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| **Project Title:** | ECOPOTENTIAL: IMPROVING FUTURE ECOSYSTEM BENEFITS THROUGH EARTH OBSERVATIONS |
| **Project number:** | 641762 |
| **Project Acronym:** | ECOPOTENTIAL |
| **Proposal full title:** | IMPROVING FUTURE ECOSYSTEM BENEFITS THROUGH EARTH OBSERVATIONS |
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| **Work program topics addressed:** | SC5-16-2014: “Making Earth Observation and Monitoring Data usable for ecosystem modelling and services” |



**CERTH’s contribution to Task 4.1.2 Fusion modules and data integration from multiple source**

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| **Module Name:** | Python module for Sentinel-1A SAR speckle suppression fusing Sentinel 2-A RGB Optical data |
| **Date of contribution :** |  |
| **Version:** | V1 |
| **Developers:** | Georgios Kordelas, Ioannis Manakos |
| **Keywords:** | Python module, Speckle suppression |

**Aim of the module**

This module aims to suppress speckle in the SAR Sentinel-1A GRD product by using guided image filtering. The guided filter computes the filtered output by considering the content of a guidance image (Sentinel-2 RGB image). Guided filter has good edge-preserving property, while it suppresses speckle noise. More information about the algorithm behind this module can be found in xxx.

**Software Installation for windows**

In order to install the module, the following steps should be followed sequentially:

1. Install the “OSGeo4W project”after downloading and executing the 64bit OSGeo4W network installer, which can be found under the following link**:** <https://trac.osgeo.org/osgeo4w/> (about 1.5Gb is expected to be installed to user’s C: directory ). The OSGeo4W project includes the GDAL library which is used for processing raster and vector geospatial data formats.
2. Install “Anaconda Python 2.7” after downloading and executing the WINDOWS 64-BIT GRAPHICAL INSTALLER which can be found under the following link: <https://www.continuum.io/downloads>. This executable installs Python 2.7 version in the PC.
3. Install “OpenCV-Python” from the <https://sourceforge.net/projects/opencvlibrary/files/> site. Specifically, the opencv-3.1.0 version, which can be found in <https://sourceforge.net/projects/opencvlibrary/files/opencv-win/3.1.0/>, should be installed. This executable installs the opencv library, which includes functions used for performing image processing operations.
4. In order to use opencv via python
5. Go to /opencv/build/python/2.7/x64 folder, where cv2.pyd lies
6. Copy cv2.pyd to /OSGeo4W64/apps/Python27/Lib/site-packages

The executables downloaded from steps 1-3 have been included in “Software\_components.zip”. “osgeo4w-setup-x86\_64.exe” is downloaded via step 1, “Anaconda2-4.1.1-Windows-x86\_64.exe” is downloaded via step 2 and “opencv-3.1.0.exe” is downloaded via step 3.

**Run the Despeckling module script**

The OSGeo4W Shell command window is activated by double clicking OSGeo4W.bat, which can be found in folder /OSGeo4W64. The command to execute the python script of the descpeckling module and the explanation of input parameters are provided inside the box below.

The Descpeckling script is executed from the OSGeo4W shell command window by typing:

python To\_\Guided\_filter\_despeckling.py –i <input\_file> -g <guidancefile> -r <radius> -e <smoothness\_parameter> -m <cloud\_mask > -o <outputfile>

The user should compulsory define: (a) <input\_file>, which is the path to the source file of the geotiff input SAR image to be despeckled, (b) <guidancefile>, which is the path to the source file of the geotiff Sentinel-2 RGB image to be used as guidance image, (c) <outputfile>, which is the path the despeckled SAR image will be saved at.

The user should optionally define: (a) <radius>, which is the radius of the support window used in the guided filtering process (radius is set by default to 3 in case input value is not detected), radius should be an even positive integer number, (b) <smoothness\_parameter>, which is the smoothness parameter used in the guided filtering process (smoothness parameters is set by default to 0.001 in case input value is not detected), smoothness parameter should be a positive decimal value below “1”, (c) <cloud\_mask>, which is the path to the source file of the geotiff cloud mask image that is a binary image denoting with “1” areas in the image covered by clouds. For image areas covered by clouds, despeckling is performed via median filtering, instead of the guided filtering process. More information regarding the adjustment of radius (r) and smoothness parameter (e) can be found in [1].

An example of using the despeckling python module, based on existing files (“SAR\_image.tif” is the SAR Sentinel-1A GRD VV polarization data before despeckling, “RGB\_image.tif” contains Sentinel-2 RGB bands acquired on a close date to the SAR image, “Cloud\_mask.tif” is a binary cloud mask, “Despeckled\_SAR\_image.tif” is the name of the output despeckled SAR image), is provided below:

python “To\_insert\_path\_to\_script\Guided\_filter\_despeckling.py” –i “To\_insert\_path\_to\_file\SAR\_image.tif” –g “To\_insert\_path\_to\_file\RGB\_image.tif” –m “To\_insert\_path\_to\_file\Cloud\_mask.tif” –o “To\_insert\_path\_to\_file\Despeckled\_SAR\_image.tif”

If the above files lie within folder D:\Input then To\_insert\_path\_to\_file shall be replaced by D:\Input in the above command line.

The output “Despeckled\_SAR\_image.tif” can be visualized with any common remote sensing or geographic information system (GIS) software (e.g. QGIS - <http://www.qgis.org/en/site/>).

**Contact details**

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[1] K. He, J. Sun, and X. Tang, “Guided image filtering,” in Proc. ECCV, pp. 1–14, 2010.