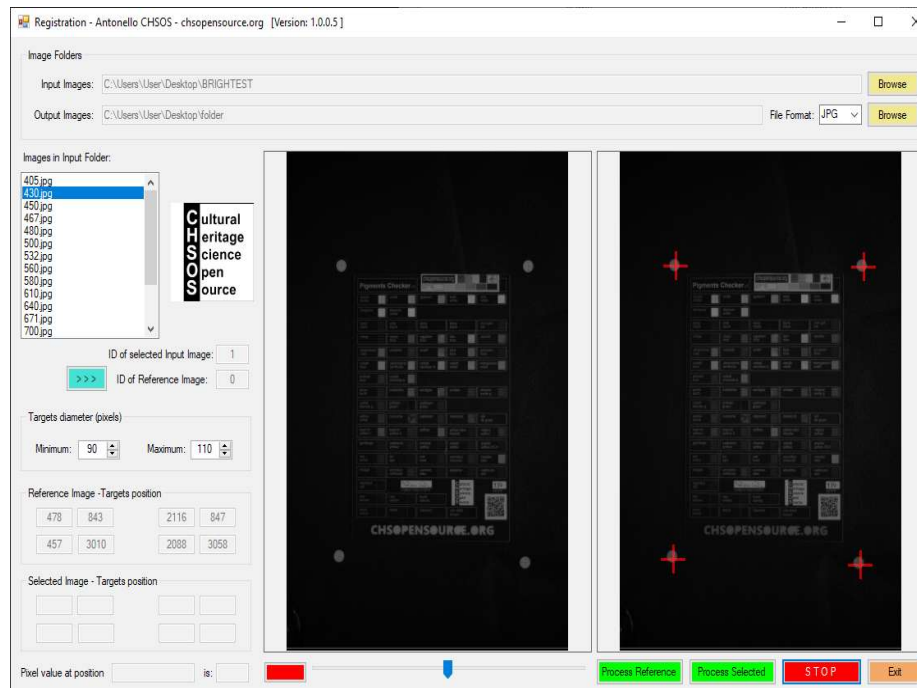


REGISTRATION App

Antonello MSI system - CHSOS

Description and User Guide



Purpose of the Registration app

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Purpose of the Registration app

The images we acquire using the Antonello's filters set will likely be not registered. **Registration** is a technical term used in imaging science, indicating the process to geometrically arrange two or more images in order to overlap to a reference image. When we take our images with Antonello, it is likely that the camera could be shaken a bit while changing the filter. More important, when we focus from the near UV to the VIS and eventually to the IR, the size of the image changes a bit.

Bottom line, before we can use these photos with a multispectral imaging software, the images must overlap each other. We cannot allow any misalignment. This process is called REGISTRATION.

CHSOS developed this Registration app to make this process totally automatic and fast!

The Registration app will:

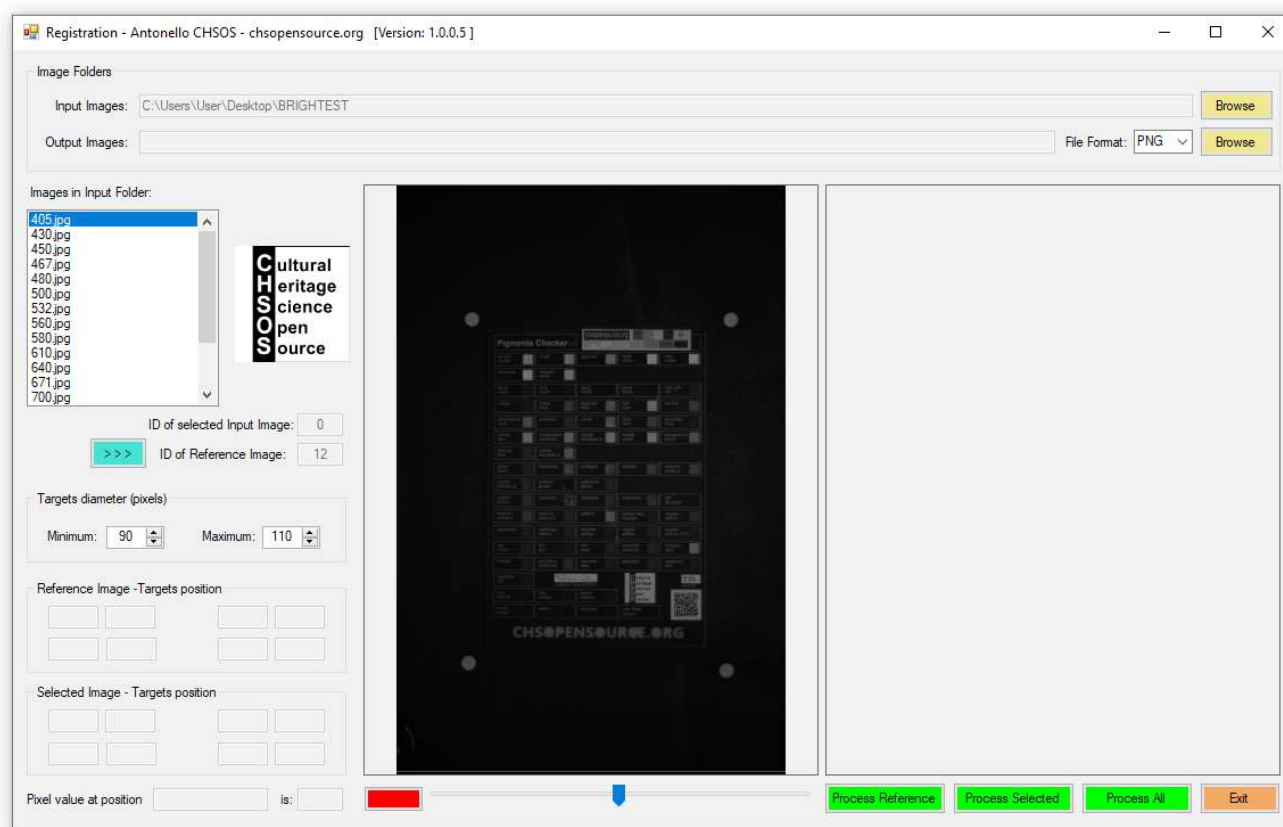
- fetch all the images of an *Input Folder*,
- transform them to the coordinate system of a reference image
- store the registered images into an *Output Folder*.

The images must contain special targets (four white circles), in order to establish the geometric relation among different images without user intervention. During the registration process, the images are transformed so that their targets will get the same position as of the reference image's targets. This way (using the four targets) distortions caused by slightly different capturing conditions can be compensated.

Description of the GUI (graphical user interface)

The Registration app user interface is compatible with the usual Window style programs, so both the implemented control's nature, usage and the processing steps are clear.

The following screenshot shows the main window:



These are the controls and their description:

Image Folders

In the upper-side field the input and output image's folder can be given (by selecting them with the usual file browser). The Input Folder must exist – but the Output will be created, if it does not exist. In addition, the type of output image files can be selected from PNG, JPG and BMP formats.

Images in Input Folder

This list contains the names of image files (with extension) found in the Input Image Folder. All file names are listed, having PNG, JPG or BMP extension. We need to select one (it's name is highlighted by clicking on it). This image will become our reference image on which all the other images will be registered. We can just choose the first image, or any other.

Targets diameter (pixels)

The app looks for the four white circles to establish the geometric relation among the set of multispectral images. In order to help the app to find these markers faster, we need to input the minimum and maximum size (diameter) of these circles (pixels).

We can measure this diameter in any photo-editing software, such as the free GIMP. We need to input a max and a min value because we expect the diameter of the circles to vary slightly among the images, since when we do focus from UV to VIS, and IR the size of the image changes. In this example we used values 90 and 110.

The app will process only those circles whose diameter is between these min and max values.

ID of Selected Input Image and ID of Reference Image

To the images listed in the "Images in Input folder" is associated an ID, starting from zero (0). Once we select an image in the list, its ID is shown in the "ID of selected Input Image" field. In order to select the image to be our reference image, we first select this image and then we click the ">>>" button. The ID of this image will appear in the "ID of reference Image" field and this image will be the reference image for the registration process.

Reference Image - Targets position

If the program finds the positions of the targets for the reference image, their coordinates are displayed in this field. The position is relative to the upper-left corner of image, that is: the {0,0} position is in the upper-left corner.

Selected image - Targets position

If the program finds the positions of the targets on the selected image, their coordinates are displayed in this field. Again, the position is relative to the upper-left corner of image, that is: the {0,0} position is in the upper-left corner.

Images

In the middle of main window there are two fields, for visualizing the images. The left one shows the selected image, before registration. It is selected by using the left-side list of images – it's name is highlighted in the list. The right image field shows

the registered image.

Process Reference

Click this button to identify the targets on the reference image. In case of success, the positions of four targets will be displayed in the "Reference Image - Targets position" field.

Process Selected

Clicking this button you can choose to register just the one selected image. In case of success, the positions of the four targets will be displayed in the "Selected Image -Targets position" field, and also the registered image will be shown on the right field and saved in the *Output Folder*.

Process All

Pressing this button, the app processes all images in the Input Image folder.

Exit

Pressing this button, the app quits.

How to use the app

Select the "Input images" and the "Output Images" folders.

Select the "File format", recommended JPG.

Select the reference image from the "Images in Input Folder" list. The default is the first image (*ID of Reference Image* is 0). You can leave this as it is.

Click "*Process Reference*" button. Targets positions are shown in the "Reference Image-Targets position" field.

Click "*Process All*" button, the app register all the images in the "*Input Images*" folder and save them in the "Output Images" folder. You are done!

The Registration algorithm

The registration process is a geometric transformation where an image is transformed into the coordinate system of reference image. The registered image will be "synchronized" with the reference image. This means that the pixels in any $\{x,y\}$ positions represent the same portion of the represented object in both the reference and registered images. For executing the registration, geometric relation must be established between the image and reference image's coordinate system.

The automatic registration requires targets on the images, that can be easily identified. These targets are usually called GCPs (Ground Control Points), because they are used mostly to process aerial and satellite images.

In our app we use four white circles. The registration process is done in 3 main steps.

1. Targets Identification

The program assumes that the four targets are circles of the same size and they are situated in the upper-left, upper-right, lower-right and lower-left quarter of the image. The user must define the interval of possible sizes (diameters in pixels). The user must measure in advance (using some 3rd party image processing program, like Photoshop or GIMP) the targets diameter (pixels). As a practical workflow, we suggest to measure the diameter in the first image and then define the min value subtracting a 10% and the maximum value adding a 10%. For example, if the diameter is 100 pixels, min values is 90 and max is 110. Wider values will result in slower execution – and in addition, other objects in the image can disturb the identification.

In order to keep the execution time as fast as possible, the program identifies the targets in two phase. In the first phase, the image is scaled down by factor 4, so the number of pixels to be processed will 1/16 of the original image. The app executes edge enhancement (applying Sobel operator), and tries to identify the “strongest” circles (using Hough's method) in all the four corners of the down-scaled images. In the second phase, the program makes this identification finer: executes the Sobel edge enhancement within small portions of the original images in full resolution where the targets were previously detected. Then applies the Hough circle detection in these small regions. The result will be the most precise positions of the four targets, without spending too much time working on all pixels of the original images.

2. Establishing the geometric relation among targets

The app first determines targets' relative positions in the reference image. Then the app applies these ratios on the images to be registered, so that the targets of the reference and the registered images overlap.

3. Executing the registration

The geometric correction for the registered image is created using the four targets relative positions to the reference image, as done in step 2. Using these data, the programs creates an output row (stepping from its starting position till the end position), and after finishing the current row, decides the starting and ending positions of next output row in the image system.