MS-SSIM INDEX: a plugin written in Java for ImageJ.

USER'S MANUAL.

To install this plugin, simply copy the file "MS_SSIM_INDEX.class" into the "plugins" folder of ImageJ (1). This folder is automatically created after the installation of ImageJ, under the "ImageJ" folder. You will need to restart ImageJ to use this plugin. After restarting, open the menu option "Plugins" and you will see a new option, "MS_SSIM index".

Preconditions:

1. Two images must be open simultaneously (i.e., Figure 1) with ImageJ (Ver 1.41o or higher). Do not worry about the format: DICOM, TIFF, JPEG, etc. The plugin works with the memory map of the computer, not with the stored files

2. Both images must have the same dimensions and gray levels: 8, 16 or 32.
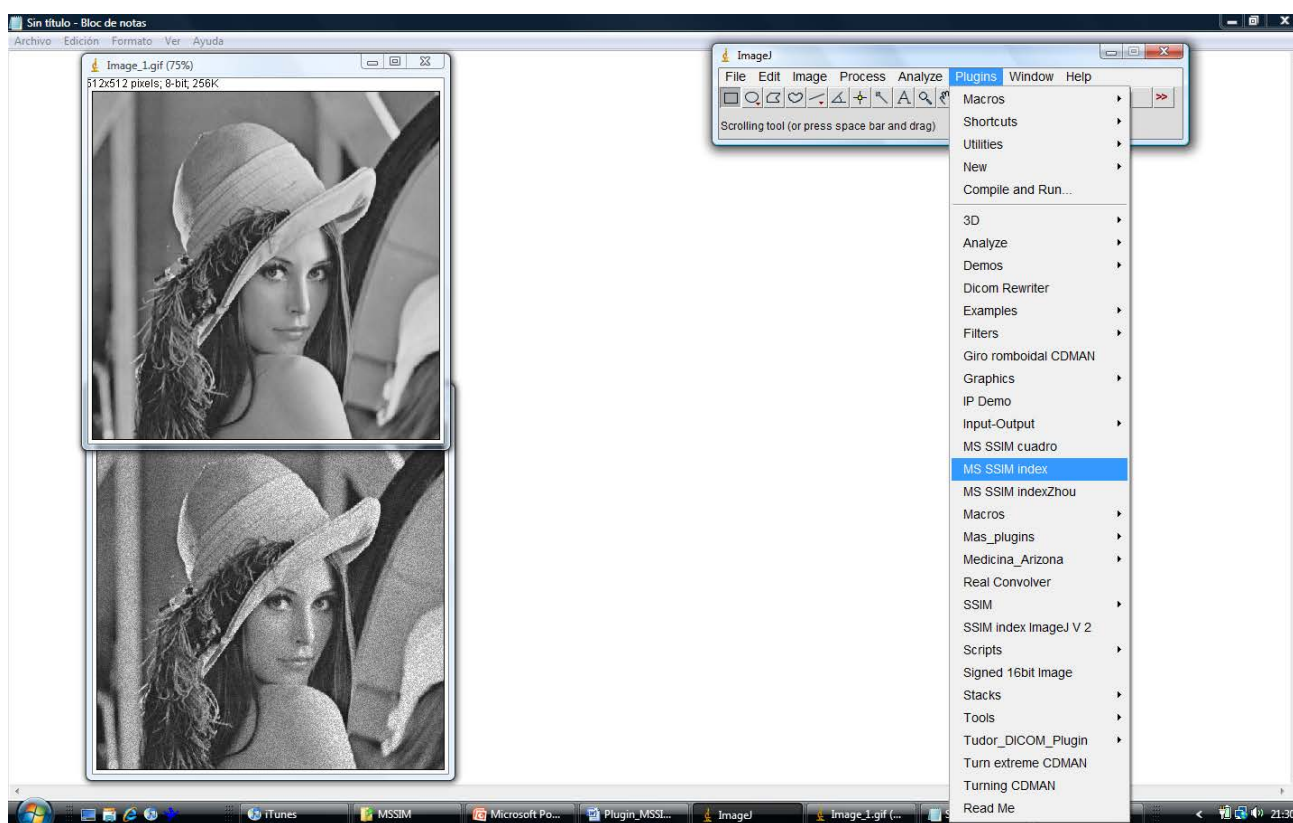

Figure 1

Under the menu option "Plugins", you will find the option "MS_SSIM index" (see Figure 1). Select it. The next dialog box will appear (Figure 2):
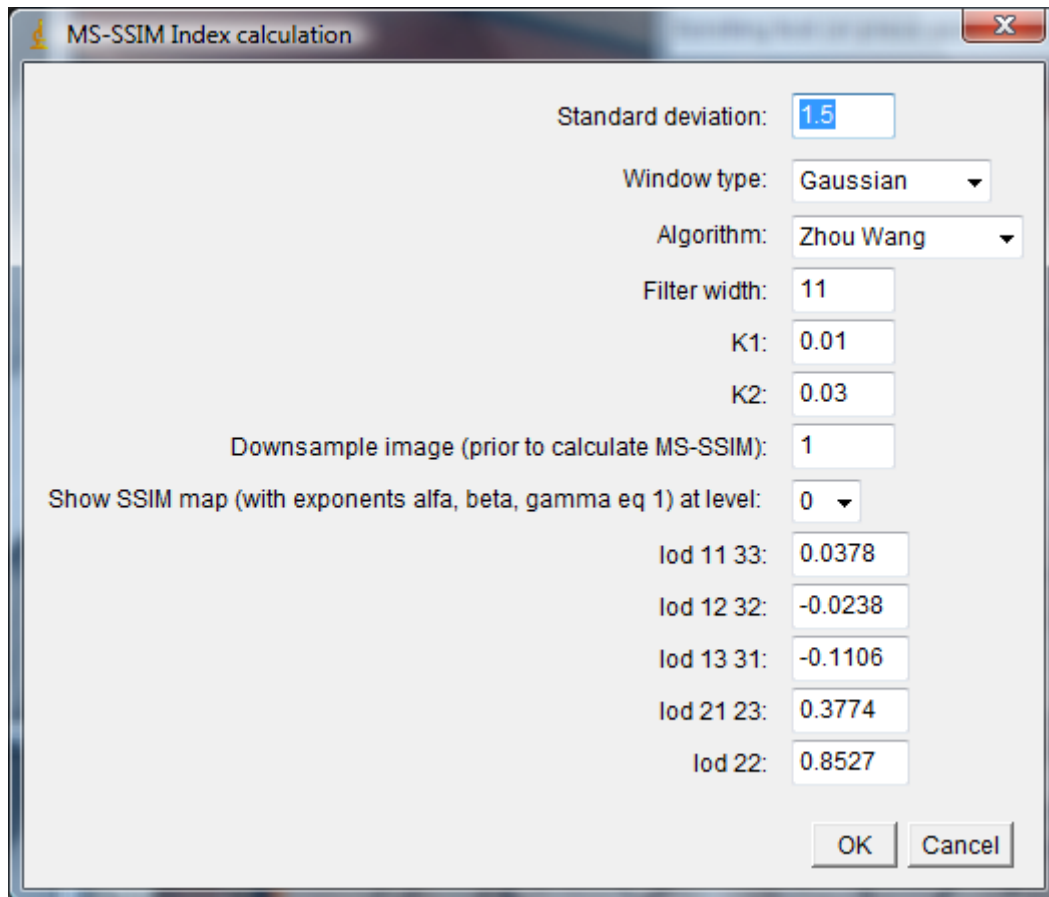
Figure 2

Standard deviation. In (2), standard deviation is the value of sigma for the gaussian filter we need to use to evaluate the index in the local window to avoid blocking artifacts. You can change this value.

Window type. It has two values, "Gaussian" or "Media". In spite of the fact of the "blocking" problem in (2) if MS_SSIM index is computed with a square window with the same weights for all the cells, you can calculate the index with this option.

Algorithm. This plugin calculates two kinds of MS_SSIM index: one for the supra-threshold problem (MS_SSIM by Zhou Wang in (3)) and another one for the recognition threshold problem (MS_SSIM* by Rouse/Hemami in (4)). You can select one of them from the drop down list.

Filter width. It is the width of the square window which moves pixel-by-pixel over the entire image n (2). Some authors change this value between 7 to 15 pixels.

K1 and K2 are constants C1 y C2 in (2) to avoid instability in the calculation of SSIM and MS_SSIM index. Their value is irrelevant if you are calculating the MS_SSIM* index in (4).

Downsample image. If you want to downsample both images before calculating MS_SSIM or MS_SSIM* index. The number entered is the downsampling factor.

Show SSIM map. It displays the SSIM map in a new window. It is very useful to analyze the difference between the images you are measuring. Black pixels mean no difference. White pixels indicate maximum difference (see figure 3). You can select the downsampling scale you want to

show the differences. If you select "0", no SSIM map will be displayed. Alfa, beta and gamma are described in (3) and (4). Their value is "1" to calculate this map.

This box is only an option. For instance, you can show the SSIM map at level 3. This means that both images will be downsampled by a factor of 3 before calculating and showing the SSIM map, but the calculation of MSSIM index will be done according to the scale entered in the previous box "**Donwnsample image**".
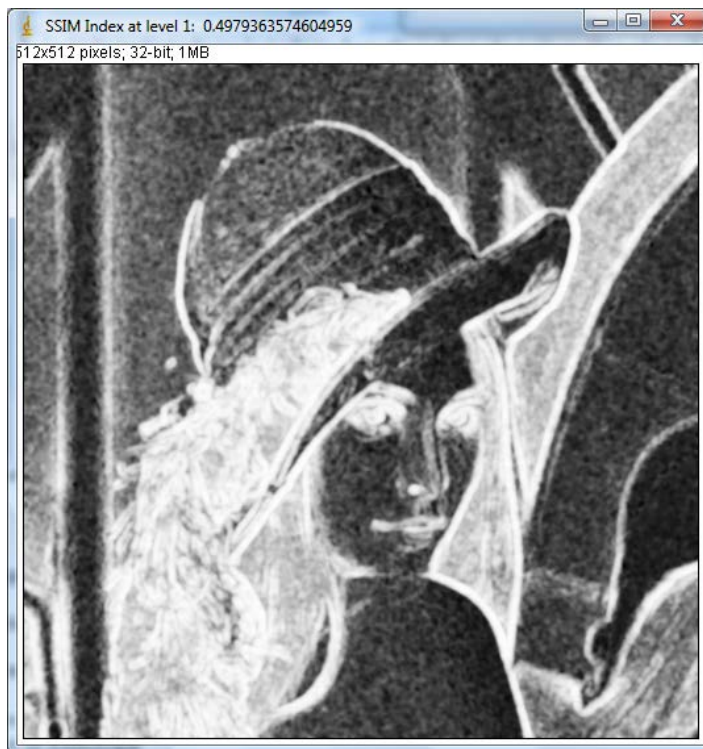
Figure 3

Lod. These indexes are the values of the low pass filter you need for processing the image in (3) and (4). In our algorithm, we have used the low pass filter described in (4), but there is no big difference between the results obtained with this filter and the filter proposed by Mr. Wang in (3) (see https://www.ucm.es/data/cont/media/www/pag-58296/Archivos/Comparisson.pdf). In Table 1 you can see the mask we use for the low pass filter and the position of each index, according to (4).

Lod 11	Lod 12	Lod 13
Lod 21	Lod 22	Lod 23
Lod 31	Lod 32	Lod 33

Table 1

The home page related with this plugin is https://www.ucm.es/gabriel_prieto/ms-ssim

For any question, please, email to gprietor@med.ucm.es

Thank you very much.

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References:

1. Rasband, Wayne S., ImageJ, U. S. National Institutes of Health, Bethesda, Maryland, USA, http://rsb.info.nih.gov/ij/. 1997-2007. 24th january 2009.

2. Z. Wang, A. C. Bovik, H. R. Sheikh, and E. P. Simoncelli, "Image quality assessment: From error visibility to structural similarity", IEEE Trans. Image Processing, vol. 13, pp. 600–612, Apr. 2004. http://www.ece.uwaterloo.ca/~z70wang/publications/ssim.html

3. Z. Wang, E. P. Simoncelli, and A. C. Bovik, "Multi-scale structural similarity for image quality assessment, in Proc. of the 37th IEEE Asilomar Conf. on Sig., Sys. and Comp., (Pacific Grove, CA), Nov. 2003. http://www.ece.uwaterloo.ca/~z70wang/publications/msssim.html

4. David M. Rouse and Sheila S. Hemami, "Analyzing the Role of Visual Structure in the Recognition of Natural Image Content with Multi-Scale SSIM", Proc. SPIE Vol. 6806, Human Vision and Electronic Imaging 2008. http://foulard.ece.cornell.edu/publications/dmr_hvei2008_paper.pdf

5. Z. Wang. Zhou Wang's homepage. Dept. of Electrical & Computer Engineering. University of Waterloo. Waterloo, Ontario, Canada. http://www.ece.uwaterloo.ca/~z70wang/ 24th january 2009.

6. H.R. Sheikh and A.C. Bovik, "Image information and visual quality," *Image Processing, IEEE Transactions on*, vol.15, no.2pp. 430- 444, Feb. 2006.

7. H.R. Sheikh, M.F. Sabir and A.C. Bovik, "A statistical evaluation of recent full reference image quality assessment algorithms", *Image Processing, IEEE Transactions on,* vol. 15, no. 11, pp. 3440-3451, Nov. 2006.

8. Z. Wang and A.C. Bovik, "A universal image quality index," *Signal Processing Letters, IEEE*, vol.9, no.3pp.81-84, Mar 2002.

The sample images used in this web have been extracted from Zhou Wang's page "Lena image with different type of distortions", http://www.cns.nyu.edu/~zwang/files/research/quality_index/demo_lena.html

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