# Sefexa Image Segmentation Tool

What is the Tool about

Sefexa is a free semi-automatic tool for the segmentation and analysis of images. Segmentation is the process of splitting an image into two parts, e.g. objects of interest (bacteria, fruits, etc.) and the background. This application allows you to *automatically segment an image* and *modify the segmentation manually.* The way it works is simple; you load an image into the application and then you mark some pixels as objects of interest (foreground) or as background in a similar way to "drawing" in some common paint applications by using delete/erase/fill operations. Once you are happy with the segmentation, you can start e.g. counting segmented objects and exporting statistics like object sizes into Excel, or just save the segmentation and go on to the next image.

Loading of an Image

In order to start the segmentation process, the image to be segmented has to be loaded into the application first. There are multiple ways to load an image. You can 1) click on the "Load Icon", or 2) Go to Menu → File → Open, 3) Press CTRL-O, or 4) Start the application and drag and drop the image into the image area. Options 1 and 2 are shown in the screenshot below.
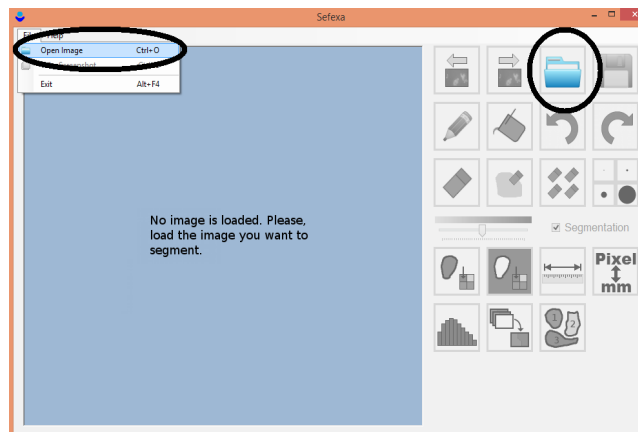
When the application starts, the image from your previous run is loaded automatically. The application supports the following image formats: BMP, GIF, EXIF, JPG, PNG and TIFF. The two icons left from the "Load Icon" in the screenshot above can be used for a quick navigation to the previous or next image in the same directory as the currently loaded image. Note that once you have loaded an image, a lot of icons get activated (i.e. the icons are no more "grayed" as they get enabled).
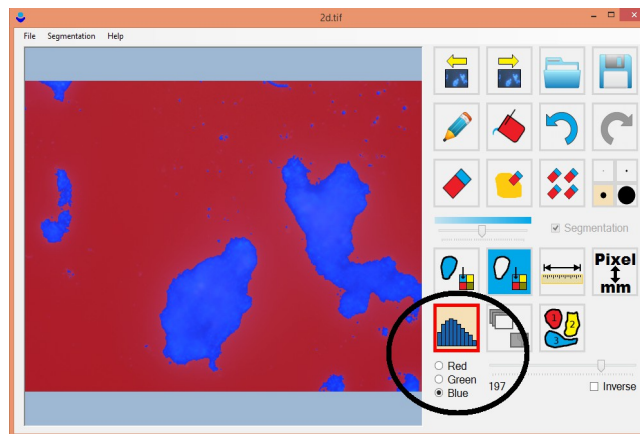
Manual Segmentation

Once you have loaded an image, you can start the segmentation. You segment in a similar way as you draw in applications like Microsoft Paintbrush. You can draw/erase below cursor, erase a whole object, erase everything, fill an area, and undo/redo using the icons in the screenshot below. Just click on the corresponding icon and start the editing by moving the mouse while simultaneously keeping your mouse button pressed (left button for the foreground, i.e. for the required objects, and right button for the background). SHIFT+Left mouse button can also be used to mark the background. The example in the screenshot below shows both foreground and background areas (in blue and red respectively). You can change the foreground/background colors and their opacities by using the icons in the screenshot below.
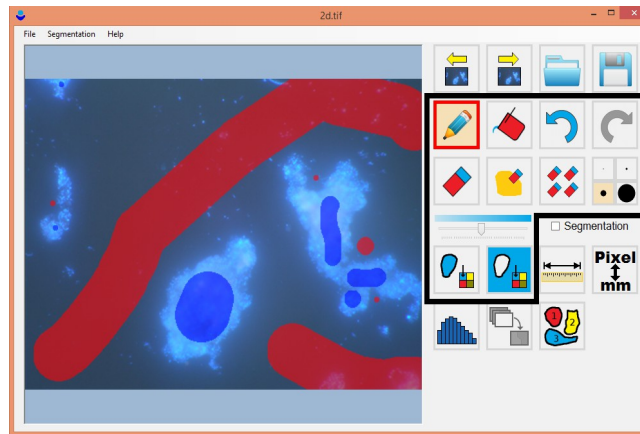
Threshold based Segmentation

For some images, the objects of interest can be separated by selecting a *threshold*. The tool supports a threshold based segmentation. You can select the threshold and the color channel for thresholding (red, green, blue) using the functionality shown in the screenshot below:


If you need to create a threshold in the "opposite direction", i.e. you need to switch the background and the foreground, you can do this by checking the checkbox "Inverse".

It may happen that you are not happy with the threshold based segmentation in some places. That's fine, you can manually edit the segmentation in the same way as described in the Manual Segmentation (e.g. by drawing/erasing etc.). Indeed, the threshold segmentation can be used to make just a rough segmentation while the final result gets created by subsequent manual corrections.

Automatic Segmentation from Partial Manual Segmentation

You don't have to segment manually the whole image, only some parts of background and foreground areas are required to segment the remaining areas in the image *automatically*. If you turn the automatic segmentation on (see the checkbox in the screenshot below), all unmarked areas get segmented. The segmentation of the unmarked areas is shown in semi-transparent colors. You can continue to edit the segmentation (e.g. by drawing/erasing etc., see Manual Segmentation), and the whole segmentation gets recomputed on the fly.
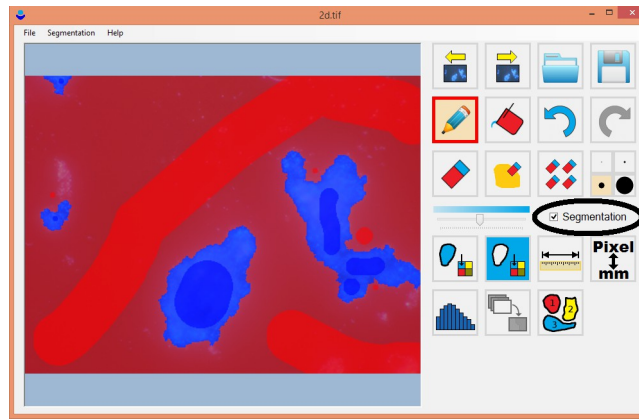
Automatic Segmentation from Segmentation Model

Another possibility to get automatic segmentation is to create a *segmentation model*. Once you (partially) segment one or more images (e.g. see the left screenshot below), you can create a segmentation model by Menu → Segmentation → Train Segmentation Model. The application takes all the segmented images in the current image directory and use their segmentations to create a segmentation model that can be used to segment a completely new image.
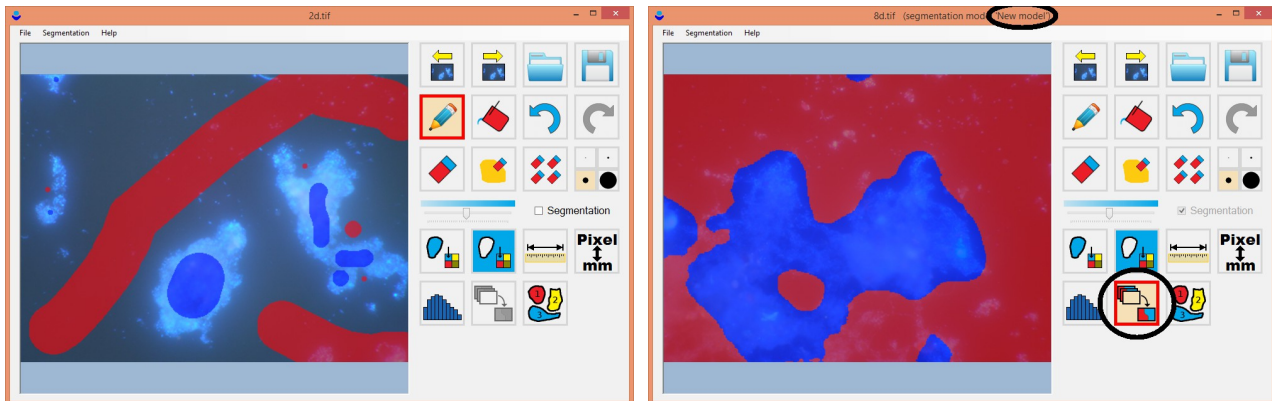
The right screenshot above shows use of a segmentation model "New model" computed from the segmentation of the left image. You can edit or undo the automatically created segmentation manually (e.g. by drawing/erasing etc., see Manual Segmentation), but you do not have to if you are already happy with the automatic segmentation.

The trained segmentation model can be stored in Menu → Segmentation → Save Segmentation Model. The stored model is loaded automatic at the next application run. You may create, store and load an unlimited amount of segmentation models (e.g. one to segment apples, another one for peaches etc.). However, it should be noted that the images used for training should be similar to the new ones you want to segment. Note that multiple images can be segmented at once using Menu → Segmentation → Segment All Images.

Saving of the Segmentation

You can save the segmentation by clicking the diskette icon in the upper right corner, or going to Menu → File → Save, or by CTRL-S. The segmentation is not saved into the original image (the original image is never modified), but in a subdirectory named *segmentation*. For example, if you segment an image "*c:\images\image1.png*", then the segmentation is stored in "*c:\images\segmentation\image1.png*". The image with the segmentation contains just three colors; black for the background, white for the segmented objects, and gray for unclassified regions.

If you want to save the original image together with the overlaid segmentation exactly as shown in the application, then you can do it by going to Menu → File → Screenshot, or by CTRL-E.

Object Statistics

This application allows you to measure some basic statistics of the segmented objects. You can measure distances using the "ruler icon" (see the left screenshot below). To do this, click on the point where you want to start to measure, and while holding the mouse left button down, start to move the mouse to the point where you want to end the measure, and finally release the left mouse button. The measured distance is shown in the lower right corner. The distance is measured in the user unit and with the specified scale. You can change the user unit and the scale (i.e. the size relation between a single pixel and the user unit) using the "scale icon" (i.e. the Pixel ↔ mm icon, see the left screenshot below).
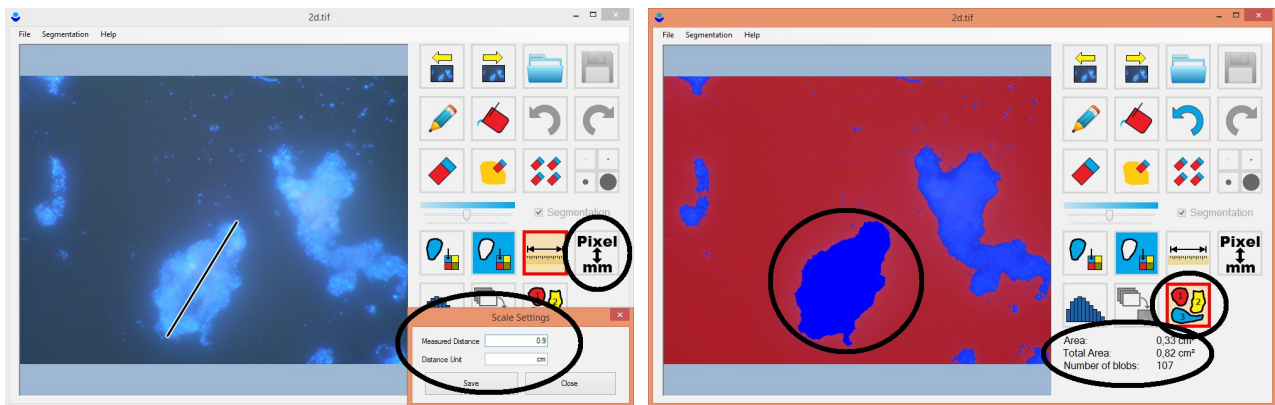
You can also measure object sizes (see the right screenshot above). Area is the size of the object (i.e. the connected component) where the mouse cursor is currently located. Total area is the area of all objects in the image together. Number of blobs is the total number of objects in the image.

Statistics of all images in the same directory as the current image are shown by going to Menu → Analysis → Object Statistics.

A single object is represented by a single row. Statistics like object size, center, and the bounding box (represented by minimal/maximal X/Y coordinates, in pixels) are computed. The result can be exported into .xlsx (Excel).

Further Questions?

If you have any questions, please, do not hesitate and send us an email to sefexa@fexovi.com. We are very happy for any questions, comments, bug reports or suggestions.