce2roipac()

```
def pysar.prep4timeseries.attribute_isce2roipac (
              metaDict,
              dates = [],
              baselineDict = {} )
```

20.57.1.2 baselineTimeseries()

```
def pysar.prep4timeseries.baselineTimeseries (
              baselineDir )
```

20.57.1.3 check_variable_name()

```
def pysar.prep4timeseries.check_variable_name (
              path )
```

20.57.1.4 cmdLineParse()

```
def pysar.prep4timeseries.cmdLineParse (
              iargs = None )
```

20.57.1.5 createParser()

```
def pysar.prep4timeseries.createParser ( )
```

```
Command line parser.
```

20.57.1.6 extractIsceMetadata()

```
def pysar.prep4timeseries.extractIsceMetadata (
              xmlFile )
```

20.57.1.7 main()

```
def pysar.prep4timeseries.main (
              iargs = None )
```

20.57.1.8 prepare_geometry()

```
def pysar.prep4timeseries.prepare_geometry (
              geometryDir,
              exDict = None )
```

```
Prepare Geometry files for PySAR: DEM in radar coord, and lookup table
Input:
    geometryDir - string, path to the directory of merged/geo
    exDict      - dictionary, interferogram attributes to be updated with geometry file
Output:
    geometryRadar.h5 - HDF5 file with group - geometry and sub-datasets:
        latitude
        longitude
        height
        incidenceAngle
        headingAngle
```

20.57.1.9 prepare_stack()

```
def pysar.prep4timeseries.prepare_stack (
              inputDir,
              filePattern,
              metaDictIn,
              baselineDict )
```

20.57.1.10 read_baseline()

```
def pysar.prep4timeseries.read_baseline (
              baselineFile )
```

20.57.1.11 read_rsc()

```
def pysar.prep4timeseries.read_rsc (
              rscFile )
```

20.57.1.12 read_template()

```
def pysar.prep4timeseries.read_template (
              File,
              delimiter = '=' )
```

from _read_file.py Need to be removed once we can import _readfile.py

```
Reads the template file into a python dictionary structure.
Input : string, full path to the template file
Output: dictionary, pysar template content
Example:
    tmpl = read_template(KyushuT424F610_640AlosA.template)
    tmpl = read_template(R1_54014_ST5_L0_F898.000.pi, ':')
```

20.57.1.13 write_rsc()

```
def pysar.prep4timeseries.write_rsc (
              rscDict,
              rscFile )
```

20.57.2 Variable Documentation

20.57.2.1 EXAMPLE

```
EXAMPLE
```

20.57.2.2 GDAL2NUMPY_DATATYPE

```
GDAL2NUMPY_DATATYPE
```

20.58 pysar.prep_gamma Namespace Reference

Functions

- def get_perp_baseline (m_par_file, s_par_file, off_file, atr_dict={})

  Sub Functions ##.
- def get_lalo_ref (m_par_file, atr_dict={})
- def extract_attribute_interferogram (fname)
- def extract_attribute_lookup_table (fname)
- def extract_attribute_dem_geo (fname)
- def extract_attribute_dem_radar (fname)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- DESCRIPTION

20.58.1 Function Documentation

20.58.1.1 cmdLineParse()

```
def pysar.prep_gamma.cmdLineParse ( )
```

20.58.1.2 extract_attribute_dem_geo()

```
def pysar.prep_gamma.extract_attribute_dem_geo (
              fname )
```

```
Read/extract attribute for .dem file from Gamma to ROI_PAC
For example, it read input file, sim_150911-150922.utm.dem,
find its associated par file, sim_150911-150922.utm.dem.par, read it, and
convert to ROI_PAC style and write it to an rsc file, sim_150911-150922.utm.dem.rsc
```

20.58.1.3 extract_attribute_dem_radar()

```
def pysar.prep_gamma.extract_attribute_dem_radar (
              fname )
```

```
Read/extract attribute for .hgt_sim file from Gamma to ROI_PAC
Input:
    sim_150911-150922.hgt_sim
    sim_150911-150922.rdc.dem
Search for:
    sim_150911-150922.diff_par
Output:
    sim_150911-150922.hgt_sim.rsc
    sim_150911-150922.rdc.dem.rsc
```

20.58.1.4 extract_attribute_interferogram()

```
def pysar.prep_gamma.extract_attribute_interferogram (
              fname )
```

```
Read/extract attributes for PySAR from Gamma .unw, .cor and .int file
Inputs:
    fname : str, Gamma interferogram filename or path, i.e. /PopoSLT143TsxD/diff_filt_HDR_130118-130129_4rlks.
Output:
    atr : dict, Attributes dictionary
```

20.58.1.5 extract_attribute_lookup_table()

```
def pysar.prep_gamma.extract_attribute_lookup_table (
              fname )
```

```
Read/extract attribute for .UTM_TO_RDC file from Gamma to ROI_PAC
For example, it read input file, sim_150911-150922.UTM_TO_RDC,
find its associated par file, sim_150911-150922.utm.dem.par, read it, and
convert to ROI_PAC style and write it to an rsc file, sim_150911-150922.UTM_TO_RDC.rsc
```

20.58.1.6 get_lalo_ref()

```
def pysar.prep_gamma.get_lalo_ref (
              m_par_file,
              atr_dict = {} )
```

```
Extract LAT/LON_REF1/2/3/4 from corner file, e.g. 130118_4rlks.amp.corner.
If it’s not existed, call Gamma script - SLC_corners - to generate it from SLC par file, e.g. 130118_4rlks.amp

Parameters: m_par_file : str, path, master date parameter file, i.e. 130118_4rlks.amp.par
            atr_dict   : dict, optional, attributes dictionary
Returns:  lalo_ref
```

20.58.1.7 get_perp_baseline()

```
def pysar.prep_gamma.get_perp_baseline (
              m_par_file,
              s_par_file,
              off_file,
              atr_dict = {} )
```

Sub Functions ##.

```
Get perpendicular baseline info from master/slave par file and off file.
Parameters: m_par_file : str, path, master parameter file, i.e. 130118_4rlks.amp.par
            s_par_file : str, path, slave  parameter file, i.e. 130129_4rlks.amp.oar
            off_file   : str, path, interferogram off file, i.e. 130118-130129_4rlks.off
            atr_dict   : dict, optional, attributes dictionary
Returns:  bperp : str, perpendicular baseline for pixel at [0,0]
```

20.58.1.8 main()

```
def pysar.prep_gamma.main (
              argv )
```

20.58.2 Variable Documentation

20.58.2.1 DESCRIPTION

```
DESCRIPTION
```

20.58.2.2 EXAMPLE

```
EXAMPLE
```

20.59 pysar.prep_giant_ifg_list Namespace Reference

Functions

- def get_mission_name (meta_dict)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.59.1 Function Documentation

20.59.1.1 cmdLineParse()

```
def pysar.prep_giant_ifg_list.cmdLineParse ( )
```

20.59.1.2 get_mission_name()

```
def pysar.prep_giant_ifg_list.get_mission_name (
              meta_dict )
```

```
Get mission name in UNAVCO InSAR Archive format from attribute mission/PLATFORM
Input:  meta_dict : dict, attributes
Output: mission   : string, mission name in standard UNAVCO format.
```

20.59.1.3 main()

```
def pysar.prep_giant_ifg_list.main (
              argv )
```

20.59.2 Variable Documentation

20.59.2.1 EXAMPLE

```
EXAMPLE
```

20.60 pysar.prep_isce Namespace Reference

Functions

- def createParser ()
- def cmdLineParse (iargs=None)
- def extractIsceMetadata (xmlFile)
- def write_rsc (isceFile, dates, metadata, baselineDict)
- def prepare_stack (inputDir, filePattern, metadata, baselineDict)
- def read_baseline (baselineFile)
- def baselineTimeseries (baselineDir)
- def prepare_geometry (geometryDir)
- def main (iargs=None)

Variables

- GDAL2NUMPY_DATATYPE

20.60.1 Function Documentation

20.60.1.1 baselineTimeseries()

```
def pysar.prep_isce.baselineTimeseries (
              baselineDir )
```

20.60.1.2 cmdLineParse()

```
def pysar.prep_isce.cmdLineParse (
              iargs = None )
```

20.60.1.3 createParser()

```
def pysar.prep_isce.createParser ( )
```

```
Command line parser.
```

20.60.1.4 extractIsceMetadata()

```
def pysar.prep_isce.extractIsceMetadata (
              xmlFile )
```

20.60.1.5 main()

```
def pysar.prep_isce.main (
              iargs = None )
```

20.60.1.6 prepare_geometry()

```
def pysar.prep_isce.prepare_geometry (
              geometryDir )
```

20.60.1.7 prepare_stack()

```
def pysar.prep_isce.prepare_stack (
              inputDir,
              filePattern,
              metadata,
              baselineDict )
```

20.60.1.8 read_baseline()

```
def pysar.prep_isce.read_baseline (
              baselineFile )
```

20.60.1.9 write_rsc()

```
def pysar.prep_isce.write_rsc (
              isceFile,
              dates,
              metadata,
              baselineDict )
```

20.60.2 Variable Documentation

20.60.2.1 GDAL2NUMPY_DATATYPE

```
GDAL2NUMPY_DATATYPE
```

20.61 pysar.prep_roipac Namespace Reference

Functions

- def extract_attribute (fname)

  Sub Functions ##.
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- DESCRIPTION

20.61.1 Function Documentation

20.61.1.1 cmdLineParse()

```
def pysar.prep_roipac.cmdLineParse ( )
```

20.61.1.2 extract_attribute()

```
def pysar.prep_roipac.extract_attribute (
              fname )
```

Sub Functions ##.

```
Read/extract attributes for PySAR from ROI_PAC .unw, .int, .cor file.

For each unwrapped interferogram or spatial coherence file, there are 2 .rsc files:
    basic metadata file and baseline parameter file.
    e.g. filt_100901-110117-sim_HDR_4rlks_c10.unw
         filt_100901-110117-sim_HDR_4rlks_c10.unw.rsc
         100901-110117_baseline.rsc
Inputs:
    fname : string, ROI_PAC interferogram filename or path,
            i.e. /KujuT422F650AlosA/filt_100901-110117-sim_HDR_4rlks_c10.unw
Outputs:
    atr : dict, Attributes dictionary
```

20.61.1.3 main()

```
def pysar.prep_roipac.main (
              argv )
```

20.61.2 Variable Documentation

20.61.2.1 DESCRIPTION

```
DESCRIPTION
```

20.61.2.2 EXAMPLE

```
EXAMPLE
```

20.62 pysar.pysarApp Namespace Reference

Functions

- def check_geocode_file (lookupFile, File, templateFile=None, outFile=None)
- def check_subset_file (File, inps_dict, outFile=None, overwrite=False)
- def subset_dataset (inps, template_file)
- def multilook_dataset (inps, lks_y=None, lks_x=None)
- def cmdLineParse ()
- def main (argv)

Variables

- LOGO
- TEMPLATE
- EXAMPLE
- UM_FILE_STRUCT

20.62.1 Function Documentation

20.62.1.1 check_geocode_file()

```
def pysar.pysarApp.check_geocode_file (
              lookupFile,
              File,
              templateFile = None,
              outFile = None )
```

```
Geocode input file or use existed geocoded file.
```

20.62.1.2 check_subset_file()

```
def pysar.pysarApp.check_subset_file (
              File,
              inps_dict,
              outFile = None,
              overwrite = False )
```

```
Subset input file or use existed subseted file.
```

20.62.1.3 cmdLineParse()

```
def pysar.pysarApp.cmdLineParse ( )
```

20.62.1.4 main()

```
def pysar.pysarApp.main (
              argv )
```

20.62.1.5 multilook_dataset()

```
def pysar.pysarApp.multilook_dataset (
              inps,
              lks_y = None,
              lks_x = None )
```

```
Create a multilooked dataset
```

20.62.1.6 subset_dataset()

```
def pysar.pysarApp.subset_dataset (
              inps,
              template_file )
```

```
Create/prepare subset of datasets in different folder for time series analysis.
1) Read subset info from lat/lon or y/x, and convert into y/x
   where lat/lon > y/x in priority unless a) no lookup file AND b) dataset is in radar coord
   While converting lalo to yx, yx should be the bounding box of lalo.
2) for geo-coord dataset, use y/x from 1) to subset all the files
   for radar-coord dataset, use y/x from 1) to subset all radar-coord files; then get y/x bounding box
      in lat/lon and use it to subset all geo-coord files.
```

20.62.2 Variable Documentation

20.62.2.1 EXAMPLE

```
EXAMPLE
```

20.62.2.2 LOGO

```
LOGO
```

20.62.2.3 TEMPLATE

```
TEMPLATE
```

20.62.2.4 UM_FILE_STRUCT

```
UM_FILE_STRUCT
```

20.63 pysar.quality_map Namespace Reference

Functions

- def usage ()
- def main (argv)

20.63.1 Function Documentation

20.63.1.1 main()

```
def pysar.quality_map.main (
              argv )
```

20.63.1.2 usage()

```
def pysar.quality_map.usage ( )
```

20.64 pysar.range_distance Namespace Reference

Functions

- def usage ()
- def main (argv)

20.64.1 Function Documentation

20.64.1.1 main()

```
def pysar.range_distance.main (
              argv )
```

20.64.1.2 usage()

```
def pysar.range_distance.usage ( )
```

20.65 pysar.reference_epoch Namespace Reference

Functions

- def ref_date_attribute (atr_in, ref_date, date_list)
- def ref_date_file (inFile, ref_date, outFile=None)
- def read_template2inps (templateFile, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- TEMPLATE
- EXAMPLE

20.65.1 Function Documentation

20.65.1.1 cmdLineParse()

```
def pysar.reference_epoch.cmdLineParse ( )
```

20.65.1.2 main()

```
def pysar.reference_epoch.main (
              argv )
```

20.65.1.3 read_template2inps()

```
def pysar.reference_epoch.read_template2inps (
              templateFile,
              inps = None )
```

```
Update inps with options from templateFile
```

20.65.1.4 ref_date_attribute()

```
def pysar.reference_epoch.ref_date_attribute (
              atr_in,
              ref_date,
              date_list )
```

```
Update attribute dictionary for reference date
```

20.65.1.5 ref_date_file()

```
def pysar.reference_epoch.ref_date_file (
              inFile,
              ref_date,
              outFile = None )
```

```
Change input file reference date to a different one.
```

20.65.2 Variable Documentation

20.65.2.1 EXAMPLE

```
EXAMPLE
```

20.65.2.2 TEMPLATE

```
TEMPLATE
```

20.66 pysar.remove_plane Namespace Reference

Functions

- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.66.1 Function Documentation

20.66.1.1 cmdLineParse()

```
def pysar.remove_plane.cmdLineParse ( )
```

20.66.1.2 main()

```
def pysar.remove_plane.main (
              argv )
```

20.66.2 Variable Documentation

20.66.2.1 EXAMPLE

```
EXAMPLE
```

20.67 pysar.rewrap Namespace Reference

Functions

- def usage ()
- def rewrap (unw, cycle=2 ∗np.pi)
- def main (argv)

20.67.1 Function Documentation

20.67.1.1 main()

```
def pysar.rewrap.main (
              argv )
```

20.67.1.2 rewrap()

```
def pysar.rewrap.rewrap (
              unw,
              cycle = 2*np.pi )
```

20.67.1.3 usage()

```
def pysar.rewrap.usage ( )
```

20.68 pysar.save_gmt Namespace Reference

Functions

- def get_geo_lat_lon (atr)
- def write_grd_file (data, atr, fname_out=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.68.1 Function Documentation

20.68.1.1 cmdLineParse()

```
def pysar.save_gmt.cmdLineParse ( )
```

20.68.1.2 get_geo_lat_lon()

```
def pysar.save_gmt.get_geo_lat_lon (
              atr )
```

20.68.1.3 main()

```
def pysar.save_gmt.main (
              argv )
```

20.68.1.4 write_grd_file()

```
def pysar.save_gmt.write_grd_file (
              data,
              atr,
              fname_out = None )
```

```
Write GMT .grd file for input data matrix, using giant._gmt module.
Inputs:
    data - 2D np.array in int/float, data matrix to write
    atr  - dict, attributes of input data matrix
    fname_out - string, output file name
Output:
    fname_out - string, output file name
```

20.68.2 Variable Documentation

20.68.2.1 EXAMPLE

```
EXAMPLE
```

20.69 pysar.save_hdfeos5 Namespace Reference

Functions

- def get_mission_name (meta_dict)
- def metadata_pysar2unavco (pysar_meta_dict, dateList)
- def get_hdfeos5_filename (timeseriesFile)
- def read_template2inps (template_file, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- BOOL_ZERO
- INT_ZERO
- FLOAT_ZERO
- CPX_ZERO
- TEMPALTE
- EXAMPLE

20.69.1 Function Documentation

20.69.1.1 cmdLineParse()

```
def pysar.save_hdfeos5.cmdLineParse ( )
```

20.69.1.2 get_hdfeos5_filename()

```
def pysar.save_hdfeos5.get_hdfeos5_filename (
              timeseriesFile )
```

```
Get output file name of HDF-EOS5 time series file
```

20.69.1.3 get_mission_name()

```
def pysar.save_hdfeos5.get_mission_name (
              meta_dict )
```

```
Get mission name in UNAVCO InSAR Archive format from attribute mission/PLATFORM
Input:  meta_dict : dict, attributes
Output: mission   : string, mission name in standard UNAVCO format.
```

20.69.1.4 main()

```
def pysar.save_hdfeos5.main (
              argv )
```

20.69.1.5 metadata_pysar2unavco()

```
def pysar.save_hdfeos5.metadata_pysar2unavco (
              pysar_meta_dict,
              dateList )
```

20.69.1.6 read_template2inps()

```
def pysar.save_hdfeos5.read_template2inps (
              template_file,
              inps = None )
```

```
Read input template options into Namespace inps
```

20.69.2 Variable Documentation

20.69.2.1 BOOL_ZERO

```
BOOL_ZERO
```

20.69.2.2 CPX_ZERO

```
CPX_ZERO
```

20.69.2.3 EXAMPLE

```
EXAMPLE
```

20.69.2.4 FLOAT_ZERO

```
FLOAT_ZERO
```

20.69.2.5 INT_ZERO

```
INT_ZERO
```

20.69.2.6 TEMPALTE

```
TEMPALTE
```

20.70 pysar.save_kml Namespace Reference

Functions

- def write_kmz_file (data, atr, out_name_base, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.70.1 Function Documentation

20.70.1.1 cmdLineParse()

```
def pysar.save_kml.cmdLineParse ( )
```

20.70.1.2 main()

```
def pysar.save_kml.main (
              argv )
```

20.70.1.3 write_kmz_file()

```
def pysar.save_kml.write_kmz_file (
              data,
              atr,
              out_name_base,
              inps = None )
```

```
Generate Google Earth KMZ file for input data matrix.
Inputs:
    data - 2D np.array in int/float, data matrix to write
    out_name_base - string, output file name base
    atr  - dict, containing the following attributes:
           WIDTH/FILE_LENGTH : required, file size
           X/Y_FIRST/STEP    : required, for lat/lon spatial converage
           ref_x/y           : optional, column/row number of reference pixel
           PROJECT_NAME      : optional, for KMZ folder name
    inps - Namespace, optional, input options for display
Output:
    kmz_file - string, output KMZ filename
Example:
    import pysar._readfile as readfile
    import pysar.view as pview
    import pysar.save_kml as save_kml
    fname = 'geo_velocity_masked.h5'
    data, atr = readfile.read(fname)
    out_name_base = pview.auto_figure_title(fname, None)
    save_kml.write_kmz_file(data, atr, out_name_base)
```

20.70.2 Variable Documentation

20.70.2.1 EXAMPLE

```
EXAMPLE
```

20.71 pysar.save_mat Namespace Reference

Functions

- def usage ()
- def yyyymmdd2years (date)
- def main (argv)

20.71.1 Function Documentation

20.71.1.1 main()

```
def pysar.save_mat.main (
              argv )
```

20.71.1.2 usage()

```
def pysar.save_mat.usage ( )
```

20.71.1.3 yyyymmdd2years()

```
def pysar.save_mat.yyyymmdd2years (
              date )
```

20.72 pysar.save_roipac Namespace Reference

Functions

- def usage ()
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.72.1 Function Documentation

20.72.1.1 cmdLineParse()

```
def pysar.save_roipac.cmdLineParse ( )
```

20.72.1.2 main()

```
def pysar.save_roipac.main (
              argv )
```

20.72.1.3 usage()

```
def pysar.save_roipac.usage ( )
```

20.72.2 Variable Documentation

20.72.2.1 EXAMPLE

```
EXAMPLE
```

20.73 pysar.seed_data Namespace Reference

Functions

- def nearest (x, tbase, xstep)

  Sub Functions ##.
- def seed_file_reference_value (File, outName, refList, ref_y='', ref_x='')
- def seed_file_inps (File, inps=None, outFile=None)
- def seed_attributes (atr_in, x, y)
- def manual_select_reference_yx (stack, inps)
- def select_max_coherence_yx (cohFile, mask=None, min_coh=0.85)
- def random_select_reference_yx (data_mat, print_msg=True)
- def print_warning (next_method)
- def read_seed_template2inps (template_file, inps=None)
- def read_seed_reference2inps (reference_file, inps=None)
- def remove_reference_pixel (File)
- def cmdLineParse ()
- def main (argv)

  Main Function ###.

Variables

- TEMPLATE

  Usage ##.
- NOTE
- EXAMPLE

20.73.1 Function Documentation

20.73.1.1 cmdLineParse()

```
def pysar.seed_data.cmdLineParse ( )
```

20.73.1.2 main()

```
def pysar.seed_data.main (
              argv )
```

Main Function ##.

20.73.1.3 manual_select_reference_yx()

```
def pysar.seed_data.manual_select_reference_yx (
              stack,
              inps )
```

```
Input:
    data4display : 2D np.array, stack of input file
    inps    : namespace, with key 'ref_x' and 'ref_y', which will be updated
```

20.73.1.4 nearest()

```
def pysar.seed_data.nearest (
              x,
              tbase,
              xstep )
```

Sub Functions ###.

20.73.1.5 print_warning()

```
def pysar.seed_data.print_warning (
              next_method )
```

20.73.1.6 random_select_reference_yx()

```
def pysar.seed_data.random_select_reference_yx (
              data_mat,
              print_msg = True )
```

20.73.1.7 read_seed_reference2inps()

```
def pysar.seed_data.read_seed_reference2inps (
              reference_file,
              inps = None )
```

```
Read seed/reference info from reference file and update input namespace
```

20.73.1.8 read_seed_template2inps()

```
def pysar.seed_data.read_seed_template2inps (
              template_file,
              inps = None )
```

```
Read seed/reference info from template file and update input namespace
```

20.73.1.9 remove_reference_pixel()

```
def pysar.seed_data.remove_reference_pixel (
              File )
```

```
Remove reference pixel info from input file
```

20.73.1.10 seed_attributes()

```
def pysar.seed_data.seed_attributes (
              atr_in,
              x,
              y )
```

20.73.1.11 seed_file_inps()

```
def pysar.seed_data.seed_file_inps (
              File,
              inps = None,
              outFile = None )
```

```
Seed input file with option from input namespace
Return output file name if succeed; otherwise, return None
```

20.73.1.12 seed_file_reference_value()

```
def pysar.seed_data.seed_file_reference_value (
              File,
              outName,
              refList,
              ref_y = '',
              ref_x = '' )
```

20.73.1.13 select_max_coherence_yx()

```
def pysar.seed_data.select_max_coherence_yx (
              cohFile,
              mask = None,
              min_coh = 0.85 )
```

```
Select pixel with coherence > min_coh in random
```

20.73.2 Variable Documentation

20.73.2.1 EXAMPLE

```
EXAMPLE
```

20.73.2.2 NOTE

```
NOTE
```

20.73.2.3 TEMPLATE

```
TEMPLATE
```

Usage ##.

20.74 pysar.select_network Namespace Reference

Functions

- def log (msg)
- def project_name2sensor (projectName)
- def read_template2inps (templateFile, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- sar_sensor_list
- REFERENCE
- EXAMPLE
- TEMPLATE

20.74.1 Function Documentation

20.74.1.1 cmdLineParse()

```
def pysar.select_network.cmdLineParse ( )
```

20.74.1.2 log()

```
def pysar.select_network.log (
              msg )
```

```
Log function writen by Falk
```

20.74.1.3 main()

```
def pysar.select_network.main (
              argv )
```

20.74.1.4 project_name2sensor()

```
def pysar.select_network.project_name2sensor (
              projectName )
```

20.74.1.5 read_template2inps()

```
def pysar.select_network.read_template2inps (
              templateFile,
              inps = None )
```

```
Read network options from template file into Namespace variable inps
```

20.74.2 Variable Documentation

20.74.2.1 EXAMPLE

```
EXAMPLE
```

20.74.2.2 REFERENCE

```
REFERENCE
```

20.74.2.3 sar_sensor_list

```
sar_sensor_list
```

20.74.2.4 TEMPLATE

```
TEMPLATE
```

20.75 pysar.spatial_average Namespace Reference

Functions

- def cmdLineParse ()
- def main (argv)

  Main Function ##################################.

Variables

- EXAMPLE

  Usage ######################################.

20.75.1 Function Documentation

20.75.1.1 cmdLineParse()

```
def pysar.spatial_average.cmdLineParse ( )
```

20.75.1.2 main()

```
def pysar.spatial_average.main (
              argv )
```

Main Function ##################################.

20.75.2 Variable Documentation

20.75.2.1 EXAMPLE

```
EXAMPLE
```

Usage ####################################.

20.76 pysar.spatial_filter Namespace Reference

Functions

- def filter_data (data, filter_type, filter_par=None)
- def filter_file (fname, filter_type, filter_par=None, fname_out=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.76.1 Function Documentation

20.76.1.1 cmdLineParse()

```
def pysar.spatial_filter.cmdLineParse ( )
```

20.76.1.2 filter_data()

```
def pysar.spatial_filter.filter_data (
              data,
              filter_type,
              filter_par = None )
```

```
Filter 2D matrix with selected filter
Inputs:
    data        : 2D np.array, matrix to be filtered
    filter_type : string, filter type
    filter_par  : string, optional, parameter for low/high pass filter
                  for low/highpass_avg, it's kernel size in int
                  for low/highpass_gaussain, it's sigma in float
Output:
    data_filt   : 2D np.array, matrix after filtering.
```

20.76.1.3 filter_file()

```
def pysar.spatial_filter.filter_file (
              fname,
              filter_type,
              filter_par = None,
              fname_out = None )
```

```
Filter 2D matrix with selected filter
Inputs:
    fname       : string, name/path of file to be filtered
    filter_type : string, filter type
    filter_par  : string, optional, parameter for low/high pass filter
                  for low/highpass_avg, it's kernel size in int
                  for low/highpass_gaussain, it's sigma in float
Output:
    fname_out   : string, optional, output file name/path
```

20.76.1.4 main()

```
def pysar.spatial_filter.main (
              argv )
```

20.76.2 Variable Documentation

20.76.2.1 EXAMPLE

```
EXAMPLE
```

20.77 pysar.stacking Namespace Reference

Functions

- def cmdLineParse ()
- def main (argv)

  Main Function ################################.

Variables

- EXAMPLE

  Usage ####################################.

20.77.1 Function Documentation

20.77.1.1 cmdLineParse()

```
def pysar.stacking.cmdLineParse ( )
```

20.77.1.2 main()

```
def pysar.stacking.main (
              argv )
```

Main Function ##################################.

20.77.2 Variable Documentation

20.77.2.1 EXAMPLE

```
EXAMPLE
```

Usage #######################################.

20.78 pysar.subset Namespace Reference

Functions

- def coord_geo2radar (geoCoordIn, atr, coordType)

  Example: 300 = coord_geo2radar(32.104990, atr,'lat') [1000,1500] = coord_geo2radar([130.5,131.4],atr,'lon')
- def coord_radar2geo (radarCoordIn, atr, coordType)

  Inputs: radarCoord : coordinate (list) in row/col in int atr : dictionary of file attributes coordType : coordinate type: row, col, y, x.
- def check_box_within_data_coverage (pixel_box, atr_dict)
- def subset_attribute (atr_dict, subset_box, print_msg=True)
- def get_coverage_box (atr)
- def read_subset_template2box (templateFile)
- def bbox_geo2radar (geo_box, atr_rdr=dict(), lookupFile=None)
- def bbox_radar2geo (pix_box, atr_rdr=dict(), lookupFile=None)
- def subset_box2inps (inps, pix_box, geo_box)
- def get_box_overlap_index (box1, box2)
- def subset_input_dict2box (subset_dict, meta_dict)
- def box_pixel2geo (pixel_box, meta_dict)
- def box_geo2pixel (geo_box, meta_dict)
- def subset_file (File, subset_dict_input, outFile=None)
- def subset_file_list (fileList, inps)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.78.1 Function Documentation

20.78.1.1 bbox_geo2radar()

```
def pysar.subset.bbox_geo2radar (
              geo_box,
              atr_rdr = dict(),
              lookupFile = None )
```

```
Calculate bounding box in x/y for file in radar coord, based on input geo box.
Inputs:
    geo_box   - tuple of 4 float, indicating the UL/LR lon/lat
    atr_rdr   - dict, attributes of file in radar coord
    lookupFile - string, path of transformation file, i.e. geomap_4rlks.trans
Output:
    pix_box - tuple of 4 int, indicating the UL/LR x/y of the bounding box in radar coord
              for the corresponding lat/lon coverage.
```

20.78.1.2 bbox_radar2geo()

```
def pysar.subset.bbox_radar2geo (
              pix_box,
              atr_rdr = dict(),
              lookupFile = None )
```

```
Calculate bounding box in lat/lon for file in geo coord, based on input radar/pixel box
Inputs:
    pix_box   - tuple of 4 int, indicating the UL/LR x/y
    atr_rdr   - dict, attributes of file in radar coord
    lookupFile - string, path of transformation file, i.e. geomap_4rlks.trans
Output:
    geo_box - tuple of 4 float, indicating the UL/LR lon/lat of the bounding box
```

20.78.1.3 box_geo2pixel()

```
def pysar.subset.box_geo2pixel (
              geo_box,
              meta_dict )
```

```
Convert geo_box to pixel_box
```

20.78.1.4 box_pixel2geo()

```
def pysar.subset.box_pixel2geo (
              pixel_box,
              meta_dict )
```

```
Convert pixel_box to geo_box
```

20.78.1.5 check_box_within_data_coverage()

```
def pysar.subset.check_box_within_data_coverage (
              pixel_box,
              atr_dict )
```

```
Check the subset box's conflict with data coverage
Inputs:
    pixel_box : 4-tuple of int, indicating y/x coordinates of subset
    atr       : dictionary of file attributes
```

20.78.1.6 cmdLineParse()

```
def pysar.subset.cmdLineParse ( )
```

20.78.1.7 coord_geo2radar()

```
def pysar.subset.coord_geo2radar (
              geoCoordIn,
              atr,
              coordType )
```

Example: 300 = coord_geo2radar(32.104990, atr,'lat') [1000,1500] = coord_geo2radar([130.5,131.4],atr,'lon')

20.78.1.8 coord_radar2geo()

```
def pysar.subset.coord_radar2geo (
              radarCoordIn,
              atr,
              coordType )
```

Inputs: radarCoord : coordinate (list) in row/col in int atr : dictionary of file attributes coordType : coordinate type: row, col, y, x.

Example: 32.104990 = coord_radar2geo(300, atr,'y') [130.5,131.4] = coord_radar2geo([1000,1500],atr,'x')

20.78.1.9 get_box_overlap_index()

```
def pysar.subset.get_box_overlap_index (
              box1,
              box2 )
```

```
Get index box overlap area of two input boxes

Inputs:
    box1/2 : 4-tuple of int, indicating coverage of box1/2
             defining in (x0, y0, x1, y1)
Outputs:
    overlap_idx_box1/2 : 4-tuple of int, indicating index of overlap area in box1/2
                         defining in (idx_x0, idx_y0, idx_x1, idx_y1)
```

20.78.1.10 get_coverage_box()

```
def pysar.subset.get_coverage_box (
              atr )
```

```
Get Coverage Box of data in geo and pixel coordinates
Inputs: atr - dict, meta data dictionary
Outputs:
    pix_box : 4-tuple of int, defining in (UL_X, UL_Y, LR_X, LR_Y)
    geo_box : 4-tuple of float in lat/lon
```

20.78.1.11 main()

```
def pysar.subset.main (
              argv )
```

20.78.1.12 read_subset_template2box()

```
def pysar.subset.read_subset_template2box (
              templateFile )
```

```
Read pysar.subset.lalo/yx option from template file into box type
Return None if not specified.
```

20.78.1.13 subset_attribute()

```
def pysar.subset.subset_attribute (
              atr_dict,
              subset_box,
              print_msg = True )
```

```
Update attributes dictionary due to subset
Inputs:
    atr_dict   : dict, data attributes to update
    subset_box : 4-tuple of int, subset box defined in (x0, y0, x1, y1)
Outputs:
    atr      : dict, updated data attributes
```

20.78.1.14 subset_box2inps()

```
def pysar.subset.subset_box2inps (
              inps,
              pix_box,
              geo_box )
```

```
Update inps.subset_y/x/lat/lon from pixel_box and geo_box
```

20.78.1.15 subset_file()

```
def pysar.subset.subset_file (
              File,
              subset_dict_input,
              outFile = None )
```

```
Subset file with
Inputs:
    File        : str, path/name of file
    outFile     : str, path/name of output file
    subset_dict : dict, subsut parameter, including the following items:
                  subset_x   : list of 2 int,   subset in x direction,   default=None
                  subset_y   : list of 2 int,   subset in y direction,   default=None
                  subset_lat : list of 2 float, subset in lat direction, default=None
                  subset_lon : list of 2 float, subset in lon direction, default=None
                  fill_value : float, optional. filled value for area outside of data coverage. default=None
                               None/not-existed to subset within data coverage only.
                  tight  : bool, tight subset or not, for lookup table file, i.e. geomap*.trans
Outputs:
    outFile :  str, path/name of output file;
               outFile = 'subset_'+File, if File is in current directory;
               outFile = File, if File is not in the current directory.
```

20.78.1.16 subset_file_list()

```
def pysar.subset.subset_file_list (
              fileList,
              inps )
```

```
Subset file list
```

20.78.1.17 subset_input_dict2box()

```
def pysar.subset.subset_input_dict2box (
              subset_dict,
              meta_dict )
```

```
Convert subset inputs dict into box in radar and/or geo coord.
Inputs:
    subset_dict : dict, including the following 4 objects:
                  subset_x   : list of 2 int,   subset in x direction,   default=None
                  subset_y   : list of 2 int,   subset in y direction,   default=None
                  subset_lat : list of 2 float, subset in lat direction, default=None
                  subset_lon : list of 2 float, subset in lon direction, default=None
    meta_dict   : dict, including the following items:
                  'WIDTH'      : int
                  'FILE_LENGTH': int
                  'X_FIRST'    : float, optional
                  'Y_FIRST'    : float, optional
                  'X_STEP'     : float, optional
                  'Y_STEP'     : float, optional
Outputs:
    # box defined by 4-tuple of number, defining (left, upper, right, lower) coordinate,
    #                                             (UL_X, UL_Y,  LR_X,  LR_Y )
    pixel_box   : 4-tuple of int, in pixel unit - 1
    geo_box     : 4-tuple of float, in  lat/lon unit - degree
                  None if file is in radar coordinate.
example:
    subset_dict = {'subset_x': None, 'subset_y': None, 'subset_lat': [30.5, 31.0], 'subset_lon': [130.0, 131.0
    subset_dict = {'subset_x': [100, 1100], 'subset_y': [2050, 2550], 'subset_lat': None, 'subset_lon': None}
    pixel_box          = subset_input_dict2box(subset_dict, pysar_meta_dict)[0]
    pixel_box, geo_box = subset_input_dict2box(subset_dict, pysar_meta_dict)
```

20.78.2 Variable Documentation

20.78.2.1 EXAMPLE

```
EXAMPLE
```

20.79 pysar.sum_epochs Namespace Reference

Functions

- def usage ()
- def main (argv)

20.79.1 Function Documentation

20.79.1.1 main()

```
def pysar.sum_epochs.main (
              argv )
```

20.79.1.2 usage()

```
def pysar.sum_epochs.usage ( )
```

20.80 pysar.temporal_average Namespace Reference

Functions

- def usage ()

  Usage ######################################.
- def main (argv)

  Main Function ##################################.

20.80.1 Function Documentation

20.80.1.1 main()

```
def pysar.temporal_average.main (
              argv )
```

Main Function ##################################.

20.80.1.2 usage()

```
def pysar.temporal_average.usage ( )
```

Usage ######################################.

20.81 pysar.temporal_coherence Namespace Reference

Functions

- def temporal_coherence (timeseriesFile, ifgramFile)
- def usage ()
- def main (argv)

Variables

- USAGE
- DESCRIPTION
- REFERENCE
- EXAMPLE

20.81.1 Function Documentation

20.81.1.1 main()

```
def pysar.temporal_coherence.main (
              argv )
```

20.81.1.2 temporal_coherence()

```
def pysar.temporal_coherence.temporal_coherence (
              timeseriesFile,
              ifgramFile )
```

```
Calculate temporal coherence based on input timeseries file and interferograms file
Inputs:
    timeseriesFile - string, path of time series file
    ifgramFile     - string, path of interferograms file
Output:
    temp_coh - 2D np.array, temporal coherence in float32
```

20.81.1.3 usage()

```
def pysar.temporal_coherence.usage ( )
```

20.81.2 Variable Documentation

20.81.2.1 DESCRIPTION

```
DESCRIPTION
```

20.81.2.2 EXAMPLE

```
EXAMPLE
```

20.81.2.3 REFERENCE

```
REFERENCE
```

20.81.2.4 USAGE

```
USAGE
```

20.82 pysar.temporal_derivative Namespace Reference

Functions

- def usage ()
- def main (argv)

20.82.1 Function Documentation

20.82.1.1 main()

```
def pysar.temporal_derivative.main (
              argv )
```

20.82.1.2 usage()

```
def pysar.temporal_derivative.usage ( )
```

20.83 pysar.temporal_filter Namespace Reference

Functions

- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

20.83.1 Function Documentation

20.83.1.1 cmdLineParse()

```
def pysar.temporal_filter.cmdLineParse ( )
```

20.83.1.2 main()

```
def pysar.temporal_filter.main (
              argv )
```

20.83.2 Variable Documentation

20.83.2.1 EXAMPLE

```
EXAMPLE
```

20.84 pysar.timeseries2velocity Namespace Reference

Functions

- def get_exclude_date (inps, date_list_all)
- def get_velocity_filename (timeseries_file, template_file=None, vel_file='velocity.h5', inps=None)
- def read_template2inps (template_file, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- TEMPLATE
- DROP_DATE_TXT

20.84.1 Function Documentation

20.84.1.1 cmdLineParse()

```
def pysar.timeseries2velocity.cmdLineParse ( )
```

20.84.1.2 get_exclude_date()

```
def pysar.timeseries2velocity.get_exclude_date (
              inps,
              date_list_all )
```

```
Get inps.ex_date full list
Inputs:
    inps          - Namespace,
    date_list_all - list of string for all available date in YYYYMMDD format
Output:
    inps.ex_date  - list of string for exclude date in YYYYMMDD format
```

20.84.1.3 get_velocity_filename()

```
def pysar.timeseries2velocity.get_velocity_filename (
              timeseries_file,
              template_file = None,
              vel_file = 'velocity.h5',
              inps = None )
```

```
Get output velocity filename
Example: velocity_file = get_output_filename('timeseries_ECMWF_demErr_refDate.h5', 'KujuAlosAT422F650.template
```

20.84.1.4 main()

```
def pysar.timeseries2velocity.main (
              argv )
```

20.84.1.5 read_template2inps()

```
def pysar.timeseries2velocity.read_template2inps (
              template_file,
              inps = None )
```

```
Read input template file into inps.ex_date
```

20.84.2 Variable Documentation

20.84.2.1 DROP_DATE_TXT

```
DROP_DATE_TXT
```

20.84.2.2 EXAMPLE

```
EXAMPLE
```

20.84.2.3 TEMPLATE

```
TEMPLATE
```

20.85 pysar.timeseries_rms Namespace Reference

Functions

- def read_template2inps (templateFile, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- TEMPLATE
- EXAMPLE

20.85.1 Function Documentation

20.85.1.1 cmdLineParse()

```
def pysar.timeseries_rms.cmdLineParse ( )
```

20.85.1.2 main()

```
def pysar.timeseries_rms.main (
              argv )
```

20.85.1.3 read_template2inps()

```
def pysar.timeseries_rms.read_template2inps (
              templateFile,
              inps = None )
```

```
Update inps with pysar.residualRms.* option from templateFile
```

20.85.2 Variable Documentation

20.85.2.1 EXAMPLE

```
EXAMPLE
```

20.85.2.2 TEMPLATE

```
TEMPLATE
```

20.86 pysar.transect Namespace Reference

Functions

- def get_scale_from_disp_unit (disp_unit, data_unit)
- def read_lonlat_file (lonlat_file)
- def manual_select_start_end_point (File)
- def transect_yx (z, atr, start_yx, end_yx, interpolation='nearest')
- def transect_lalo (z, atr, start_lalo, end_lalo, interpolation='nearest')
- def transect_list (fileList, inps)
- def cmdLineParse ()
- def main (argv)

  Main ####################################.

Variables

- EXAMPLE

20.86.1 Function Documentation

20.86.1.1 cmdLineParse()

```
def pysar.transect.cmdLineParse ( )
```

20.86.1.2 get_scale_from_disp_unit()

```
def pysar.transect.get_scale_from_disp_unit (
              disp_unit,
              data_unit )
```

20.86.1.3 main()

```
def pysar.transect.main (
              argv )
```

Main ####################################.

20.86.1.4 manual_select_start_end_point()

```
def pysar.transect.manual_select_start_end_point (
              File )
```

```
Manual Select Start/End Point in display figure.
```

20.86.1.5 read_lonlat_file()

```
def pysar.transect.read_lonlat_file (
              lonlat_file )
```

```
Read Start/End lat/lon from lonlat text file in gmt format.
Inputs:
    lonlat_file : text file in gmt lonlat point file
Outputs:
    start/end_lalo : list of 2 float
```

20.86.1.6 transect_lalo()

```
def pysar.transect.transect_lalo (
              z,
              atr,
              start_lalo,
              end_lalo,
              interpolation = 'nearest' )
```

```
Extract 2D matrix (z) value along the line [start_lalo, end_lalo]
```

20.86.1.7 transect_list()

```
def pysar.transect.transect_list (
              fileList,
              inps )
```

```
Get transection along input line from file list
Inputs:
    fileList : list of str, path of files to get transect
    inps     : Namespace including the following items:
               start/end_lalo
               start/end_yx
               interpolation
Outputs:
    transectList : list of N*2 matrix containing distance and its value
    atrList      : list of attribute dictionary, for each input file
```

20.86.1.8 transect_yx()

```
def pysar.transect.transect_yx (
              z,
              atr,
              start_yx,
              end_yx,
              interpolation = 'nearest' )
```

```
Extract 2D matrix (z) value along the line [x0,y0;x1,y1]
Ref link: http://stackoverflow.com/questions/7878398/how-to-e
          xtract-an-arbitrary-line-of-values-from-a-numpy-array

Inputs:
    z        - (np.array)   2D data matrix
    atr      - (dictionary) 2D data matrix attribute dictionary
    start_yx - (list) y,x coordinate of start point
    end_yx   - (list) y,x coordinate of end   point
    interpolation - sampling/interpolation method, including:
            'nearest'  - nearest neighbour, by default
            'cubic'    - cubic interpolation
            'bilinear' - bilinear interpolation

Output:
    transect - N*2 matrix containing distance - 1st col - and its corresponding
               values - 2nd col - along the line, N is the number of points.

Example:
    transect = transect_yx(dem,demRsc,[10,15],[100,115])
```

20.86.2 Variable Documentation

20.86.2.1 EXAMPLE

```
EXAMPLE
```

20.87 pysar.transect_legacy Namespace Reference

Functions

- def dms2d (Coord)
- def gps_to_LOS (Ve, Vn, theta, heading)
- def check_st_in_box (x, y, x0, y0, x1, y1, X0, Y0, X1, Y1)
- def check_st_in_box2 (x, y, x0, y0, x1, y1, X0, Y0, X1, Y1)
- def line (x0, y0, x1, y1)
- def dist_point_from_line (m, c, x, y, dx, dy)
- def get_intersect (m, c, x, y)
- def readGPSfile (gpsFile, gps_source)
- def redGPSfile (gpsFile)
- def redGPSfile_cmm4 (gpsFile)
- def nearest (x, tbase, xstep)
- def find_row_column (Lon, Lat, lon, lat, lon_step, lat_step)
- def get_lat_lon (atr)
- def nanmean (data, args)
- def nanstd (data, args)
- def get_transect (z, x0, y0, x1, y1, interpolation='nearest')

  Option: interpolation : sampling/interpolation method, including: 'nearest' - nearest neighbour, by default 'cubic' - cubic interpolation 'bilinear' - bilinear interpolation.
- def Usage ()
- def main (argv)
- def onclick (event)

Variables

- fig
- ax
- xc
- yc
- cid
- x0
- x1
- y0
- y1
- mf
- cf
- df0
- df1
- mp
- Info_aboutFault
- length
- x
- y
- zi
- lat_transect
- lon_transect
- earth_radius
- dx
- dy
- DX
- DY
- D
- df0_km
- transect
- XX0
- XX1
- YY0
- YY1
- m
- c
- m1
- X0
- Y0
- X1
- Y1
- transect_lat
- transect_lon
- m_prof_edge
- c_prof_edge
- gpsFile
- insarData
- fileName
- fileExtension
- Stations
- Lat
- Lon
- Ve
- Se

- Vn
- Sn
- idxRef
- Length
- Width
- lat
- lon
- lat_step
- lon_step
- lat_all
- lon_all
- IDYref
- IDXref
- stationsList
- h5file_theta
- dset
- theta
- heading
- unitVec
- gpsLOS_ref
- GPS
- GPS_station
- GPSx
- GPSy
- GPS_lat
- GPS_lon
- idx
- IDY
- IDX
- gpsLOS
- NoInSAR
- DistGPS
- GPS_in_bound
- GPS_in_bound_st
- GPSxx
- GPSyy
- gx
- gy
- check_result
- check_result2
- dg
- axes
- nrows
- ms

  ax.fill_between(D/1000.0, (avgInSAR-stdInSAR)∗1000, (avgInSAR+stdInSAR)∗1000,where=(avgInSAR+stdInS↩ AR)∗1000>=(avgInSAR-stdInSAR)∗1000,alpha=1, facecolor='Red')
- avgInSAR
- axis
- stdInSAR
- fig2
- axes2
- FaultLine
- figName

Temporary To plot DEM try: majorLocator = MultipleLocator(5) ax.yaxis.set_major_locator(majorLocator) minor↩ Locator = MultipleLocator(1) ax.yaxis.set_minor_locator(minorLocator)

- mfc
- linewidth
- matFile
- dataset
- color

  ax.plot(D/1000.0, avgInSAR∗1000, 'r-')
- alpha
- fontsize
- lbound

  lower and higher bounds for diplaying the profile
- hbound
- fault_loc
- ylim

20.87.1 Function Documentation

20.87.1.1 check_st_in_box()

```
def pysar.transect_legacy.check_st_in_box (
              x,
              y,
              x0,
              y0,
              x1,
              y1,
              X0,
              Y0,
              X1,
              Y1 )
```

20.87.1.2 check_st_in_box2()

```
def pysar.transect_legacy.check_st_in_box2 (
              x,
              y,
              x0,
              y0,
              x1,
              y1,
              X0,
              Y0,
              X1,
              Y1 )
```

20.87.1.3 dist_point_from_line()

```
def pysar.transect_legacy.dist_point_from_line (
              m,
              c,
              x,
              y,
              dx,
              dy )
```

20.87.1.4 dms2d()

```
def pysar.transect_legacy.dms2d (
              Coord )
```

20.87.1.5 find_row_column()

```
def pysar.transect_legacy.find_row_column (
              Lon,
              Lat,
              lon,
              lat,
              lon_step,
              lat_step )
```

20.87.1.6 get_intersect()

```
def pysar.transect_legacy.get_intersect (
              m,
              c,
              x,
              y )
```

20.87.1.7 get_lat_lon()

```
def pysar.transect_legacy.get_lat_lon (
              atr )
```

20.87.1.8 get_transect()

```
def pysar.transect_legacy.get_transect (
              z,
              x0,
              y0,
              x1,
              y1,
              interpolation = 'nearest' )
```

Option: interpolation : sampling/interpolation method, including: 'nearest' - nearest neighbour, by default 'cubic' - cubic interpolation 'bilinear' - bilinear interpolation.

20.87.1.9 gps_to_LOS()

```
def pysar.transect_legacy.gps_to_LOS (
              Ve,
              Vn,
              theta,
              heading )
```

20.87.1.10 line()

```
def pysar.transect_legacy.line (
              x0,
              y0,
              x1,
              y1 )
```

20.87.1.11 main()

```
def pysar.transect_legacy.main (
              argv )
```

20.87.1.12 nanmean()

```
def pysar.transect_legacy.nanmean (
              data,
              args )
```

20.87.1.13 nanstd()

```
def pysar.transect_legacy.nanstd (
              data,
              args )
```

20.87.1.14 nearest()

```
def pysar.transect_legacy.nearest (
              x,
              tbase,
              xstep )
```

20.87.1.15 onclick()

```
def pysar.transect_legacy.onclick (
              event )
```

20.87.1.16 readGPSfile()

```
def pysar.transect_legacy.readGPSfile (
              gpsFile,
              gps_source )
```

20.87.1.17 redGPSfile()

```
def pysar.transect_legacy.redGPSfile (
              gpsFile )
```

20.87.1.18 redGPSfile_cmm4()

```
def pysar.transect_legacy.redGPSfile_cmm4 (
              gpsFile )
```

20.87.1.19 Usage()

```
def pysar.transect_legacy.Usage ( )
```

20.87.2 Variable Documentation

20.87.2.1 alpha

```
alpha
```

20.87.2.2 avgInSAR

```
avgInSAR
```

20.87.2.3 ax

ax

20.87.2.4 axes

axes

20.87.2.5 axes2

axes2

20.87.2.6 axis

axis

20.87.2.7 c

c

20.87.2.8 c_prof_edge

c_prof_edge

20.87.2.9 cf

cf

20.87.2.10 check_result

check_result

20.87.2.11 check_result2

check_result2

20.87.2.12 cid

```
cid
```

20.87.2.13 color

```
color
```

ax.plot(D/1000.0, avgInSAR∗1000, 'r-')

To plot the Fault location on the profile.

20.87.2.14 D

```
D
```

20.87.2.15 dataset

```
dataset
```

20.87.2.16 df0

```
df0
```

20.87.2.17 df0_km

```
df0_km
```

20.87.2.18 df1

```
df1
```

20.87.2.19 dg

```
dg
```

20.87.2.20 DistGPS

```
DistGPS
```

20.87.2.21 dset

```
dset
```

20.87.2.22 dx

```
dx
```

20.87.2.23 DX

```
DX
```

20.87.2.24 dy

```
dy
```

20.87.2.25 DY

```
DY
```

20.87.2.26 earth_radius

```
earth_radius
```

20.87.2.27 fault_loc

```
fault_loc
```

20.87.2.28 FaultLine

```
FaultLine
```

20.87.2.29 fig

```
fig
```

20.87.2.30 fig2

```
fig2
```

20.87.2.31 figName

```
figName
```

Temporary To plot DEM try: majorLocator = MultipleLocator(5) ax.yaxis.set_major_locator(majorLocator) minor↩
Locator = MultipleLocator(1) ax.yaxis.set_minor_locator(minorLocator)

20.87.2.32 fileExtension

```
fileExtension
```

20.87.2.33 fileName

```
fileName
```

20.87.2.34 fontsize

```
fontsize
```

20.87.2.35 GPS

```
GPS
```

20.87.2.36 GPS_in_bound

```
GPS_in_bound
```

20.87.2.37 GPS_in_bound_st

```
GPS_in_bound_st
```

20.87.2.38 GPS_lat

```
GPS_lat
```

20.87.2.39 GPS_lon

```
GPS_lon
```

20.87.2.40 GPS_station

```
GPS_station
```

20.87.2.41 gpsFile

```
gpsFile
```

20.87.2.42 gpsLOS

```
gpsLOS
```

20.87.2.43 gpsLOS_ref

```
gpsLOS_ref
```

20.87.2.44 GPSx

```
GPSx
```

20.87.2.45 GPSxx

```
GPSxx
```

20.87.2.46 GPSy

`GPSy`

20.87.2.47 GPSyy

`GPSyy`

20.87.2.48 gx

`gx`

20.87.2.49 gy

`gy`

20.87.2.50 h5file_theta

`h5file_theta`

20.87.2.51 hbound

`hbound`

20.87.2.52 heading

`heading`

20.87.2.53 idx

`idx`

20.87.2.54 IDX

`IDX`

20.87.2.55 idxRef

idxRef

20.87.2.56 IDXref

IDXref

20.87.2.57 IDY

IDY

20.87.2.58 IDYref

IDYref

20.87.2.59 Info_aboutFault

Info_aboutFault

20.87.2.60 insarData

insarData

20.87.2.61 Lat

Lat

20.87.2.62 lat

lat

20.87.2.63 lat_all

lat_all

20.87.2.64 lat_step

```
lat_step
```

20.87.2.65 lat_transect

```
lat_transect
```

20.87.2.66 lbound

```
lbound
```

lower and higher bounds for diplaying the profile

20.87.2.67 length

```
length
```

20.87.2.68 Length

```
Length
```

20.87.2.69 linewidth

```
linewidth
```

20.87.2.70 Lon

```
Lon
```

20.87.2.71 lon

```
lon
```

20.87.2.72 lon_all

```
lon_all
```

20.87.2.73 lon_step

```
lon_step
```

20.87.2.74 lon_transect

```
lon_transect
```

20.87.2.75 m

```
m
```

20.87.2.76 m1

```
m1
```

20.87.2.77 m_prof_edge

```
m_prof_edge
```

20.87.2.78 matFile

```
matFile
```

20.87.2.79 mf

```
mf
```

20.87.2.80 mfc

```
mfc
```

20.87.2.81 mp

```
mp
```

20.87.2.82 ms

```
ms
```

ax.fill_between(D/1000.0, (avgInSAR-stdInSAR)∗1000, (avgInSAR+stdInSAR)∗1000,where=(avgInSAR+stdInS↩
AR)∗1000>=(avgInSAR-stdInSAR)∗1000,alpha=1, facecolor='Red')

20.87.2.83 NoInSAR

```
NoInSAR
```

20.87.2.84 nrows

```
nrows
```

20.87.2.85 Se

```
Se
```

20.87.2.86 Sn

```
Sn
```

20.87.2.87 Stations

```
Stations
```

20.87.2.88 stationsList

```
stationsList
```

20.87.2.89 stdInSAR

`stdInSAR`

20.87.2.90 theta

`theta`

20.87.2.91 transect

`transect`

20.87.2.92 transect_lat

`transect_lat`

20.87.2.93 transect_lon

`transect_lon`

20.87.2.94 unitVec

`unitVec`

20.87.2.95 Ve

`Ve`

20.87.2.96 Vn

`Vn`

20.87.2.97 Width

`Width`

20.87.2.98 x

```
x
```

20.87.2.99 x0

```
x0
```

20.87.2.100 X0

```
X0
```

20.87.2.101 x1

```
x1
```

20.87.2.102 X1

```
X1
```

20.87.2.103 xc

```
xc
```

20.87.2.104 XX0

```
XX0
```

20.87.2.105 XX1

```
XX1
```

20.87.2.106 y

```
y
```

20.87.2.107 y0

`y0`

20.87.2.108 Y0

`Y0`

20.87.2.109 y1

`y1`

20.87.2.110 Y1

`Y1`

20.87.2.111 yc

`yc`

20.87.2.112 ylim

`ylim`

20.87.2.113 YY0

`YY0`

20.87.2.114 YY1

`YY1`

20.87.2.115 zi

`zi`

20.88 pysar.tropcor_phase_elevation Namespace Reference

Functions

- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- REFERENCE

20.88.1 Function Documentation

20.88.1.1 cmdLineParse()

```
def pysar.tropcor_phase_elevation.cmdLineParse ( )
```

20.88.1.2 main()

```
def pysar.tropcor_phase_elevation.main (
              argv )
```

20.88.2 Variable Documentation

20.88.2.1 EXAMPLE

```
EXAMPLE
```

20.88.2.2 REFERENCE

```
REFERENCE
```

20.89 pysar.tropcor_pyaps Namespace Reference

Functions

- def get_delay (grib_file, atr, inps_dict)
- def date_list2grib_file (date_list, hour, grib_source, grib_dir)
- def dload_grib (date_list, hour, grib_source='ECMWF', weather_dir='./')
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- REFERENCE
- TEMPLATE
- DATA_INFO

20.89.1 Function Documentation

20.89.1.1 cmdLineParse()

```
def pysar.tropcor_pyaps.cmdLineParse ( )
```

20.89.1.2 date_list2grib_file()

```
def pysar.tropcor_pyaps.date_list2grib_file (
              date_list,
              hour,
              grib_source,
              grib_dir )
```

20.89.1.3 dload_grib()

```
def pysar.tropcor_pyaps.dload_grib (
              date_list,
              hour,
              grib_source = 'ECMWF',
              weather_dir = './' )
```

```
Download weather re-analysis grib files using PyAPS
Inputs:
    date_list   : list of string in YYYYMMDD format
    hour        : string in HH:MM or HH format
    grib_source : string,
    weather_dir : string,
Output:
    grib_file_list : list of string
```

20.89.1.4 get_delay()

```
def pysar.tropcor_pyaps.get_delay (
              grib_file,
              atr,
              inps_dict )
```

```
Get delay matrix using PyAPS for one acquisition
Inputs:
    grib_file - strng, grib file path
    atr       - dict, including the following attributes:
                dem_file    - string, DEM file path
                grib_source - string, Weather re-analysis data source
                delay_type  - string, comb/dry/wet
                ref_y/x     - string, reference pixel row/col number
                inc_angle   - np.array, 0/1/2 D
Output:
    phs - 2D np.array, absolute tropospheric phase delay relative to ref_y/x
```

20.89.1.5 main()

```
def pysar.tropcor_pyaps.main (
              argv )
```

20.89.2 Variable Documentation

20.89.2.1 DATA_INFO

```
DATA_INFO
```

20.89.2.2 EXAMPLE

```
EXAMPLE
```

20.89.2.3 REFERENCE

```
REFERENCE
```

20.89.2.4 TEMPLATE

```
TEMPLATE
```

20.90 pysar.tsviewer Namespace Reference

Functions

- def read_timeseries_yx (timeseries_file, y, x, ref_yx=None)
- def read_timeseries_lalo (timeseries_file, lat, lon)
- def cmdLineParse ()
- def format_coord (x, y)
- def time_slider_update (val)
- def plot_timeseries_errorbar (ax, dis_ts, inps)
- def plot_timeseries_scatter (ax, dis_ts, inps)
- def update_timeseries (y, x)
- def plot_timeseries_event (event)

Variables

- EXAMPLE
- inps

  Actual code.
- atr
- k
- h5
- dateList
- date_num
- dates
- tims
- input_ex_date
- ex_date_list
- ex_date
- ex_dates
- ex_idx_list
- zero_idx

  Zero displacement for 1st acquisition.
- length
- width
- ullon
- ullat
- lon_step
- lat_step
- lrlon
- lrlat
- y
- x
- yx
- ref_yx
- unit_fac
- flip_ud
- left_lr
- file_list
- mask_file
- mask
- epoch
- d_v

- timeseries_file
- ref_d_v
- data_lim
- ylim_mat
- fig_v

    Fig 1 - Cumulative Displacement Map.
- ax_v
- dem
- dem_file
- img
- cmap
- colormap
- clim
- interpolation
- ms
- markeredgecolor
- format_coord
- cbar
- orientation
- ax_time
- axisbg
- yticks
- tslider
- valinit
- facecolor
- ecolor
- fig_ts

    Fig 2 - Time Series Displacement - Point.
- figsize
- ax_ts
- error_ts
- error_fileContent
- error_file
- dtype
- e_ts
- ex_error_ts
- d_ts
- fig_base

    Output.
- outName = inps.fig_base+'_ts.pdf'
- header_info
- lat
- lon
- fmt
- string delimiter = header_info)
- bbox_inches
- transparent
- True
- dpi
- cid = fig_v.canvas.mpl_connect('button_press_event', plot_timeseries_event)

    Final linking of the canvas to the plots.

20.90.1 Function Documentation

20.90.1.1 cmdLineParse()

```
def pysar.tsviewer.cmdLineParse ( )
```

20.90.1.2 format_coord()

```
def pysar.tsviewer.format_coord (
              x,
              y )
```

20.90.1.3 plot_timeseries_errorbar()

```
def pysar.tsviewer.plot_timeseries_errorbar (
              ax,
              dis_ts,
              inps )
```

20.90.1.4 plot_timeseries_event()

```
def pysar.tsviewer.plot_timeseries_event (
              event )
```

```
Event function to get y/x from button press
```

20.90.1.5 plot_timeseries_scatter()

```
def pysar.tsviewer.plot_timeseries_scatter (
              ax,
              dis_ts,
              inps )
```

20.90.1.6 read_timeseries_lalo()

```
def pysar.tsviewer.read_timeseries_lalo (
              timeseries_file,
              lat,
              lon )
```

```
Read time-series displacement on point (y,x) from timeseries_file
Inputs:
    timeseries_file : string, name/path of timeseries hdf5 file
    lat/lon : float, latitude/longitude of point of interest
Output:
    dis_ts : list of float, displacement time-series of point of interest
```

20.90.1.7 read_timeseries_yx()

```
def pysar.tsviewer.read_timeseries_yx (
              timeseries_file,
              y,
              x,
              ref_yx = None )
```

```
Read time-series displacement on point (y,x) from timeseries_file
Inputs:
    timeseries_file : string, name/path of timeseries hdf5 file
    y/x : int, row/column number of point of interest
Output:
    dis_ts : list of float, displacement time-series of point of interest
```

20.90.1.8 time_slider_update()

```
def pysar.tsviewer.time_slider_update (
              val )
```

```
Update Displacement Map using Slider
```

20.90.1.9 update_timeseries()

```
def pysar.tsviewer.update_timeseries (
              y,
              x )
```

```
Plot point time series displacement at pixel [y, x]
```

20.90.2 Variable Documentation

20.90.2.1 atr

```
atr
```

20.90.2.2 ax_time

```
ax_time
```

20.90.2.3 ax_ts

```
ax_ts
```

20.90.2.4 ax_v

```
ax_v
```

20.90.2.5 axisbg

```
axisbg
```

20.90.2.6 bbox_inches

```
bbox_inches
```

20.90.2.7 cbar

```
cbar
```

20.90.2.8 cid

```
cid = fig_v.canvas.mpl_connect('button_press_event', plot_timeseries_event)
```

Final linking of the canvas to the plots.

20.90.2.9 clim

`clim`

20.90.2.10 cmap

`cmap`

20.90.2.11 colormap

`colormap`

20.90.2.12 d_ts

`d_ts`

20.90.2.13 d_v

`d_v`

20.90.2.14 data_lim

`data_lim`

20.90.2.15 date_num

`date_num`

20.90.2.16 dateList

`dateList`

20.90.2.17 dates

`dates`

20.90.2.18 delimiter

string delimiter = header_info)

20.90.2.19 dem

dem

20.90.2.20 dem_file

dem_file

20.90.2.21 dpi

dpi

20.90.2.22 dtype

dtype

20.90.2.23 e_ts

e_ts

20.90.2.24 ecolor

ecolor

20.90.2.25 epoch

epoch

20.90.2.26 error_file

error_file

20.90.2.27 error_fileContent

```
error_fileContent
```

20.90.2.28 error_ts

```
error_ts
```

20.90.2.29 ex_date

```
ex_date
```

20.90.2.30 ex_date_list

```
ex_date_list
```

20.90.2.31 ex_dates

```
ex_dates
```

20.90.2.32 ex_error_ts

```
ex_error_ts
```

20.90.2.33 ex_idx_list

```
ex_idx_list
```

20.90.2.34 EXAMPLE

```
EXAMPLE
```

20.90.2.35 facecolor

```
facecolor
```

20.90.2.36 fig_base

```
fig_base
```

Output.

20.90.2.37 fig_ts

```
fig_ts
```

Fig 2 - Time Series Displacement - Point.

20.90.2.38 fig_v

```
fig_v
```

Fig 1 - Cumulative Displacement Map.

20.90.2.39 figsize

```
figsize
```

20.90.2.40 file_list

```
file_list
```

20.90.2.41 flip_ud

```
flip_ud
```

20.90.2.42 fmt

```
fmt
```

20.90.2.43 format_coord

```
format_coord
```

20.90.2.44 h5

```
h5
```

20.90.2.45 header_info

```
header_info
```

20.90.2.46 img

```
img
```

20.90.2.47 inps

```
inps
```

Actual code.

20.90.2.48 input_ex_date

```
input_ex_date
```

20.90.2.49 interpolation

```
interpolation
```

20.90.2.50 k

```
k
```

20.90.2.51 lat

```
lat
```

20.90.2.52 lat_step

`lat_step`

20.90.2.53 left_lr

`left_lr`

20.90.2.54 length

`length`

20.90.2.55 lon

`lon`

20.90.2.56 lon_step

`lon_step`

20.90.2.57 lrlat

`lrlat`

20.90.2.58 lrlon

`lrlon`

20.90.2.59 markeredgecolor

`markeredgecolor`

20.90.2.60 mask

`mask`

20.90.2.61 mask_file

```
mask_file
```

20.90.2.62 ms

```
ms
```

20.90.2.63 orientation

```
orientation
```

20.90.2.64 outName

```
string outName = inps.fig_base+'_ts.pdf'
```

20.90.2.65 ref_d_v

```
ref_d_v
```

20.90.2.66 ref_yx

```
ref_yx
```

20.90.2.67 timeseries_file

```
timeseries_file
```

20.90.2.68 tims

```
tims
```

20.90.2.69 transparent

```
transparent
```

20.90.2.70 True

```
True
```

20.90.2.71 tslider

```
tslider
```

20.90.2.72 ullat

```
ullat
```

20.90.2.73 ullon

```
ullon
```

20.90.2.74 unit_fac

```
unit_fac
```

20.90.2.75 valinit

```
valinit
```

20.90.2.76 width

```
width
```

20.90.2.77 x

```
x
```

20.90.2.78 y

```
y
```

20.90.2.79 ylim_mat

```
ylim_mat
```

20.90.2.80 yticks

```
yticks
```

20.90.2.81 yx

```
yx
```

20.90.2.82 zero_idx

```
zero_idx
```

Zero displacement for 1st acquisition.

20.91 pysar.unwrap_error Namespace Reference

Functions

- def bridging_data (data, mask, x, y)
- def unwrap_error_correction_phase_closure (ifgram_file, mask_file, ifgram_cor_file=None)
- def unwrap_error_correction_bridging (ifgram_file, mask_file, y_list, x_list, ramp_type='plane', ifgram_cor_↩ file=None, save_cor_deramp_file=False)
- def read_template2inps (template_file, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- string EXAMPLE
- string TEMPLATE
- string REFERENCE
- string DESCRIPTION

20.91.1 Function Documentation

20.91.1.1 bridging_data()

```
def pysar.unwrap_error.bridging_data (
              data,
              mask,
              x,
              y )
```

```
Phase Jump Correction, using phase continuity on bridge/bonding points in each pair of patches.
Inputs:
    data : 2D np.array, phase matrix need to be corrected
    mask : mask file marks different patches with different positive integers
    x/y  : list of int, array of bridge points, lied as: x_ref, x, x_ref, x
Output:
    data : 2D np.array, phase corrected matrix
```

20.91.1.2 cmdLineParse()

```
def pysar.unwrap_error.cmdLineParse ( )
```

20.91.1.3 main()

```
def pysar.unwrap_error.main (
              argv )
```

20.91.1.4 read_template2inps()

```
def pysar.unwrap_error.read_template2inps (
              template_file,
              inps = None )
```

```
Read input template options into Namespace inps
```

20.91.1.5 unwrap_error_correction_bridging()

```
def pysar.unwrap_error.unwrap_error_correction_bridging (
              ifgram_file,
              mask_file,
              y_list,
              x_list,
              ramp_type = 'plane',
              ifgram_cor_file = None,
              save_cor_deramp_file = False )
```

```
Unwrapping error correction with bridging.
Inputs:
    ifgram_file : string, name/path of interferogram(s) to be corrected
    mask_file   : string, name/path of mask file to mark different patches
    y/x_list    : list of int, bonding points in y/x
    ifgram_cor_file : string, optional, output file name
    save_cor_deramp_file : bool, optional
Output:
    ifgram_cor_file
Example:
    y_list = [235, 270, 350, 390]
    x_list = [880, 890, 1200, 1270]
    unwrap_error_correction_bridging('unwrapIfgram.h5', 'mask_all.h5', y_list, x_list, 'quadratic')
```

20.91.1.6 unwrap_error_correction_phase_closure()

```
def pysar.unwrap_error.unwrap_error_correction_phase_closure (
              ifgram_file,
              mask_file,
              ifgram_cor_file = None )
```

```
Correct unwrapping errors in network of interferograms using phase closure.
Inputs:
    ifgram_file     - string, name/path of interferograms file
    mask_file       - string, name/path of mask file to mask the pixels to be corrected
    ifgram_cor_file - string, optional, name/path of corrected interferograms file
Output:
    ifgram_cor_file
Example:
    'unwrapIfgram_unwCor.h5' = unwrap_error_correction_phase_closure('Seeded_unwrapIfgram.h5','mask.h5')
```

20.91.2 Variable Documentation

20.91.2.1 DESCRIPTION

```
string DESCRIPTION
```

20.91.2.2 EXAMPLE

```
string EXAMPLE
```

Initial value:

```
= '''example:
Phase Closure:
  unwrap_error.py  Seeded_unwrapIfgram.h5  --mask mask.h5
Bridging:
  unwrap_error.py  unwrapIfgram.h5    -t ShikokuT417F650_690AlosA.template
  unwrap_error.py  unwrapIfgram.h5    --mask mask.h5     -x 283 305 -y 1177 1247
  unwrap_error.py  081018_090118.unw  --mask mask_all.h5 -x 283 305 -y 1177 1247 --ramp quadratic
'''
```

20.91.2.3 REFERENCE

```
string REFERENCE
```

Initial value:

```
= '''reference:
  Fattahi, H. (2015), Geodetic Imaging of Tectonic Deformation with InSAR, 190 pp, University of Miami,
     Miami, FL.
'''
```

20.91.2.4 TEMPLATE

```
string TEMPLATE
```

Initial value:

```
= '''
## 4. Unwrapping Error Correction
## unwrapping error correction based on the following two methods:
## a. phase closure (Fattahi, 2015, PhD Thesis)
## b. connecting bridge
pysar.unwrapError.method   = auto   #[bridging / phase_closure / no], auto for no
pysar.unwrapError.maskFile = auto   #[file name / no], auto for no
pysar.unwrapError.ramp     = auto   #[plane / quadratic], auto for plane
pysar.unwrapError.yx       = auto   #[y1_start,x1_start,y1_end,x1_end;y2_start,...], auto for none
'''
```

20.92 pysar.view Namespace Reference

Classes

- class Basemap2

  Class ##.

Functions

- def round_to_1 (x)
- def add_inner_title (ax, title, loc, size=None, kwargs)
- def auto_flip_direction (atr_dict)
- def auto_figure_title (fname, epoch=[ ], inps_dict=None)
- def auto_row_col_num (subplot_num, data_shape, fig_size, fig_num=1)
- def check_colormap_input (atr_dict, colormap=None)
- def check_multilook_input (pixel_box, row_num, col_num)
- def get_epoch_full_list_from_input (all_epoch_list, epoch_input_list=[ ], epoch_num_input_list=[ ])
- def plot_dem_lalo (bmap, dem, box, inps_dict)
- def plot_dem_yx (ax, dem, inps_dict=dict())
- def scale_data4disp_unit_and_rewrap (data, atr, disp_unit=None, rewrapping=False)
- def scale_data2disp_unit (matrix, atr_dict, disp_unit)
- def update_plot_inps_with_display_setting_file (inps, disp_set_file)
- def update_plot_inps_with_meta_dict (inps, meta_dict)
- def update_matrix_with_plot_inps (data, meta_dict, inps)
- def plot_matrix (ax, data, meta_dict, inps=None)
- def cmdLineParse (argv)
- def main (argv)

  Main Function ##.

Variables

- list mplColors
- string EXAMPLE
- string PLOT_TEMPLATE

20.92.1 Function Documentation

20.92.1.1 add_inner_title()

```
def pysar.view.add_inner_title (
              ax,
              title,
              loc,
              size = None,
              kwargs )
```

20.92.1.2 auto_figure_title()

```
def pysar.view.auto_figure_title (
              fname,
              epoch = [],
              inps_dict = None )
```

```
Get auto figure title from meta dict and input options
Inputs:
    fname - string, input file name
    epoch - list of string, optional, epoch to read for multi dataset/group files
    inps_dict - dict, optional, processing attributes, including:
                ref_date
                pix_box
                wrap
                disp_scale
                opposite
Output:
    fig_title - string, output figure title
Example:
    'geo_velocity.h5' = auto_figure_title('geo_velocity.h5', None, vars(inps))
    '101020-110220_ECMWF_demErr_quadratic' = auto_figure_title('timeseries_ECMWF_demErr_quadratic.h5', '110220
```

20.92.1.3 auto_flip_direction()

```
def pysar.view.auto_flip_direction (
              atr_dict )
```

```
Check flip left-right and up-down based on attribute dict, for radar-coded file only
```

20.92.1.4 auto_row_col_num()

```
def pysar.view.auto_row_col_num (
              subplot_num,
              data_shape,
              fig_size,
              fig_num = 1 )
```

```
Get optimal row and column number given figure size number of subplots

Inputs:
    subplot_num : int, total number of subplots
    data_shape  : list of 2 float, data size in pixel in row and column direction of each plot
    fig_size    : list of 2 float, figure window size in inches
    fig_num     : int, number of figure windows, optional, default = 1.

Outputs:
    row_num : number of subplots in row    direction per figure
    col_num : number of subplots in column direction per figure
```

20.92.1.5 check_colormap_input()

```
def pysar.view.check_colormap_input (
              atr_dict,
              colormap = None )
```

20.92.1.6 check_multilook_input()

```
def pysar.view.check_multilook_input (
              pixel_box,
              row_num,
              col_num )
```

20.92.1.7 cmdLineParse()

```
def pysar.view.cmdLineParse (
              argv )
```

20.92.1.8 get_epoch_full_list_from_input()

```
def pysar.view.get_epoch_full_list_from_input (
              all_epoch_list,
              epoch_input_list = [],
              epoch_num_input_list = [] )
```

```
Read/Get input epoch list from input epoch and epoch_num
```

20.92.1.9 main()

```
def pysar.view.main (
              argv )
```

Main Function ##.

20.92.1.10 plot_dem_lalo()

```
def pysar.view.plot_dem_lalo (
              bmap,
              dem,
              box,
              inps_dict )
```

```
Plot DEM in geo-coordinate
Inputs:
    bmap  : basemap object
    dem   : dem data, 2D np.int16 matrix
    box   : geo bounding box, 4-tuple as (urcrnrlon,urcrnrlat,llcrnrlon,llcrnrlat)
    inps_dict : dict with the following 5 items:
                'disp_dem_shade'    : bool,  True/False
                'disp_dem_contour'  : bool,  True/False
                'dem_contour_step'  : float, 200.0
                'dem_contour_smooth': float, 3.0

Examples:
    dem_disp_dict = {'dem': 'gsi10m_30m.dem', 'disp_dem_shade': True, 'disp_dem_contour': True,\
                     'dem_contour_step': 200.0, 'dem_contour_smooth': 3.0}
    bmap = plot_dem_lalo(bmap,dem,geo_box,dem_inps_dict)
```

20.92.1.11 plot_dem_yx()

```
def pysar.view.plot_dem_yx (
              ax,
              dem,
              inps_dict = dict() )
```

```
Plot DEM in radar coordinate
Inputs:
    ax         : matplotlib axes object
    dem        : dem data, 2D np.int16 matrix
    inps_dict : dict with the following 5 items:
                'disp_dem_shade'    : bool,  True/False
                'disp_dem_contour'  : bool,  True/False
                'dem_contour_step'  : float, 200.0
                'dem_contour_smooth': float, 3.0

Examples:
    dem_disp_dict = {'dem': 'gsi10m_30m.dem', 'disp_dem_shade': True, 'disp_dem_contour': True,\
                     'dem_contour_step': 200.0, 'dem_contour_smooth': 3.0}
    ax = plot_dem_yx(ax,dem,dem_disp_dict)
```

20.92.1.12 plot_matrix()

```
def pysar.view.plot_matrix (
              ax,
              data,
              meta_dict,
              inps = None )
```

```
Plot 2D matrix

Inputs:
    ax   : matplot.pyplot axes object
    data : 2D np.array,
    meta_dict : dictionary, attributes of data
    inps : Namespace, optional, input options for display

Outputs:
    ax  : matplot.pyplot axes object

Example:
    import matplotlib.pyplot as plt
    import pysar._readfile as readfile
    import pysar.view as view

    data, atr = readfile.read('velocity.h5')
    fig = plt.figure()
    ax = fig.add_axes([0.1,0.1,0.8,0.8])
    ax = view.plot_matrix(ax, data, atr)
    plt.show()
```

20.92.1.13 round_to_1()

```
def pysar.view.round_to_1 (
              x )
```

```
Return the most significant digit of input number
```

20.92.1.14 scale_data2disp_unit()

```
def pysar.view.scale_data2disp_unit (
              matrix,
              atr_dict,
              disp_unit )
```

```
Scale data based on data unit and display unit
Inputs:
    matrix    : 2D np.array
    atr_dict  : dictionary, meta data
    disp_unit : str, display unit
Outputs:
    matrix    : 2D np.array, data after scaling
    disp_unit : str, display unit
Default data file units in PySAR are:  m, m/yr, radian, 1
```

20.92.1.15 scale_data4disp_unit_and_rewrap()

```
def pysar.view.scale_data4disp_unit_and_rewrap (
              data,
              atr,
              disp_unit = None,
              rewrapping = False )
```

```
Scale 2D matrix value according to display unit and re-wrapping flag
Disable rewrapping option 1) for specific data types, which rewrapping has no physical meaning;
                          2) if disp_unit exists and != 'radian'; priority: disp_unit > rewrapping
Inputs:
    data - 2D np.array
    atr  - dict, including the following attributes:
           UNIT
           FILE_TYPE
           WAVELENGTH
    disp_unit  - string, optional
    rewrapping - bool, optional
Outputs:
    data
    disp_unit
    rewrapping
```

20.92.1.16 update_matrix_with_plot_inps()

```
def pysar.view.update_matrix_with_plot_inps (
              data,
              meta_dict,
              inps )
```

20.92.1.17 update_plot_inps_with_display_setting_file()

```
def pysar.view.update_plot_inps_with_display_setting_file (
              inps,
              disp_set_file )
```

```
Update inps using values from display setting file
```

20.92.1.18 update_plot_inps_with_meta_dict()

```
def pysar.view.update_plot_inps_with_meta_dict (
              inps,
              meta_dict )
```

20.92.2 Variable Documentation

20.92.2.1 EXAMPLE

string EXAMPLE

Initial value:

```
= '''example:
  view.py SanAndreas.dem
  view.py velocity.h5 -u cm -m -2 -M 2 -c bwr --mask Mask_tempCoh.h5 -d SanAndreas.dem

  view.py timeseries.h5
  view.py unwrapIfgram.h5 070927-100217
  view.py Wrapped.h5    -n 5
  view.py geomap_4rlks.trans range

  # Display in subset:
  view.py velocity.h5 -x 100 600     -y 200 800
  view.py velocity.h5 -l 31.05 31.10 -L 130.05 130.10

  # Exclude Dates:
  view.py timeseries.h5 -ex drop_date.txt

  # Reference:
  view.py velocity.h5   --ref-yx   210 566
  view.py timeseries.h5 --ref-date 20101120

  # Save and Output:
  view.py velocity.h5 --save
  view.py velocity.h5 -o velocity.pdf
  view.py velocity.h5 --nodisplay
'''
```

20.92.2.2 mplColors

list mplColors

Initial value:

```
=  ['#1f77b4',\
            '#ff7f0e',\
            '#2ca02c',\
            '#d62728',\
            '#9467bd',\
            '#8c564b',\
            '#e377c2',\
            '#7f7f7f',\
            '#bcbd22',\
            '#17becf']
```

20.92.2.3 PLOT_TEMPLATE

string PLOT_TEMPLATE

Initial value:

```
= '''Plot Setting:
  plot.name          = 'Yunjun et al., 2016, AGU, Fig 4f'
  plot.type          = LOS_VELOCITY
  plot.startDate     =
  plot.endDate       =
  plot.displayUnit   = cm/yr
  plot.displayMin    = -2
  plot.displayMax    = 2
  plot.colormap      = jet
  plot.subset.lalo   = 33.05:33.15, 131.15:131.27
  plot.seed.lalo = 33.0651, 131.2076
'''
```

20.93 troposphere_uncertainty Namespace Reference

Functions

- def cmdLineParse ()
- def velocity_uncertainty_vs_distance (inps)
- def statistics (inps)
- def estimate_seasonal (inps)
- def velocity_uncertainty (realtive_std_file, inps)
- def download (inps)
- def main (argv)

Variables

- EXAMPLE

20.93.1 Function Documentation

20.93.1.1 cmdLineParse()

```
def troposphere_uncertainty.cmdLineParse ( )
```

20.93.1.2 download()

```
def troposphere_uncertainty.download (
              inps )
```

20.93.1.3 estimate_seasonal()

```
def troposphere_uncertainty.estimate_seasonal (
              inps )
```

20.93.1.4 main()

```
def troposphere_uncertainty.main (
              argv )
```

20.93.1.5 statistics()

```
def troposphere_uncertainty.statistics (
              inps )
```

20.93.1.6 velocity_uncertainty()

```
def troposphere_uncertainty.velocity_uncertainty (
              realtive_std_file,
              inps )
```

20.93.1.7 velocity_uncertainty_vs_distance()

```
def troposphere_uncertainty.velocity_uncertainty_vs_distance (
              inps )
```

20.93.2 Variable Documentation

20.93.2.1 EXAMPLE

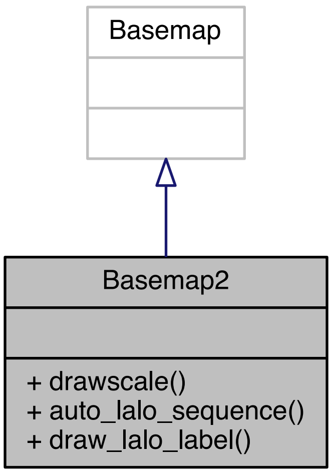
```
EXAMPLE
```

21 Class Documentation

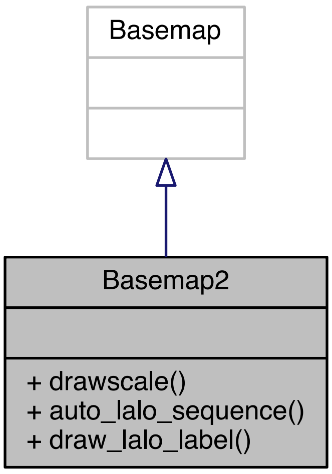
21.1 Basemap2 Class Reference

Class ##.

Inheritance diagram for Basemap2:



Collaboration diagram for Basemap2:



Public Member Functions

- def drawscale (self, lat_c, lon_c, distance, ax=None, font_size=12, yoffset=None, color='k')
- def auto_lalo_sequence (self, geo_box, lalo_step=None, max_tick_num=4, step_candidate=[1)
- def draw_lalo_label (self, geo_box, ax=None, lalo_step=None, labels=[1, font_size=12, color='k')

21.1.1 Detailed Description

Class ##.

21.1.2 Member Function Documentation

21.1.2.1 auto_lalo_sequence()

```
def auto_lalo_sequence (
              self,
              geo_box,
              lalo_step = None,
              max_tick_num = 4,
              step_candidate = [1 )
```

```
Auto calculate lat/lon label sequence based on input geo_box
Inputs:
    geo_box        : 4-tuple of float, defining UL_lon, UL_lat, LR_lon, LR_lat coordinate
    max_tick_num   : int, rough major tick number along the longer axis
    step_candidate : list of int, candidate list for the significant number of step
Outputs:
    lats/lons : np.array of float, sequence of lat/lon auto calculated from input geo_box
    lalo_step : float, lat/lon label step
Example:
    geo_box = (128.0, 37.0, 138.0, 30.0)
    lats, lons, step = m.auto_lalo_sequence(geo_box)
```

21.1.2.2 draw_lalo_label()

```
def draw_lalo_label (
              self,
              geo_box,
              ax = None,
              lalo_step = None,
              labels = [1,
              font_size = 12,
              color = 'k' )
```

```
Auto draw lat/lon label/tick based on coverage from geo_box
Inputs:
    geo_box : 4-tuple of float, defining UL_lon, UL_lat, LR_lon, LR_lat coordinate
    labels  : list of 4 int, positions where the labels are drawn as in [left, right, top, bottom]
      default: [1,0,0,1]
    ax      : axes object the labels are drawn
    draw    : bool, do not draw if False
Outputs:

Example:
    geo_box = (128.0, 37.0, 138.0, 30.0)
    m.draw_lalo_label(geo_box)
```

21.1.2.3 drawscale()

```
def drawscale (
              self,
              lat_c,
              lon_c,
              distance,
              ax = None,
              font_size = 12,
              yoffset = None,
              color = 'k' )
```

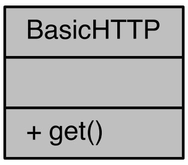
```
draw a simple map scale from x1,y to x2,y in map projection
coordinates, label it with actual distance
Inputs:
    lat_c/lon_c : float, longitude and latitude of scale bar center, in degree
    distance    : float, distance of scale bar, in m
    yoffset     : float, optional, scale bar length at two ends, in degree
Example:
    m.drawscale(33.06, 131.18, 2000)
ref_link: http://matplotlib.1069221.n5.nabble.com/basemap-scalebar-td14133.html
```

The documentation for this class was generated from the following file:

- view.py

21.2 BasicHTTP Class Reference

Collaboration diagram for BasicHTTP:



Static Public Member Functions

- def get (url)

21.2.1 Detailed Description

21.2.2 Member Function Documentation

21.2.2.1 get()

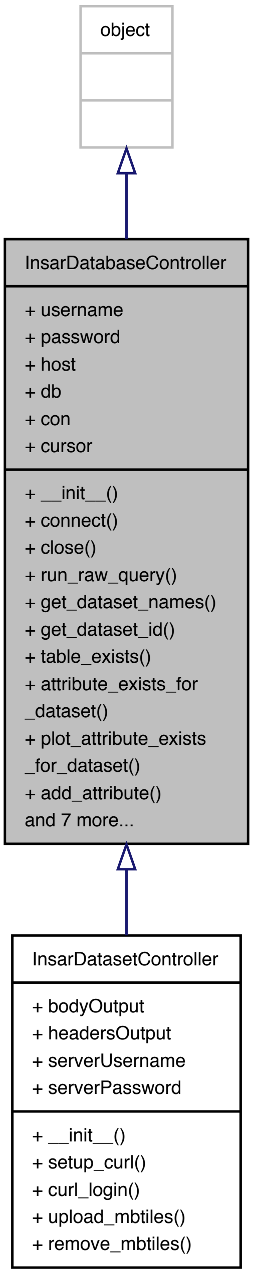
```
def get (
              url )   [static]
```

The documentation for this class was generated from the following file:

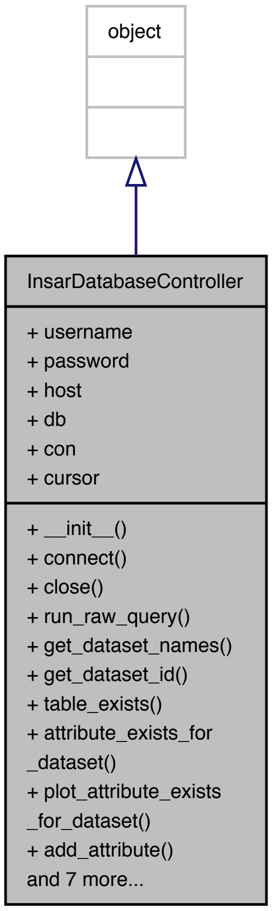
- insarmaps_query.py

21.3 InsarDatabaseController Class Reference

Inheritance diagram for InsarDatabaseController:



Collaboration diagram for InsarDatabaseController:



Public Member Functions

- def __init__ (self, username, password, host, db)
- def connect (self)
- def close (self)
- def run_raw_query (self, query)
- def get_dataset_names (self)
- def get_dataset_id (self, dataset)
- def table_exists (self, table)
- def attribute_exists_for_dataset (self, dataset, attributekey)
- def plot_attribute_exists_for_dataset (self, dataset, attributekey)
- def add_attribute (self, dataset, attributekey, attributevalue)
- def add_plot_attribute (self, dataset, attributekey, plotAttributeJSON)
- def index_table_on (self, table, on, index_name)
- def cluster_table_using (self, table, index_name)
- def remove_point_table_if_there (self, table_name)
- def create_area_table_if_not_exists (self)

- def insert_dataset_into_area_table (self, area, project_name, mid_long, mid_lat, country, region, chunk_num, attribute_keys, attribute_values, string_dates_sql, decimal_dates_sql)
- def remove_dataset_if_there (self, unavco_name)

Public Attributes

- username
- password
- host
- db
- con
- cursor

21.3.1 Detailed Description

21.3.2 Constructor & Destructor Documentation

21.3.2.1 __init__()

```
def __init__ (
              self,
              username,
              password,
              host,
              db )
```

21.3.3 Member Function Documentation

21.3.3.1 add_attribute()

```
def add_attribute (
              self,
              dataset,
              attributekey,
              attributevalue )
```

21.3.3.2 add_plot_attribute()

```
def add_plot_attribute (
              self,
              dataset,
              attributekey,
              plotAttributeJSON )
```

21.3.3.3 attribute_exists_for_dataset()

```
def attribute_exists_for_dataset (
              self,
              dataset,
              attributekey )
```

21.3.3.4 close()

```
def close (
              self )
```

21.3.3.5 cluster_table_using()

```
def cluster_table_using (
              self,
              table,
              index_name )
```

21.3.3.6 connect()

```
def connect (
              self )
```

21.3.3.7 create_area_table_if_not_exists()

```
def create_area_table_if_not_exists (
              self )
```

21.3.3.8 get_dataset_id()

```
def get_dataset_id (
              self,
              dataset )
```

21.3.3.9 get_dataset_names()

```
def get_dataset_names (
              self )
```

21.3.3.10 index_table_on()

```
def index_table_on (
             self,
             table,
             on,
             index_name )
```

21.3.3.11 insert_dataset_into_area_table()

```
def insert_dataset_into_area_table (
             self,
             area,
             project_name,
             mid_long,
             mid_lat,
             country,
             region,
             chunk_num,
             attribute_keys,
             attribute_values,
             string_dates_sql,
             decimal_dates_sql )
```

21.3.3.12 plot_attribute_exists_for_dataset()

```
def plot_attribute_exists_for_dataset (
             self,
             dataset,
             attributekey )
```

21.3.3.13 remove_dataset_if_there()

```
def remove_dataset_if_there (
             self,
             unavco_name )
```

21.3.3.14 remove_point_table_if_there()

```
def remove_point_table_if_there (
             self,
             table_name )
```

21.3.3.15 run_raw_query()

```
def run_raw_query (
              self,
              query )
```

21.3.3.16 table_exists()

```
def table_exists (
              self,
              table )
```

21.3.4 Member Data Documentation

21.3.4.1 con

```
con
```

21.3.4.2 cursor

```
cursor
```

21.3.4.3 db

```
db
```

21.3.4.4 host

```
host
```

21.3.4.5 password

```
password
```

21.3.4.6 username

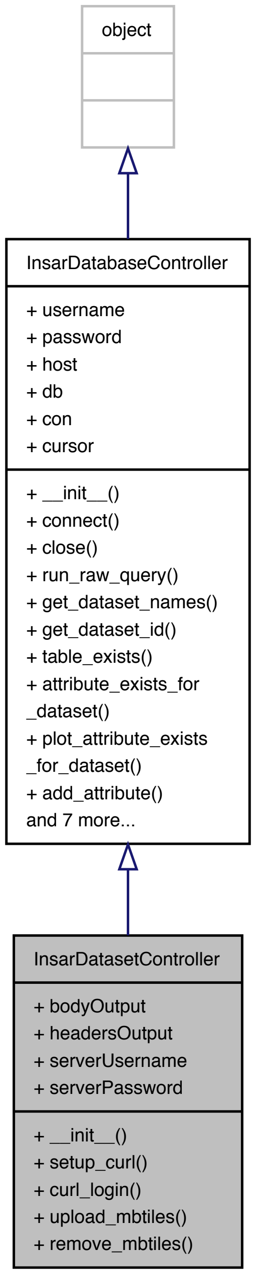
`username`

The documentation for this class was generated from the following file:

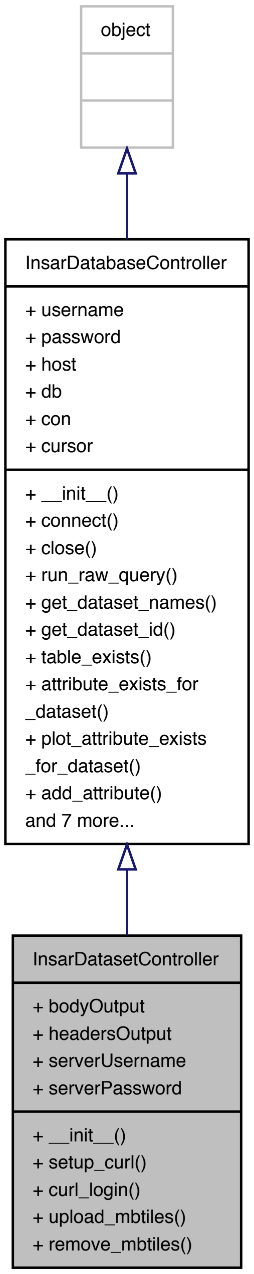
- add_attribute_insarmaps.py

21.4 InsarDatasetController Class Reference

Inheritance diagram for InsarDatasetController:



Collaboration diagram for InsarDatasetController:



Public Member Functions

- def __init__ (self, username, password, host, db, serverUsername, serverPassword)
- def setup_curl (self)
- def curl_login (self, username, password)
- def upload_mbtiles (self, fileName)
- def remove_mbtiles (self, fileName)

Public Attributes

- bodyOutput
- headersOutput
- serverUsername
- serverPassword

21.4.1 Detailed Description

21.4.2 Constructor & Destructor Documentation

21.4.2.1 __init__()

```
def __init__ (
              self,
              username,
              password,
              host,
              db,
              serverUsername,
              serverPassword )
```

21.4.3 Member Function Documentation

21.4.3.1 curl_login()

```
def curl_login (
              self,
              username,
              password )
```

21.4.3.2 remove_mbtiles()

```
def remove_mbtiles (
              self,
              fileName )
```

21.4.3.3 setup_curl()

```
def setup_curl (
              self )
```

21.4.3.4 upload_mbtiles()

```
def upload_mbtiles (
              self,
              fileName )
```

21.4.4 Member Data Documentation

21.4.4.1 bodyOutput

```
bodyOutput
```

21.4.4.2 headersOutput

```
headersOutput
```

21.4.4.3 serverPassword

```
serverPassword
```

21.4.4.4 serverUsername

```
serverUsername
```

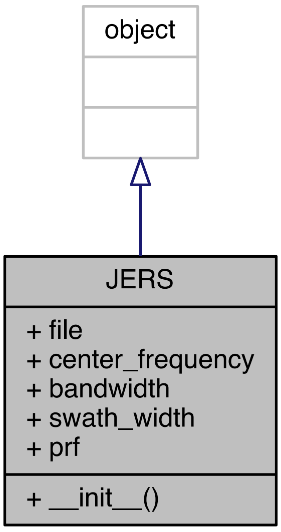
The documentation for this class was generated from the following file:

- add_attribute_insarmaps.py

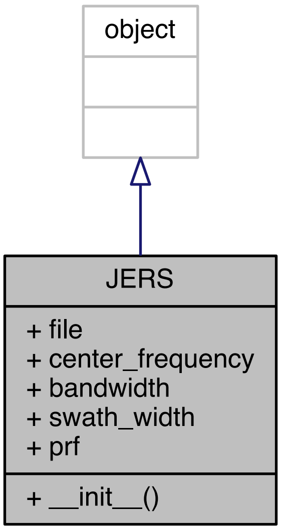
21.5 JERS Class Reference

Program is part of PySAR v1.0 # Copyright(c) 2016, Yunjun Zhang # Author: Yunjun Zhang #.

Inheritance diagram for JERS:



Collaboration diagram for JERS:



Public Member Functions

- def __init__ (self, file=None)

Public Attributes

- file
- center_frequency
- bandwidth
- swath_width
- prf

21.5.1 Detailed Description

Program is part of PySAR v1.0 # Copyright(c) 2016, Yunjun Zhang # Author: Yunjun Zhang #.

Recommended Usage: import pysar._sensor as sensor

21.5.2 Constructor & Destructor Documentation

21.5.2.1 __init__()

```
def __init__ (
              self,
              file = None )
```

21.5.3 Member Data Documentation

21.5.3.1 bandwidth

```
bandwidth
```

21.5.3.2 center_frequency

```
center_frequency
```

21.5.3.3 file

```
file
```

21.5.3.4 prf

```
prf
```

21.5.3.5 swath_width

```
swath_width
```

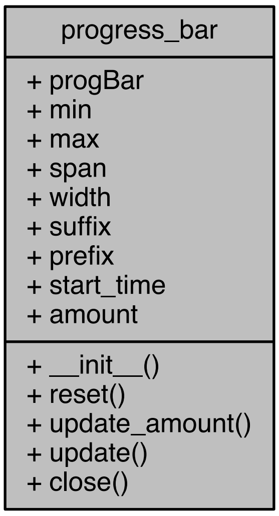
The documentation for this class was generated from the following file:

- _sensor.py

21.6 progress_bar Class Reference

Simple progress bar#####################.

Collaboration diagram for progress_bar:



Public Member Functions

- def __init__ (self, maxValue=100, prefix='', minValue=0, totalWidth=60)
- def reset (self)
- def update_amount (self, newAmount=0, suffix='')
- def update (self, value, every=1, suffix='')
- def close (self)

Public Attributes

- progBar
- min
- max
- span
- width
- suffix
- prefix
- start_time
- amount

21.6.1 Detailed Description

Simple progress bar#######################.

```
Creates a text-based progress bar. Call the object with
the simple 'print'command to see the progress bar, which looks
something like this:
[=======> 22% ]
You may specify the progress bar's width, min and max values on init.

note:
    modified from PyAPS release 1.0 (http://earthdef.caltech.edu/projects/pyaps/wiki/Main)
    Code originally from http://code.activestate.com/recipes/168639/

example:
import pysar._datetime as ptime
date12_list = ptime.list_ifgram2date12(ifgram_list)
prog_bar = ptime.progress_bar(maxValue=1000, prefix='calculating:')
for i in range(1000):
    prog_bar.update(i+1, suffix=date)
    prog_bar.update(i+1, suffix=date12_list[i])
prog_bar.close()
```

21.6.2 Constructor & Destructor Documentation

21.6.2.1 __init__()

```
def __init__ (
              self,
              maxValue = 100,
              prefix = '',
              minValue = 0,
              totalWidth = 60 )
```

21.6.3 Member Function Documentation

21.6.3.1 close()

```
def close (
              self )
```

```
Prints a blank space at the end to ensure proper printing
of future statements.
```

21.6.3.2 reset()

```
def reset (
              self )
```

21.6.3.3 update()

```
def update (
              self,
              value,
              every = 1,
              suffix = '' )
```

```
Updates the amount, and writes to stdout. Prints a
 carriage return first, so it will overwrite the current
  line in stdout.
```

21.6.3.4 update_amount()

```
def update_amount (
              self,
              newAmount = 0,
              suffix = '' )
```

```
Update the progress bar with the new amount (with min and max
values set at initialization; if it is over or under, it takes the
min or max value as a default.
```

21.6.4 Member Data Documentation

21.6.4.1 amount

```
amount
```

21.6.4.2 max

`max`

21.6.4.3 min

`min`

21.6.4.4 prefix

`prefix`

21.6.4.5 progBar

`progBar`

21.6.4.6 span

`span`

21.6.4.7 start_time

`start_time`

21.6.4.8 suffix

`suffix`

21.6.4.9 width

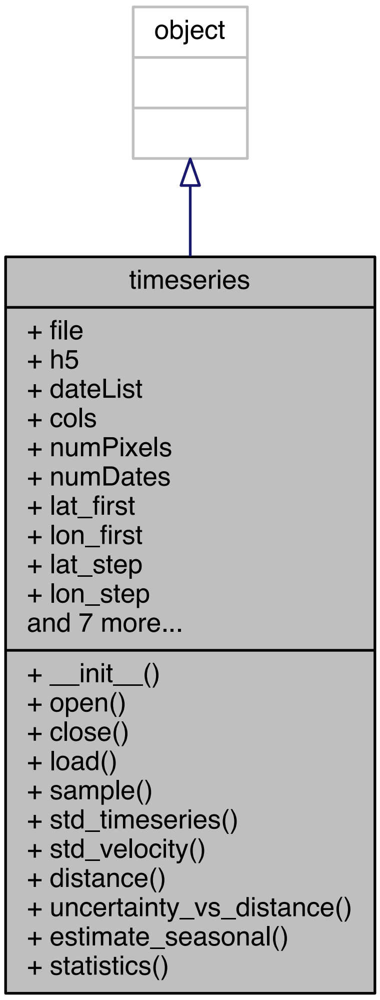
`width`

The documentation for this class was generated from the following file:

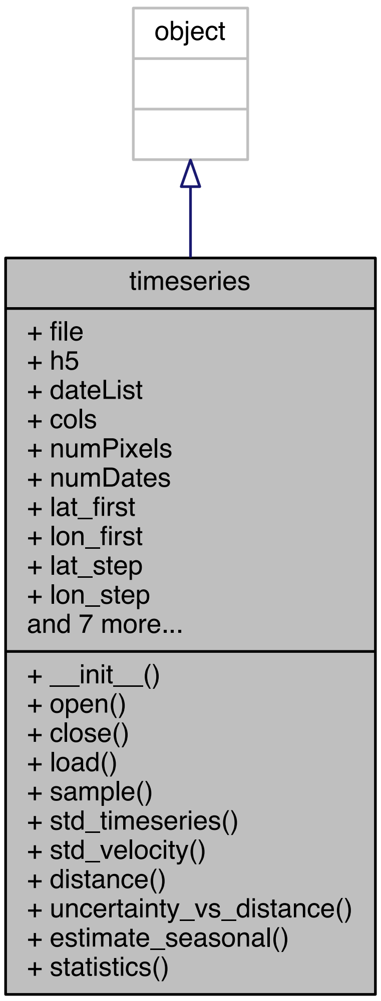
- _datetime.py

21.7 timeseries Class Reference

Inheritance diagram for timeseries:



Collaboration diagram for timeseries:



Public Member Functions

- def __init__ (self, file=None)
- def open (self)
- def close (self)
- def load (self)
- def sample (self, numSamples=500, mask=None)
- def std_timeseries (self, ref)
- def std_velocity (self, sar_dates)
- def distance (self, i)
- def uncertainty_vs_distance (self, sar_dates)
- def estimate_seasonal (self, inps)
- def statistics (self, inps)

Public Attributes

- file
- h5
- dateList
- cols
- numPixels
- numDates
- lat_first
- lon_first
- lat_step
- lon_step
- lat
- lon
- Data
- idx
- relative_std
- relative_std_velocity
- dist

21.7.1 Detailed Description

21.7.2 Constructor & Destructor Documentation

21.7.2.1 __init__()

```
def __init__ (
              self,
              file = None )
```

21.7.3 Member Function Documentation

21.7.3.1 close()

```
def close (
              self )
```

21.7.3.2 distance()

```
def distance (
              self,
              i )
```

21.7.3.3 estimate_seasonal()

```
def estimate_seasonal (
              self,
              inps )
```

21.7.3.4 load()

```
def load (
              self )
```

21.7.3.5 open()

```
def open (
              self )
```

21.7.3.6 sample()

```
def sample (
              self,
              numSamples = 500,
              mask = None )
```

21.7.3.7 statistics()

```
def statistics (
              self,
              inps )
```

21.7.3.8 std_timeseries()

```
def std_timeseries (
              self,
              ref )
```

21.7.3.9 std_velocity()

```
def std_velocity (
              self,
              sar_dates )
```

21.7.3.10 uncertainty_vs_distance()

```
def uncertainty_vs_distance (
              self,
              sar_dates )
```

21.7.4 Member Data Documentation

21.7.4.1 cols

```
cols
```

21.7.4.2 Data

```
Data
```

21.7.4.3 dateList

```
dateList
```

21.7.4.4 dist

```
dist
```

21.7.4.5 file

```
file
```

21.7.4.6 h5

```
h5
```

21.7.4.7 idx

```
idx
```

21.7.4.8 lat

```
lat
```

21.7.4.9 lat_first

```
lat_first
```

21.7.4.10 lat_step

```
lat_step
```

21.7.4.11 lon

```
lon
```

21.7.4.12 lon_first

```
lon_first
```

21.7.4.13 lon_step

```
lon_step
```

21.7.4.14 numDates

```
numDates
```

21.7.4.15 numPixels

```
numPixels
```

21.7.4.16 relative_std

```
relative_std
```

21.7.4.17 relative_std_velocity

`relative_std_velocity`

The documentation for this class was generated from the following file:

- delayTimeseries.py

22 File Documentation

22.1 __init__.py File Reference

Namespaces

- pysar

Variables

- bool miami_path = True
- int parallel_num = 8
- float figsize_single_min = 6.0
- float figsize_single_max = 12.0
- list figsize_multi = [15.0, 8.0]

22.2 _datetime.py File Reference

Classes

- class progress_bar

    Simple progress bar######################.

Namespaces

- pysar._datetime

Functions

- def yyyymmdd2years (dates)
- def yymmdd2yyyymmdd (date)
- def yyyymmdd (dates)
- def yymmdd (dates)
- def ifgram_date_list (ifgramFile, fmt='YYYYMMDD')
- def read_date_list (date_list_file)
- def date_index (dateList)
- def date_list2tbase (dateList)
- def date_list2vector (dateList)
- def auto_adjust_xaxis_date (ax, datevector, fontSize=12, every_year=1)
- def list_ifgram2date12 (ifgram_list)
- def closest_weather_product_time (sar_acquisition_time, grib_source='ECMWF')

22.3 _gmt.py File Reference

Namespaces

- pysar._gmt

Functions

- def write_gmt_simple (lons, lats, z, fname, title='default', name='z', scale=1.0, offset=0, units='meters')

22.4 _network.py File Reference

Namespaces

- pysar._network

Functions

- def read_pairs_list (date12ListFile, dateList=[ ])
- def write_pairs_list (pairs, dateList, outName)
- def read_igram_pairs (igramFile)
- def read_baseline_file (baselineFile, exDateList=[ ])
- def date12_list2index (date12_list, date_list=[ ])
- def get_date12_list (File, check_drop_ifgram=False)
- def igram_perp_baseline_list (File)
- def azimuth_bandwidth (sensor)
- def range_bandwidth (sensor)
- def wavelength (sensor)
- def incidence_angle (sensor, inc_angle=None)
- def signal2noise_ratio (sensor)
- def critical_perp_baseline (sensor, inc_angle=None, print_msg=False)
- def calculate_doppler_overlap (dop_a, dop_b, bandwidth_az)
- def simulate_coherence (date12_list, baselineFile='bl_list.txt', sensor='Env', inc_angle=22.8, decor_↩
time=200.0, coh_resid=0.2, display=False)
- def threshold_doppler_overlap (date12_list, date_list, dop_list, bandwidth_az, dop_overlap_min=0.15)
- def threshold_perp_baseline (date12_list, date_list, pbase_list, pbase_max, pbase_min=0.0)
- def threshold_temporal_baseline (date12_list, btemp_max, keep_seasonal=True, btemp_min=0.0)
- def coherence_matrix (date12_list, coh_list, diagValue=np.nan)
- def threshold_coherence_based_mst (date12_list, coh_list)
- def pair_sort (pairs)
- def pair_merge (pairs1, pairs2)
- def select_pairs_all (date_list)
- def select_pairs_sequential (date_list, increment_num=2)
- def select_pairs_hierarchical (date_list, pbase_list, temp_perp_list)
- def select_pairs_delaunay (date_list, pbase_list, norm=True)
- def select_pairs_mst (date_list, pbase_list)
- def select_pairs_star (date_list, m_date=None, pbase_list=[ ])
- def select_master_date (date_list, pbase_list=[ ])
- def select_master_interferogram (date12_list, date_list, pbase_list, m_date=None)
- def plot_network (ax, date12_list, date_list, pbase_list, plot_dict={}, date12_list_drop=[ ], print_msg=True)
- def plot_perp_baseline_hist (ax, date8_list, pbase_list, plot_dict={}, date8_list_drop=[ ])
- def plot_coherence_matrix (ax, date12_list, coherence_list, date12_list_drop=[ ], plot_dict={})
- def mode (thelist)
- def plot_coherence_history (ax, date12_list, coherence_list, plot_dict={})
- def auto_adjust_yaxis (ax, dataList, fontSize=12, ymin=None, ymax=None)

Variables

- string BASELINE_LIST_FILE
- string IFGRAM_LIST_FILE

22.5 _plot.py File Reference

Namespaces

- pysar._plot

Functions

- def plot_bar_std (ax, date_list, std_list, fig_name=None, ref_date=None)

22.6 _pysar_utilities.py File Reference

Namespaces

- pysar._pysar_utilities

Functions

- def touch (fname_list, times=None)
- def get_lookup_file (filePattern=None, abspath=False, print_msg=True)
- def get_geometry_file (dset, coordType=None, filePattern=None, abspath=False, print_msg=True)
- def check_loaded_dataset (work_dir='./', inps=None, print_msg=True)
- def is_file_exist (file_list, abspath=True)
- def four_corners (atr)
- def circle_index (atr, circle_par)
- def update_template_file (template_file, extra_dict)
- def get_residual_std (timeseries_resid_file, mask_file='maskTempCoh.h5', ramp_type='quadratic')
- def timeseries_std (inFile, maskFile='maskTempCoh.h5', outFile=None)
- def get_residual_rms (timeseries_resid_file, mask_file='maskTempCoh.h5', ramp_type='quadratic')
- def timeseries_rms (inFile, maskFile='maskTempCoh.h5', outFile=None, dimension=2)
- def timeseries_coherence (inFile, maskFile='maskTempCoh.h5', outFile=None)
- def normalize_timeseries (ts_mat, nanValue=0)
- def normalize_timeseries_old (ts_mat, nanValue=0)
- def update_file (outFile, inFile=None, overwrite=False, check_readable=True)
- def update_attribute_or_not (atr_new, atr_orig, update=False)
- def add_attribute (File, atr_new=dict())
- def check_parallel (file_num=1, print_msg=True)
- def perp_baseline_timeseries (atr, dimension=1)
- def range_distance (atr, dimension=2)
- def incidence_angle (atr, dimension=2, print_msg=True)
- def which (program)
- def check_drop_ifgram (h5, print_msg=True)
- def nonzero_mask (File, outFile='mask.h5')
- def spatial_average (File, maskFile=None, box=None, saveList=False, checkAoi=True)
- def temporal_average (File, outFile=None)

- def get_file_list (fileList, abspath=False, coord=None)
- def check_file_size (fname_list, mode_width=None, mode_length=None)
- def mode (thelist)
- def range_ground_resolution (atr, print_msg=False)
- def azimuth_ground_resolution (atr)
- def get_lookup_row_col (y, x, lut_y, lut_x, y_factor=10, x_factor=10, geoCoord=False)

  Use geomap∗.trans file for precious (pixel-level) coord conversion.
- def glob2radar (lat, lon, lookupFile=None, atr_rdr=dict(), print_msg=True)
- def radar2glob (az, rg, lookupFile=None, atr_rdr=dict(), print_msg=True)
- def check_variable_name (path)
- def hillshade (data, scale)
- def date_list (h5file)
- def design_matrix (ifgramFile=None, date12_list=[ ], referenceDate=None, zero_first=True)
- def timeseries_inversion_FGLS (h5flat, h5timeseries)
- def timeseries_inversion_L1 (h5flat, h5timeseries)
- def perp_baseline_ifgram2timeseries (ifgramFile, ifgram_list=[ ])
- def dBh_dBv_timeseries (ifgramFile)
- def Bh_Bv_timeseries (ifgramFile)
- def get_file_stack (File, maskFile=None)
- def stacking (File)
- def yymmdd2YYYYMMDD (date)
- def yyyymmdd (dates)
- def yymmdd (dates)
- def make_triangle (dates12, igram1, igram2, igram3)
- def get_triangles (h5file)
- def generate_curls (curlfile, h5file, Triangles, curls)

22.7 _readfile.py File Reference

Namespaces

- pysar._readfile

Functions

- def read (File, box=None, epoch=None, print_msg=True)
- def read_attribute (File, epoch=None)
- def check_variable_name (path)
- def is_plot_attribute (attribute)
- def read_template (File, delimiter='=')
- def read_roipac_rsc (File)
- def read_gamma_par (fname, delimiter=':', skiprows=3, convert2roipac=True)
- def read_isce_xml (File)
- def attribute_gamma2roipac (par_dict_in)
- def attribute_isce2roipac (metaDict, dates=[ ], baselineDict={})
- def attribute_envi2roipac (metaDict)
- def read_float32 (File, box=None, byte_order='l')
- def read_real_float64 (fname, box=None, byte_order='l')
- def read_complex_float32 (fname, box=None, byte_order='l', cpx=False)
- def read_real_float32 (fname, box=None, byte_order='l')
- def read_complex_int16 (File, box=None, byte_order='l', cpx=False)
- def read_real_int16 (File, box=None, byte_order='l')
- def read_bool (File, box=None)
- def read_GPS_USGS (File)
- def read_multiple (File, box='')

Variables

- list multi_group_hdf5_file = ['interferograms','coherence','wrapped','snaphu_connect_component']
- list multi_dataset_hdf5_file = ['timeseries','geometry']
- list single_dataset_hdf5_file = ['dem','mask','rmse','temporal_coherence', 'velocity']
- list geometry_dataset

22.8 _remove_surface.py File Reference

Namespaces

- pysar._remove_surface

Functions

- def remove_data_surface (data, mask, surf_type='plane')
- def remove_data_multiple_surface (data, mask, surf_type, ysub)
- def remove_surface (File, surf_type, maskFile=None, outFile=None, ysub=None)

22.9 _sensor.py File Reference

Classes

- class JERS

  Program is part of PySAR v1.0 # Copyright(c) 2016, Yunjun Zhang # Author: Yunjun Zhang #.

Namespaces

- pysar._sensor

22.10 _Sidebar.md File Reference

22.11 _variance.py File Reference

Namespaces

- pysar._variance

Functions

- def get_lat_lon (atr)
- def sample_data (lat, lon, mask=None, num_sample=500)
- def get_distance (lat, lon, i)
- def structure_function (data, lat, lon, step=5e3, min_pair_num=100e3, print_msg=True)
- def bin_variance (distance, variance, step=5e3, min_pair_num=100e3, print_msg=True)

22.12 _writefile.py File Reference

Namespaces

- pysar._writefile

Functions

- def write (args)
- def write_roipac_rsc (atr, outname, sorting=True)
- def write_float32 (args)
- def write_complex64 (data, outname)
- def write_real_int16 (data, outname)
- def write_dem (data, outname)
- def write_real_float32 (data, outname)
- def write_complex_int16 (data, outname)

22.13 add.py File Reference

Namespaces

- pysar.add

Functions

- def add_matrix (data1, data2)
- def add_files (fname_list, fname_out=None)
- def cmdLineParse ()
- def main (argv)

Variables

- string EXAMPLE

22.14 add_attribute.py File Reference

Namespaces

- pysar.add_attribute

Functions

- def usage ()
- def main (argv)

22.15 add_attribute_insarmaps.py File Reference

Classes

- class InsarDatabaseController
- class InsarDatasetController

Namespaces

- pysar.add_attribute_insarmaps

Functions

- def build_parser ()
- def main (argv)

22.16 animation.py File Reference

Namespaces

- animation

Functions

- def updatefig (args)

Variables

- string work_dir = '/Users/yunjunz/insarlab/Galapagos/AlcedoEnvA2T061/PIC'
- list fileList = [ ]
- list titleList = [ ]
- list imgs = [ ]
- img = mpimg.imread(fname)
- fig = plt.figure(figsize=[10, 5.4])
- ax = fig.add_axes([0.05, 0.05, 0.9, 0.8])
- int i = -2
- im = ax.imshow(imgs[i], animated=True)
- ttl = ax.text(200, -150, titleList[i], ha='left', fontsize=32)
- ani = animation.FuncAnimation(fig, updatefig, interval=1000, blit=True)
- savefigDict = dict()
- string outName = 'timeseries_animation.gif'
- writer
- dpi
- savefig_kwargs

22.17 asc_desc.py File Reference

Namespaces

- pysar.asc_desc

Functions

- def get_overlap_lalo (atr1, atr2)
- def cmdLineParse ()
- def main (argv)

Variables

- REFERENCE
- EXAMPLE

22.18 Attributes.md File Reference

22.19 baseline_error.py File Reference

Namespaces

- pysar.baseline_error

Functions

- def to_percent (y, position)
- def usage ()
- def main (argv)

22.20 baseline_trop.py File Reference

Namespaces

- pysar.baseline_trop

Functions

- def to_percent (y, position)
- def usage ()
- def main (argv)

22.21 Bibliography.md File Reference

22.22 coord_glob2radar.py File Reference

Namespaces

- pysar.coord_glob2radar

Functions

- def usage ()
- def main (argv)

22.23 coord_radar2glob.py File Reference

Namespaces

- pysar.coord_radar2glob

Functions

- def usage ()
- def main (argv)

22.24 Coordinate.md File Reference

22.25 correct_dem.py File Reference

Namespaces

- pysar.correct_dem

Functions

- def usage ()
- def main (argv)

22.26 correlation_with_dem.py File Reference

Namespaces

- pysar.correlation_with_dem

Functions

- def usage ()
- def main (argv)

22.27 delayTimeseries.py File Reference

Classes

- class timeseries

Namespaces

- delayTimeseries

Functions

- def write_to_h5 (dataset, outName, groupName, h5withAttributes)
- def nearest_valid (xr, yr, data_flat, rows, cols)

22.28 DEM.md File Reference

22.29 dem_error.py File Reference

Namespaces

- pysar.dem_error

Functions

- def topographic_residual_inversion (ts0, A0, inps)
- def read_template2inps (template_file, inps=None)
- def check_exclude_date (exDateIn, dateList)
- def cmdLineParse ()
- def main (argv)

Variables

- TEMPLATE
- EXAMPLE
- REFERENCE

22.30 diff.py File Reference

Namespaces

- pysar.diff

Functions

- def diff_data (data1, data2)
- def diff_file (file1, file2, outName=None, force=False)
- def usage ()
- def cmdLineParse ()
- def main (argv)

22.31 dloadUtil.py File Reference

Namespaces

- dloadUtil

Functions

- def download_modis (inps)
- def download_atmosphereModel (inps)
- def daterange (start_date, end_date)
- def get_date (f)
- def pwv2zwd (pwv)
- def zwd2swd (zwd, theta)
- def read_modis (file)

22.32 Documentation-Generation.md File Reference

22.33 Example.md File Reference

22.34 File-Descriptions.md File Reference

22.35 Gamma-File-Decription.md File Reference

22.36 gamma_view.py File Reference

Namespaces

- pysar.gamma_view

Functions

- def usage ()
- def main (argv)

22.37 generate_mask.py File Reference

Namespaces

- pysar.generate_mask

Functions

- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.38 geocode.py File Reference

Namespaces

- pysar.geocode

Functions

- def geocode_output_filename (fname)
- def update_attribute_geo_lut (atr_rdr, atr_lut, print_msg=True)

  Geocoded with lut in geo coord ########################.
- def geocode_file_geo_lut (fname, lookup_file, fname_out, inps)
- def interp_weights (xy, uv, d=2)

  Geocoded with lut in radar coord ###################### Reference: `https://stackoverflow.com/questions/20915502/speedup-scipy-griddata-for-` *multiple-interpolations-between-two-irregular-grids.*
- def interpolate (values, vtx, wts, fill_value=np.nan)
- def update_attribute_radar_lut (atr_rdr, inps, lat=None, lon=None, print_msg=True)
- def geocode_file_radar_lut (fname, lookup_file, fname_out=None, inps=None)
- def geocode_file (fname, lookup_file, fname_out, inps)
- def read_template2inps (template_file, inps)
- def cmdLineParse ()
- def main (argv)

Variables

- TEMPLATE
- EXAMPLE

22.39 get_modis_v3.py File Reference

Namespaces

- get_modis_v3

Functions

- def usage ()
- def main ()

Variables

- out
- start_time_main
- time_elapsed

22.40 Google-Earth.md File Reference

22.41 hdfeos5_2insarmaps.py File Reference

Namespaces

- pysar.hdfeos5_2insarmaps

Functions

- def get_H5_filename (path)
- def build_parser ()
- def main ()

22.42 hdfeos5_2json_mbtiles.py File Reference

Namespaces

- pysar.hdfeos5_2json_mbtiles

Functions

- def get_date (date_string)
- def get_decimal_date (d)
- def region_name_from_project_name (project_name)
- def serialize_dictionary (dictionary, fileName)
- def convert_data (attributes, decimal_dates, timeseries_datasets, dates, json_path, folder_name)
- def make_json_file (chunk_num, points, dates, json_path, folder_name)
- def build_parser ()
- def main ()

Variables

- needed_attributes

22.43 Home.md File Reference

22.44 ifgram_closure.py File Reference

Namespaces

- pysar.ifgram_closure

Functions

- def usage ()
- def main (argv)

22.45 ifgram_inversion.py File Reference

Namespaces

- pysar.ifgram_inversion

Functions

- def phase_pdf_ds (L, coherence=None, phiNum=1000)
- def phase_variance_ds (L, coherence=None)
- def phase_variance_ps (L, coherence=None)
- def coherence2phase_variance_ds (coherence, L=32, print_msg=False)
- def coherence2fisher_info_index (coherence, L=32, epsilon=1e-4)
- def round_to_1 (x)
- def ceil_to_1 (x)
- def network_inversion_sbas (B, ifgram, tbase_diff, skipZeroPhase=True)
- def network_inversion_wls (A, ifgram, weight, skipZeroPhase=True, Astd=None)
- def temporal_coherence (A, ts, ifgram, weight=None, chunk_size=500)
- def ifgram_inversion_patch (ifgramFile, coherenceFile, meta, box=None)
- def ifgram_inversion (ifgramFile='unwrapIfgram.h5', coherenceFile='coherence.h5', meta=None)
- def write_timeseries_hdf5_file (timeseries, date8_list, atr, timeseriesFile=None)
- def read_template2inps (template_file, inps)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- TEMPLATE
- REFERENCE

22.46 ifgram_reconstruction.py File Reference

Namespaces

- pysar.ifgram_reconstruction

Functions

- def usage ()
- def main (argv)

22.47 ifgram_simulation.py File Reference

Namespaces

- pysar.ifgram_simulation

Functions

- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.48 image_math.py File Reference

Namespaces

- pysar.image_math

Functions

- def data_operation (data, operator, operand)
- def file_operation (fname, operator, operand, fname_out=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.49 incidence_angle.py File Reference

Namespaces

- pysar.incidence_angle

Functions

- def usage ()
- def main (argv)

22.50 info.py File Reference

Namespaces

- pysar.info

Functions

- def print_attributes (atr, sorting=True)
- def print_hdf5_structure (File)

  By andrewcollette at `https://github.com/h5py/h5py/issues/406`.
- def print_timseries_date_info (dateList)
- def usage ()
- def main (argv)

22.51 insar_vs_gps.py File Reference

Namespaces

- pysar.insar_vs_gps

Functions

- def readGPSfile (gpsFile, gps_source)
- def nearest (x, tbase, xstep)
- def find_row_column (Lon, Lat, lon, lat, lon_step, lat_step)
- def usage ()
- def main (argv)

22.52 insarmaps_query.py File Reference

Classes

- class BasicHTTP

Namespaces

- pysar.insarmaps_query

Functions

- def buildURL (args)
- def build_parser ()
- def main ()

22.53 json_mbtiles2insarmaps.py File Reference

Namespaces

- pysar.json_mbtiles2insarmaps

Functions

- def get_unavco_name (json_path)
- def upload_insarmaps_metadata (fileName)
- def upload_json (folder_path)
- def build_parser ()
- def main ()

Variables

- dbUsername
- dbPassword
- dbHost

22.54 l1.py File Reference

Namespaces

- pysar.l1

Functions

- def l1mosek (P, q)
- def l1mosek2 (P, q)
- def l1 (P, q)
- def l1blas (P, q)

Variables

- __MOSEK
- task
- x

22.55 load_data.py File Reference

Namespaces

- pysar.load_data

Functions

- def project_name2sensor (projectName)

  Sub Functions ####################################.
- def auto_path_miami (inps, template={})
- def mode (thelist)
- def check_file_size (fileList, mode_width=None, mode_length=None)
- def check_existed_hdf5_file (inFiles, hdf5File)
- def load_multi_group_hdf5 (fileType, fileList, outfile='unwrapIfgram.h5', exDict=dict())
- def load_geometry_hdf5 (fileType, fileList, outfile=None, exDict=dict())
- def load_single_dataset_hdf5 (file_type, infile, outfile=None, exDict=dict())
- def copy_file (targetFile, destDir)
- def load_file (fileList, inps_dict=dict(), outfile=None, file_type=None)
- def load_data_from_template (inps)
- def cmdLineParse ()
- def main (argv)

  Main Function ################################.

Variables

- sensorList
- EXAMPLE

  Usage ################################.
- TEMPLATE

22.56 load_dem.py File Reference

Namespaces

- pysar.load_dem

Variables

- demFile
- ext
- amp
- dem
- demRsc
- outName
- h5
- group
- dset
- data
- compression

22.57 lod.py File Reference

Namespaces

- pysar.lod

Functions

- def correct_lod_file (File, rangeDistFile=None, outFile=None)
- def cmdLineParse ()
- def main (argv)

Variables

- REFERENCE
- EXAMPLE

22.58 look_angle.py File Reference

Namespaces

- pysar.look_angle

Functions

- def usage ()
- def main (argv)

22.59 los2enu.py File Reference

Namespaces

- pysar.los2enu

Functions

- def usage ()
- def main (argv)

22.60 mask.py File Reference

Namespaces

- pysar.mask

Functions

- def mask_matrix (data_mat, mask_mat, fill_value=None)
- def update_mask (mask, inps_dict, print_msg=True)
- def mask_file (File, maskFile, outFile=None, inps_dict=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.61 match.py File Reference

Namespaces

- pysar.match

Functions

- def corners (atr)
- def nearest (x, X)
- def manual_offset_estimate (matrix1, matrix2)
- def match_two_files (File1, File2, outName=None, manual_match=False, disp_fig=False)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.62 modify_network.py File Reference

Namespaces

- pysar.modify_network

Functions

- def nearest_neighbor (x, y, x_array, y_array)

    Sub Function ##############################.
- def reset_pairs (File)
- def manual_select_pairs_to_remove (File)
- def modify_file_date12_list (File, date12_to_rmv, mark_attribute=False, outFile=None)
- def read_template2inps (template_file, inps=None)
- def cmdLineParse ()
- def main (argv)

    Main Function ###############################.

Variables

- EXAMPLE

    Usage ##################################.
- TEMPLATE

22.63 multi_transect.py File Reference

Namespaces

- pysar.multi_transect

Functions

- def usage ()
- def dms2d (Coord)
- def gps_to_LOS (Ve, Vn, theta, heading)
- def check_st_in_box (x, y, x0, y0, x1, y1, X0, Y0, X1, Y1)
- def check_st_in_box2 (x, y, x0, y0, x1, y1, X0, Y0, X1, Y1)
- def line (x0, y0, x1, y1)
- def dist_point_from_line (m, c, x, y, dx, dy)
- def get_intersect (m, c, x, y)
- def readGPSfile (gpsFile, gps_source)
- def redGPSfile (gpsFile)
- def redGPSfile_cmm4 (gpsFile)
- def nearest (x, tbase, xstep)
- def find_row_column (Lon, Lat, lon, lat, lon_step, lat_step)
- def get_lat_lon (h5file)
- def nanmean (data, args)
- def nanstd (data, args)
- def get_transect (z, x0, y0, x1, y1)
- def get_start_end_point (Xf0, Yf0, Xf1, Yf1, L, dx, dy)
- def point_with_distance_from_line (Xf0, Yf0, Xf1, Yf1, L)
- def point_on_line_with_distance_from_beginning (Xf0, Yf0, Xf1, Yf1, L)
- def read_fault_coords (Fault_coord_file, Dp)
- def main (argv)
- def onclick (event)

Variables

- lat
- lon
- lat_step
- lon_step
- lat_all
- lon_all
- Fault_lon
- Fault_lat
- Num_profiles
- FaultCoords
- Lat0
- Lon0
- Lat1
- Lon1
- Length
- Width
- Yf0
- Xf0
- Yf1
- Xf1
- y0
- x0
- y1
- x1
- fig
- ax
- xc
- yc
- cid
- length

    try: mf=float(Yf1-Yf0)/float((Xf1-Xf0)) # slope of the fault line cf=float(Yf0-mf∗Xf0) # intercept of the fault line df0=dist←↩ _point_from_line(mf,cf,x0,y0,1,1) #distance of the profile start point from the Fault line df1=dist_point_from_←↩ line(mf,cf,x1,y1,1,1) #distance of the profile end point from the Fault line
- x
- y
- zi
- lat_transect
- lon_transect
- dx
- dy
- DX
- DY
- D
- mf
- cf
- df0_km
- transect
- XX0
- XX1
- YY0
- YY1
- m
- c

- m1
- dp
- X0
- Y0
- X1
- Y1
- transect_lat
- transect_lon
- m_prof_edge
- c_prof_edge
- gpsFile
- insarData
- fileName
- fileExtension
- Stations
- Lat
- Lon
- Ve
- Se
- Vn
- Sn
- idxRef
- IDYref
- IDXref
- stationsList
- h5file_theta
- dset
- theta
- heading
- unitVec
- gpsLOS_ref
- GPS
- GPS_station
- GPSx
- GPSy
- GPS_lat
- GPS_lon
- idx
- IDY
- IDX
- gpsLOS
- NoInSAR
- DistGPS
- GPS_in_bound
- GPS_in_bound_st
- GPSxx
- GPSyy
- gx
- gy
- check_result
- check_result2
- dg
- axes
- nrows
- ms

ax.fill_between(D/1000.0, (avgInSAR-stdInSAR)∗1000, (avgInSAR+stdInSAR)∗1000,where=(avgInSAR+stdInS↩ AR)∗1000>=(avgInSAR-stdInSAR)∗1000,alpha=1, facecolor='Red')

- avgInSAR
- axis
- stdInSAR
- fig2
- axes2
- FaultLine
- figName

  Temporary To plot DEM try: majorLocator = MultipleLocator(5) ax.yaxis.set_major_locator(majorLocator) minor↩ Locator = MultipleLocator(1) ax.yaxis.set_minor_locator(minorLocator)
- mfc
- linewidth
- matFile
- dataset
- color

  ax.plot(D/1000.0, avgInSAR∗1000, 'r-')
- alpha
- fontsize
- lbound

  lower and higher bounds for diplaying the profile
- hbound
- ylim
- xlim

22.64 multilook.py File Reference

Namespaces

- pysar.multilook

Functions

- def multilook_matrix (matrix, lks_y, lks_x)

  Sub Functions ###.
- def multilook_attribute (atr_dict, lks_y, lks_x, print_msg=True)
- def multilook_file (infile, lks_y, lks_x, outfile=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.65 perp_baseline.py File Reference

Namespaces

- pysar.perp_baseline

Functions

- def usage ()
- def main (argv)

22.66 plot_network.py File Reference

Namespaces

- pysar.plot_network

Functions

- def read_template2inps (template_file, inps=None)

  Sub Function ###############################.
- def cmdLineParse ()
- def main (argv)

  Main Function ###############################.

Variables

- BL_LIST

  Sub Function ###############################.
- DATE12_LIST
- EXAMPLE
- TEMPLATE

22.67 plot_tropcor_phase_elevation.py File Reference

Namespaces

- plot_tropcor_phase_elevation

Variables

- workDir
- demFile
- timeseriesFile
- timeseriesFile2
- maskFile
- tropHgtFile
- ecmwfFile
- epoch
- dem
- dem_atr
- data
- atr
- data2
- atr2

- tropHgt
- atr3
- ecmwf
- atr4
- mask
- msk_atr
- ndx
- dataList
- fig
- axes
- nrows
- ncols
- sharex
- True
- sharey
- figsize
- i
- ms
- bbox_inches
- dpi

22.68 prep4timeseries.py File Reference

Namespaces

- pysar.prep4timeseries

Functions

- def createParser ()
- def cmdLineParse (iargs=None)
- def extractIsceMetadata (xmlFile)
- def read_baseline (baselineFile)
- def baselineTimeseries (baselineDir)
- def read_rsc (rscFile)
- def write_rsc (rscDict, rscFile)
- def attribute_isce2roipac (metaDict, dates=[ ], baselineDict={})
- def prepare_stack (inputDir, filePattern, metaDictIn, baselineDict)
- def prepare_geometry (geometryDir, exDict=None)
- def read_template (File, delimiter='=')

  from _read_file.py Need to be removed once we can import _readfile.py
- def check_variable_name (path)
- def main (iargs=None)

Variables

- GDAL2NUMPY_DATATYPE
- EXAMPLE

22.69 prep_gamma.py File Reference

Namespaces

- pysar.prep_gamma

Functions

- def get_perp_baseline (m_par_file, s_par_file, off_file, atr_dict={})

    Sub Functions ##.
- def get_lalo_ref (m_par_file, atr_dict={})
- def extract_attribute_interferogram (fname)
- def extract_attribute_lookup_table (fname)
- def extract_attribute_dem_geo (fname)
- def extract_attribute_dem_radar (fname)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- DESCRIPTION

22.70 prep_giant_ifg_list.py File Reference

Namespaces

- pysar.prep_giant_ifg_list

Functions

- def get_mission_name (meta_dict)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.71 prep_isce.py File Reference

Namespaces

- pysar.prep_isce

Functions

- def createParser ()
- def cmdLineParse (iargs=None)
- def extractIsceMetadata (xmlFile)
- def write_rsc (isceFile, dates, metadata, baselineDict)
- def prepare_stack (inputDir, filePattern, metadata, baselineDict)
- def read_baseline (baselineFile)
- def baselineTimeseries (baselineDir)
- def prepare_geometry (geometryDir)
- def main (iargs=None)

Variables

- GDAL2NUMPY_DATATYPE

22.72 prep_roipac.py File Reference

Namespaces

- pysar.prep_roipac

Functions

- def extract_attribute (fname)

  Sub Functions ##.
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- DESCRIPTION

22.73 pysarApp.py File Reference

Namespaces

- pysar.pysarApp

Functions

- def check_geocode_file (lookupFile, File, templateFile=None, outFile=None)
- def check_subset_file (File, inps_dict, outFile=None, overwrite=False)
- def subset_dataset (inps, template_file)
- def multilook_dataset (inps, lks_y=None, lks_x=None)
- def cmdLineParse ()
- def main (argv)

Variables

- LOGO
- TEMPLATE
- EXAMPLE
- UM_FILE_STRUCT

22.74 quality_map.py File Reference

Namespaces

- pysar.quality_map

Functions

- def usage ()
- def main (argv)

22.75 range_distance.py File Reference

Namespaces

- pysar.range_distance

Functions

- def usage ()
- def main (argv)

22.76 README.md File Reference

22.77 reference_epoch.py File Reference

Namespaces

- pysar.reference_epoch

Functions

- def ref_date_attribute (atr_in, ref_date, date_list)
- def ref_date_file (inFile, ref_date, outFile=None)
- def read_template2inps (templateFile, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- TEMPLATE
- EXAMPLE

22.78 remove_plane.py File Reference

Namespaces

- pysar.remove_plane

Functions

- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.79 rewrap.py File Reference

Namespaces

- pysar.rewrap

Functions

- def usage ()
- def rewrap (unw, cycle=2 ∗np.pi)
- def main (argv)

22.80 SAR-Sensor-Parameter.md File Reference

22.81 save_gmt.py File Reference

Namespaces

- pysar.save_gmt

Functions

- def get_geo_lat_lon (atr)
- def write_grd_file (data, atr, fname_out=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.82 save_hdfeos5.py File Reference

Namespaces

- pysar.save_hdfeos5

Functions

- def get_mission_name (meta_dict)
- def metadata_pysar2unavco (pysar_meta_dict, dateList)
- def get_hdfeos5_filename (timeseriesFile)
- def read_template2inps (template_file, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- BOOL_ZERO
- INT_ZERO
- FLOAT_ZERO
- CPX_ZERO
- TEMPALTE
- EXAMPLE

22.83 save_kml.py File Reference

Namespaces

- pysar.save_kml

Functions

- def write_kmz_file (data, atr, out_name_base, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.84 save_mat.py File Reference

Namespaces

- pysar.save_mat

Functions

- def usage ()
- def yyyymmdd2years (date)
- def main (argv)

22.85 save_roipac.py File Reference

Namespaces

- pysar.save_roipac

Functions

- def usage ()
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.86 seed_data.py File Reference

Namespaces

- pysar.seed_data

Functions

- def nearest (x, tbase, xstep)

  Sub Functions ###.
- def seed_file_reference_value (File, outName, refList, ref_y='', ref_x='')
- def seed_file_inps (File, inps=None, outFile=None)
- def seed_attributes (atr_in, x, y)
- def manual_select_reference_yx (stack, inps)
- def select_max_coherence_yx (cohFile, mask=None, min_coh=0.85)
- def random_select_reference_yx (data_mat, print_msg=True)
- def print_warning (next_method)
- def read_seed_template2inps (template_file, inps=None)
- def read_seed_reference2inps (reference_file, inps=None)
- def remove_reference_pixel (File)
- def cmdLineParse ()
- def main (argv)

  Main Function ##.

Variables

- TEMPLATE

    Usage ###.
- NOTE
- EXAMPLE

22.87 select_network.py File Reference

Namespaces

- pysar.select_network

Functions

- def log (msg)
- def project_name2sensor (projectName)
- def read_template2inps (templateFile, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- sar_sensor_list
- REFERENCE
- EXAMPLE
- TEMPLATE

22.88 spatial_average.py File Reference

Namespaces

- pysar.spatial_average

Functions

- def cmdLineParse ()
- def main (argv)

    Main Function ################################.

Variables

- EXAMPLE

    Usage ####################################.

22.89 spatial_filter.py File Reference

Namespaces

- pysar.spatial_filter

Functions

- def filter_data (data, filter_type, filter_par=None)
- def filter_file (fname, filter_type, filter_par=None, fname_out=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.90 stacking.py File Reference

Namespaces

- pysar.stacking

Functions

- def cmdLineParse ()
- def main (argv)

  Main Function ##################################.

Variables

- EXAMPLE

  Usage ####################################.

22.91 subset.py File Reference

Namespaces

- pysar.subset

Functions

- def coord_geo2radar (geoCoordIn, atr, coordType)

  Example: 300 = coord_geo2radar(32.104990, atr,'lat') [1000,1500] = coord_geo2radar([130.5,131.4],atr,'lon')
- def coord_radar2geo (radarCoordIn, atr, coordType)

  Inputs: radarCoord : coordinate (list) in row/col in int atr : dictionary of file attributes coordType : coordinate type: row, col, y, x.
- def check_box_within_data_coverage (pixel_box, atr_dict)
- def subset_attribute (atr_dict, subset_box, print_msg=True)
- def get_coverage_box (atr)
- def read_subset_template2box (templateFile)
- def bbox_geo2radar (geo_box, atr_rdr=dict(), lookupFile=None)
- def bbox_radar2geo (pix_box, atr_rdr=dict(), lookupFile=None)
- def subset_box2inps (inps, pix_box, geo_box)
- def get_box_overlap_index (box1, box2)
- def subset_input_dict2box (subset_dict, meta_dict)
- def box_pixel2geo (pixel_box, meta_dict)
- def box_geo2pixel (geo_box, meta_dict)
- def subset_file (File, subset_dict_input, outFile=None)
- def subset_file_list (fileList, inps)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.92 sum_epochs.py File Reference

Namespaces

- pysar.sum_epochs

Functions

- def usage ()
- def main (argv)

22.93 temporal_average.py File Reference

Namespaces

- pysar.temporal_average

Functions

- def usage ()

  Usage ####################################.
- def main (argv)

  Main Function ################################.

22.94 temporal_coherence.py File Reference

Namespaces

- pysar.temporal_coherence

Functions

- def temporal_coherence (timeseriesFile, ifgramFile)
- def usage ()
- def main (argv)

Variables

- USAGE
- DESCRIPTION
- REFERENCE
- EXAMPLE

22.95 temporal_derivative.py File Reference

Namespaces

- pysar.temporal_derivative

Functions

- def usage ()
- def main (argv)

22.96 temporal_filter.py File Reference

Namespaces

- pysar.temporal_filter

Functions

- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE

22.97 timeseries2velocity.py File Reference

Namespaces

- pysar.timeseries2velocity

Functions

- def get_exclude_date (inps, date_list_all)
- def get_velocity_filename (timeseries_file, template_file=None, vel_file='velocity.h5', inps=None)
- def read_template2inps (template_file, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- TEMPLATE
- DROP_DATE_TXT

22.98 timeseries_rms.py File Reference

Namespaces

- pysar.timeseries_rms

Functions

- def read_template2inps (templateFile, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- TEMPLATE
- EXAMPLE

22.99 transect.py File Reference

Namespaces

- pysar.transect

Functions

- def get_scale_from_disp_unit (disp_unit, data_unit)
- def read_lonlat_file (lonlat_file)
- def manual_select_start_end_point (File)
- def transect_yx (z, atr, start_yx, end_yx, interpolation='nearest')
- def transect_lalo (z, atr, start_lalo, end_lalo, interpolation='nearest')
- def transect_list (fileList, inps)
- def cmdLineParse ()
- def main (argv)

  Main ####################################.

Variables

- EXAMPLE

22.100 transect_legacy.py File Reference

Namespaces

- pysar.transect_legacy

Functions

- def dms2d (Coord)
- def gps_to_LOS (Ve, Vn, theta, heading)
- def check_st_in_box (x, y, x0, y0, x1, y1, X0, Y0, X1, Y1)
- def check_st_in_box2 (x, y, x0, y0, x1, y1, X0, Y0, X1, Y1)
- def line (x0, y0, x1, y1)
- def dist_point_from_line (m, c, x, y, dx, dy)
- def get_intersect (m, c, x, y)
- def readGPSfile (gpsFile, gps_source)
- def redGPSfile (gpsFile)
- def redGPSfile_cmm4 (gpsFile)
- def nearest (x, tbase, xstep)
- def find_row_column (Lon, Lat, lon, lat, lon_step, lat_step)
- def get_lat_lon (atr)
- def nanmean (data, args)
- def nanstd (data, args)
- def get_transect (z, x0, y0, x1, y1, interpolation='nearest')

  Option: interpolation : sampling/interpolation method, including: 'nearest' - nearest neighbour, by default 'cubic' - cubic interpolation 'bilinear' - bilinear interpolation.
- def Usage ()
- def main (argv)
- def onclick (event)

Variables

- fig
- ax
- xc
- yc
- cid
- x0
- x1
- y0
- y1
- mf
- cf
- df0
- df1
- mp
- Info_aboutFault
- length
- x
- y
- zi
- lat_transect
- lon_transect
- earth_radius
- dx
- dy
- DX
- DY
- D
- df0_km
- transect
- XX0
- XX1
- YY0
- YY1
- m
- c
- m1
- X0
- Y0
- X1
- Y1
- transect_lat
- transect_lon
- m_prof_edge
- c_prof_edge
- gpsFile
- insarData
- fileName
- fileExtension
- Stations
- Lat
- Lon
- Ve
- Se

- Vn
- Sn
- idxRef
- Length
- Width
- lat
- lon
- lat_step
- lon_step
- lat_all
- lon_all
- IDYref
- IDXref
- stationsList
- h5file_theta
- dset
- theta
- heading
- unitVec
- gpsLOS_ref
- GPS
- GPS_station
- GPSx
- GPSy
- GPS_lat
- GPS_lon
- idx
- IDY
- IDX
- gpsLOS
- NoInSAR
- DistGPS
- GPS_in_bound
- GPS_in_bound_st
- GPSxx
- GPSyy
- gx
- gy
- check_result
- check_result2
- dg
- axes
- nrows
- ms

  ax.fill_between(D/1000.0, (avgInSAR-stdInSAR)∗1000, (avgInSAR+stdInSAR)∗1000,where=(avgInSAR+stdInS↩ AR)∗1000>=(avgInSAR-stdInSAR)∗1000,alpha=1, facecolor='Red')
- avgInSAR
- axis
- stdInSAR
- fig2
- axes2
- FaultLine
- figName

Temporary To plot DEM try: majorLocator = MultipleLocator(5) ax.yaxis.set_major_locator(majorLocator) minorLocator = MultipleLocator(1) ax.yaxis.set_minor_locator(minorLocator)

- mfc
- linewidth
- matFile
- dataset
- color

ax.plot(D/1000.0, avgInSAR∗1000, 'r-')

- alpha
- fontsize
- lbound

lower and higher bounds for diplaying the profile

- hbound
- fault_loc
- ylim

22.101 tropcor_phase_elevation.py File Reference

Namespaces

- pysar.tropcor_phase_elevation

Functions

- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- REFERENCE

22.102 tropcor_pyaps.py File Reference

Namespaces

- pysar.tropcor_pyaps

Functions

- def get_delay (grib_file, atr, inps_dict)
- def date_list2grib_file (date_list, hour, grib_source, grib_dir)
- def dload_grib (date_list, hour, grib_source='ECMWF', weather_dir='./')
- def cmdLineParse ()
- def main (argv)

Variables

- EXAMPLE
- REFERENCE
- TEMPLATE
- DATA_INFO

22.103 troposphere_uncertainty.py File Reference

Namespaces

- troposphere_uncertainty

Functions

- def cmdLineParse ()
- def velocity_uncertainty_vs_distance (inps)
- def statistics (inps)
- def estimate_seasonal (inps)
- def velocity_uncertainty (realtive_std_file, inps)
- def download (inps)
- def main (argv)

Variables

- EXAMPLE

22.104 tsviewer.py File Reference

Namespaces

- pysar.tsviewer

Functions

- def read_timeseries_yx (timeseries_file, y, x, ref_yx=None)
- def read_timeseries_lalo (timeseries_file, lat, lon)
- def cmdLineParse ()
- def format_coord (x, y)
- def time_slider_update (val)
- def plot_timeseries_errorbar (ax, dis_ts, inps)
- def plot_timeseries_scatter (ax, dis_ts, inps)
- def update_timeseries (y, x)
- def plot_timeseries_event (event)

Variables

- EXAMPLE
- inps

    Actual code.
- atr
- k
- h5
- dateList
- date_num
- dates
- tims
- input_ex_date
- ex_date_list
- ex_date
- ex_dates
- ex_idx_list
- zero_idx

    Zero displacement for 1st acquisition.
- length
- width
- ullon
- ullat
- lon_step
- lat_step
- lrlon
- lrlat
- y
- x
- yx
- ref_yx
- unit_fac
- flip_ud
- left_lr
- file_list
- mask_file
- mask
- epoch
- d_v
- timeseries_file
- ref_d_v
- data_lim
- ylim_mat
- fig_v

    Fig 1 - Cumulative Displacement Map.
- ax_v
- dem
- dem_file
- img
- cmap
- colormap
- clim
- interpolation
- ms

- markeredgecolor
- format_coord
- cbar
- orientation
- ax_time
- axisbg
- yticks
- tslider
- valinit
- facecolor
- ecolor
- fig_ts

    Fig 2 - Time Series Displacement - Point.
- figsize
- ax_ts
- error_ts
- error_fileContent
- error_file
- dtype
- e_ts
- ex_error_ts
- d_ts
- fig_base

    Output.
- outName = inps.fig_base+'_ts.pdf'
- header_info
- lat
- lon
- fmt
- string delimiter = header_info)
- bbox_inches
- transparent
- True
- dpi
- cid = fig_v.canvas.mpl_connect('button_press_event', plot_timeseries_event)

    Final linking of the canvas to the plots.

22.105 UNAVCO-InSAR-Archive.md File Reference

22.106 unwrap_error.py File Reference

Namespaces

- pysar.unwrap_error

Functions

- def bridging_data (data, mask, x, y)
- def unwrap_error_correction_phase_closure (ifgram_file, mask_file, ifgram_cor_file=None)
- def unwrap_error_correction_bridging (ifgram_file, mask_file, y_list, x_list, ramp_type='plane', ifgram_cor_↩ file=None, save_cor_deramp_file=False)
- def read_template2inps (template_file, inps=None)
- def cmdLineParse ()
- def main (argv)

Variables

- string EXAMPLE
- string TEMPLATE
- string REFERENCE
- string DESCRIPTION

22.107 view.py File Reference

Classes

- class Basemap2

  Class ###.

Namespaces

- pysar.view

Functions

- def round_to_1 (x)
- def add_inner_title (ax, title, loc, size=None, kwargs)
- def auto_flip_direction (atr_dict)
- def auto_figure_title (fname, epoch=[ ], inps_dict=None)
- def auto_row_col_num (subplot_num, data_shape, fig_size, fig_num=1)
- def check_colormap_input (atr_dict, colormap=None)
- def check_multilook_input (pixel_box, row_num, col_num)
- def get_epoch_full_list_from_input (all_epoch_list, epoch_input_list=[ ], epoch_num_input_list=[ ])
- def plot_dem_lalo (bmap, dem, box, inps_dict)
- def plot_dem_yx (ax, dem, inps_dict=dict())
- def scale_data4disp_unit_and_rewrap (data, atr, disp_unit=None, rewrapping=False)
- def scale_data2disp_unit (matrix, atr_dict, disp_unit)
- def update_plot_inps_with_display_setting_file (inps, disp_set_file)
- def update_plot_inps_with_meta_dict (inps, meta_dict)
- def update_matrix_with_plot_inps (data, meta_dict, inps)
- def plot_matrix (ax, data, meta_dict, inps=None)
- def cmdLineParse (argv)
- def main (argv)

  Main Function ##.

Variables

- list mplColors
- string EXAMPLE
- string PLOT_TEMPLATE

22.108 Web-Viewer.md File Reference

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