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Shedding light on a Picasso

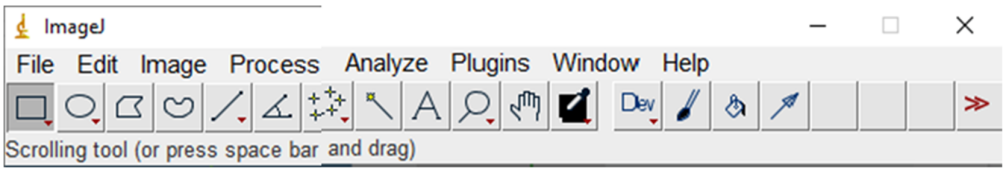
Intensity normalization

For each spectral band i, henceforth called 'wavelength', a standard acquisition process is followed. A white, highly reflective target is placed in front of the object. The 'white' image, *W*, is acquired. The whitetarget is removed and, keeping all settings unchanged, the acquisition of spectral image *Q* follows. With the same settings, light entrance is blocked in front of the camera and a 'black' image, *B*, is captured, corresponding to the dark current of the camera.[1]

Intensity normalization is performed independently for each spectral image and for each pixel *x* as:

$$I_i(x) = \frac{Q_i(x) - B_i(x)}{W_i(x) - B_i(x)}$$

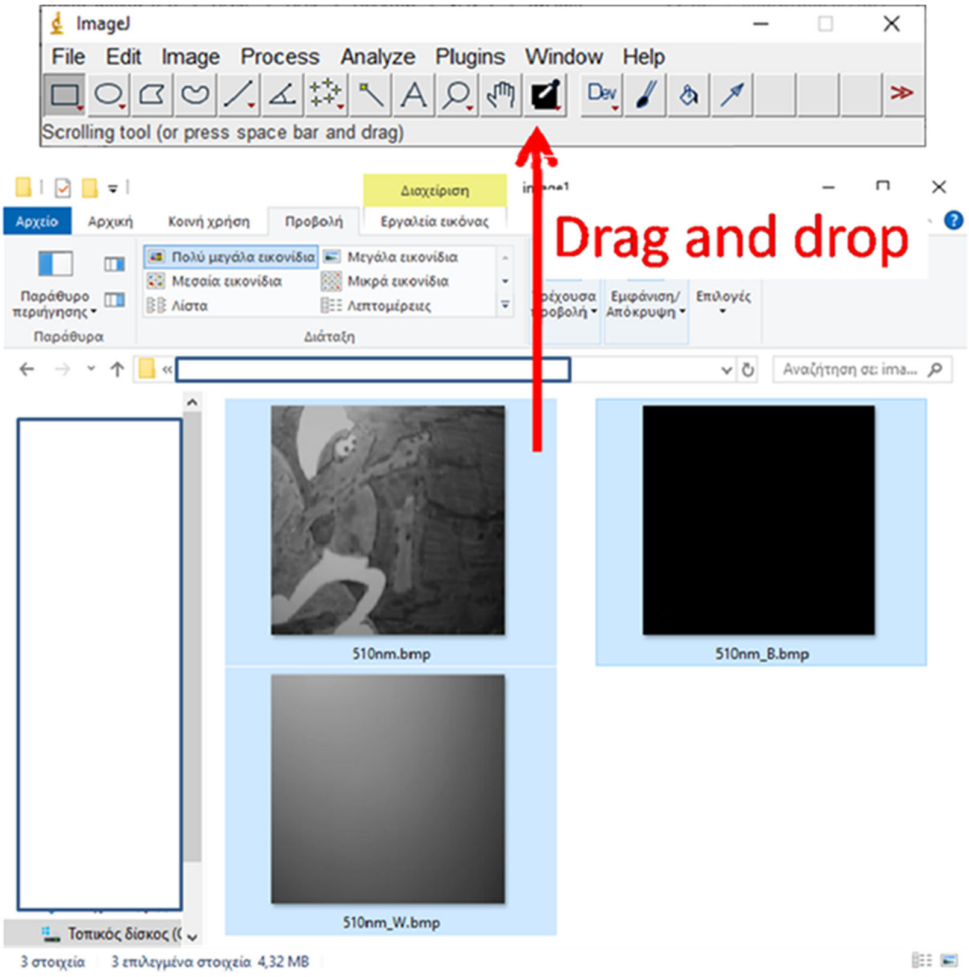
The procedure for image manipulation is done with the free, open-source, software ImageJ.

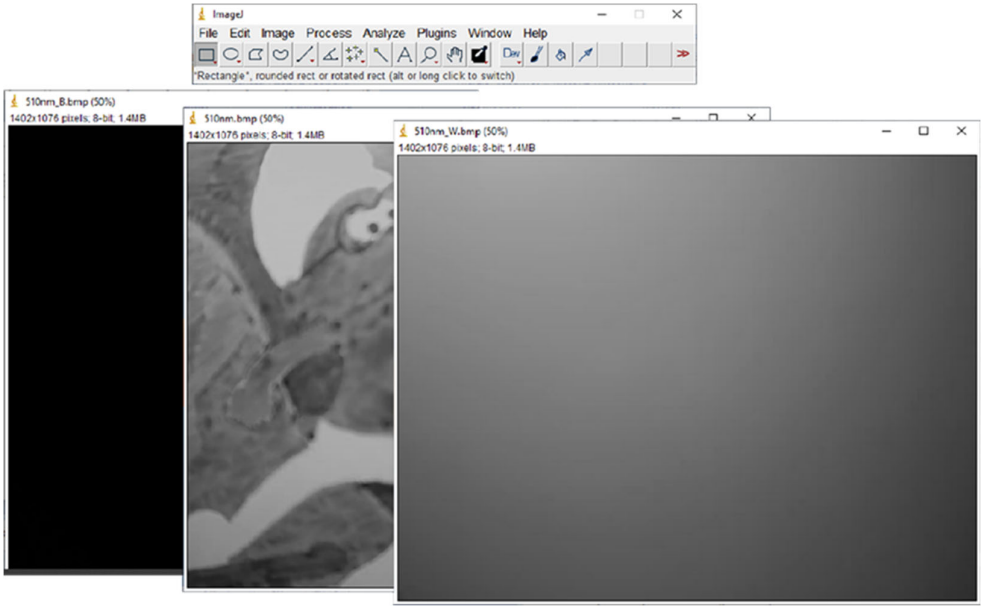


Procedure

Step 1

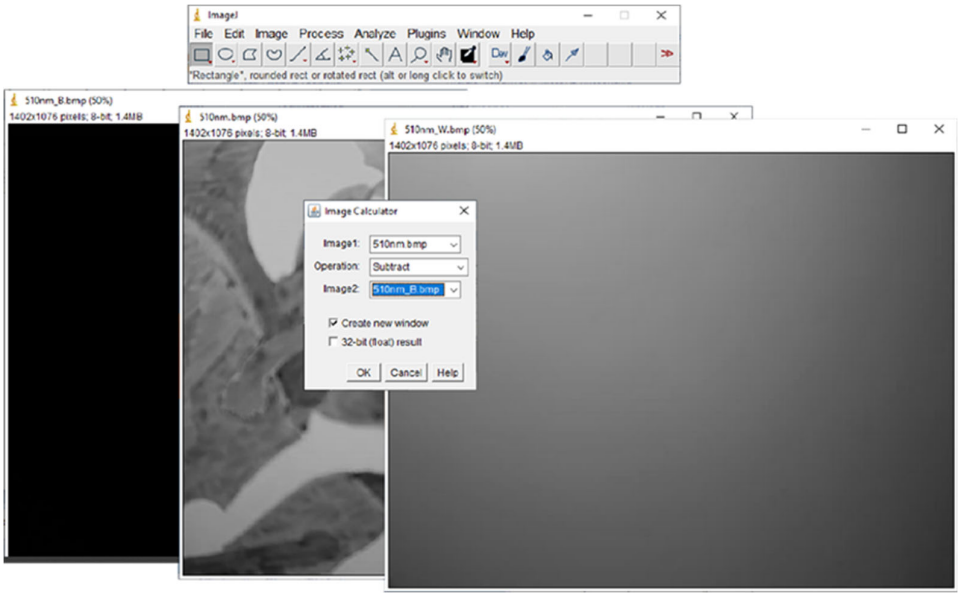
For each wavelength (filter), drag and drop the three image files into ImageJ (white, picture, black).





Step 2

To remove the noise (black image) from our painting, go to Process→Image Calculator. A small window will pop up.



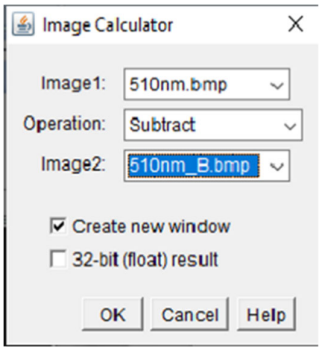
Step 3

Image 1: the image of the painting.

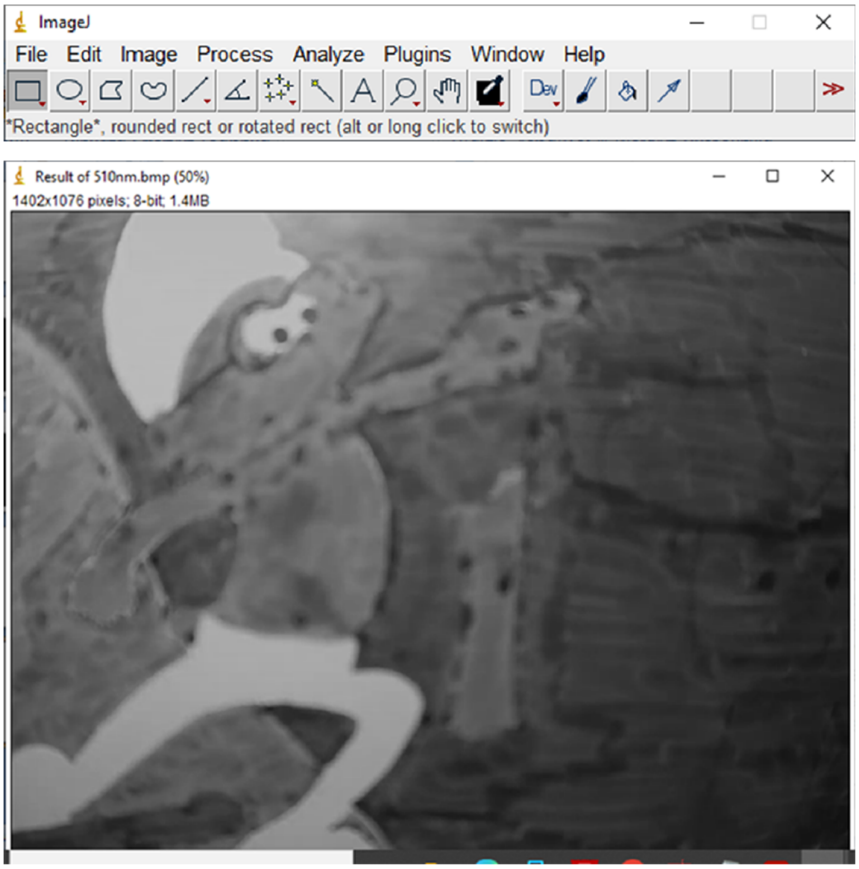
Image 2: the black image.

Operation: subtract.

Click OK.

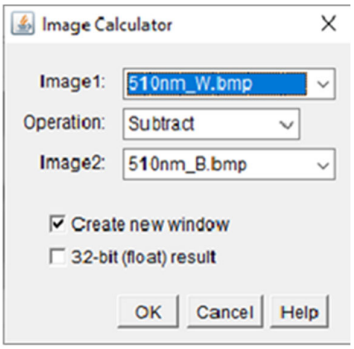


The result of this manipulation will be shown in a new window with a new image name.

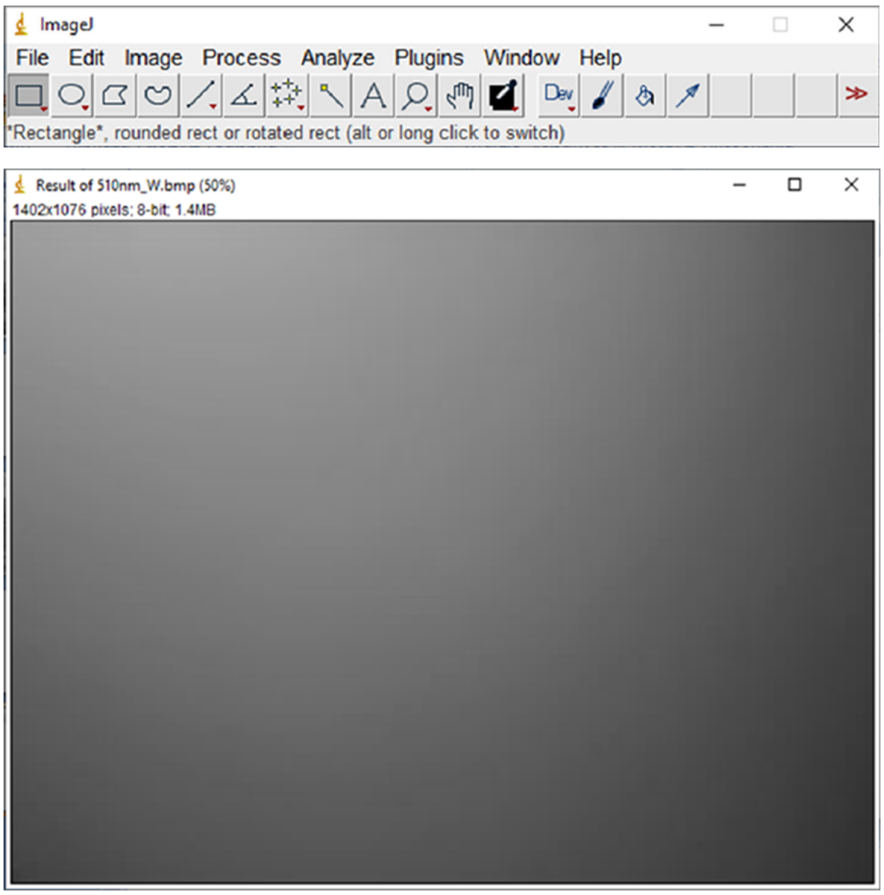


Step 4

To remove noise from the white image, select again Process->Image Calculator. And in the small window, select the white image as Image 1.



The result of this manipulation will be shown in a new window with a new image name.

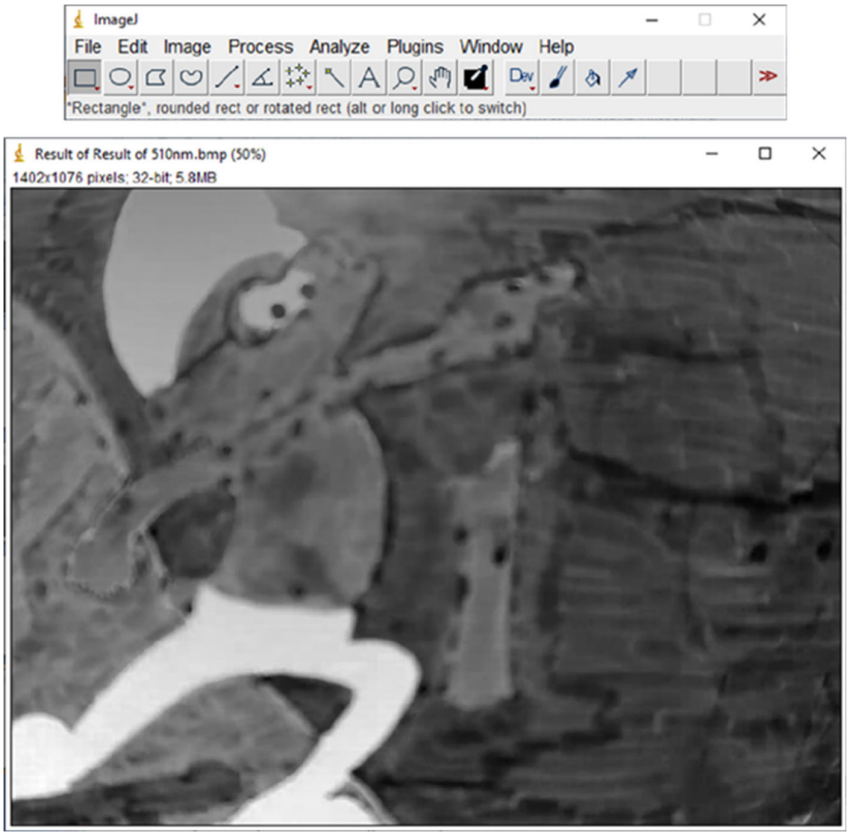


Step 5

To get the normalized image, select again Process→Image Calculator. And in the small window, select the Result of the manipulation of the painting as Image 1 and the result of the manipulation of the white image as Image 2. As the operation, choose Divide and select the option "32-bit (float) result".

Step 6

The normalized image will pop up. You can save this image by selecting File→Save as→BMP. It is good practice to save all normalized images in a specific folder. You can follow these steps for each wavelength (filter) to get all normalized images.



References

[1] Zacharopoulos A et al. (2018) A method for the registration of spectral images of paintings and its evaluation. *Journal of Cultural Heritage* **29**: 10–18. doi: 10.1016/j.culher.2017.07.004