2D-SIFT in 3D space volume stitching user manual

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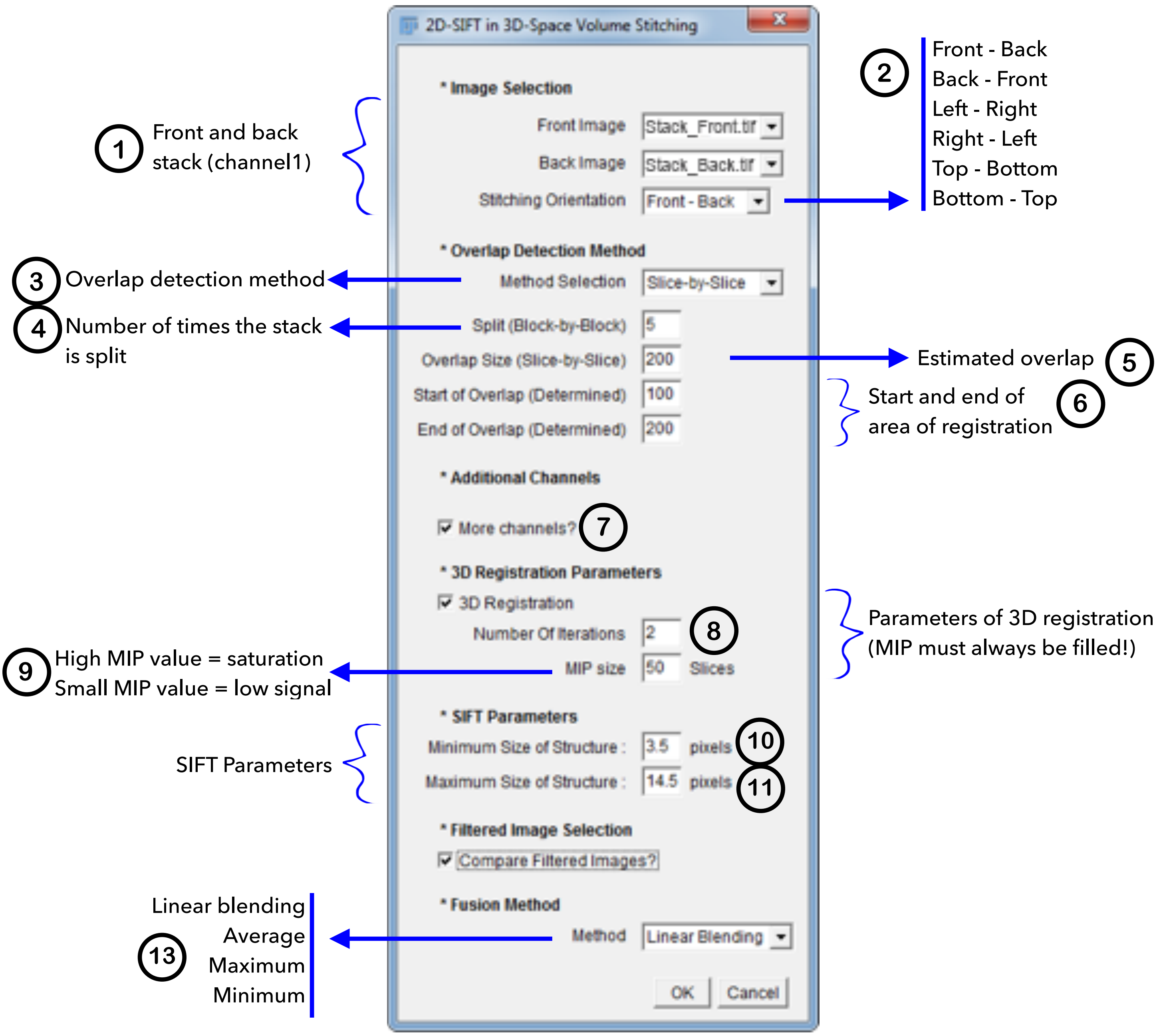
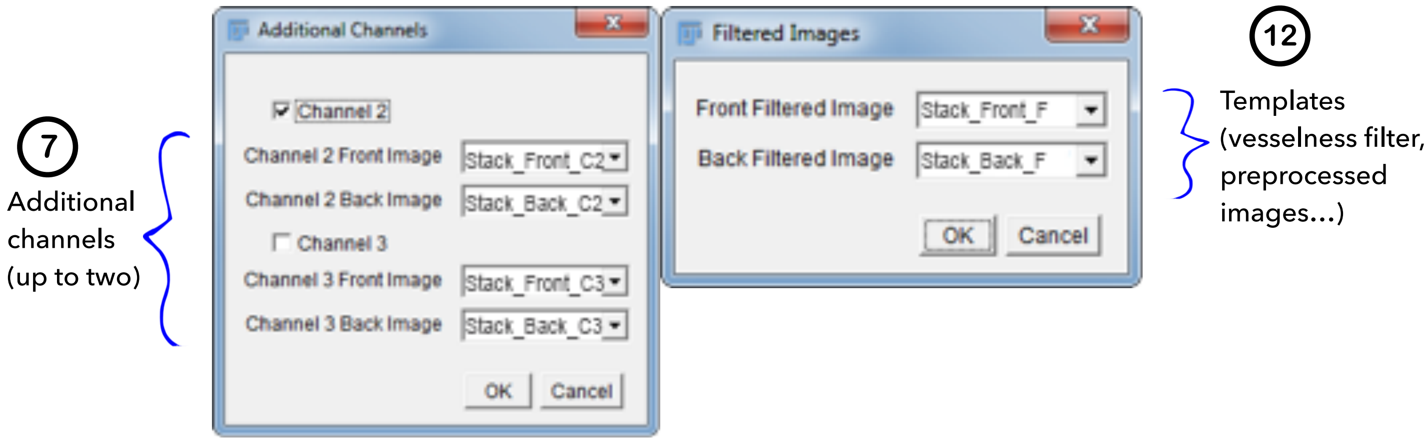
1. Introduction

This plugin has been designed for the registration and the stitching of two tilted half image stacks from the same sample. The registration is an iterative procedure described in (paper) based on the matching of SIFT local descriptors developed by Lowe (1999, 2004).

2. User interface





3. Interface description

1. Image stacks to be registered
2. Splitting orientation: "Front - Back" uses the first image as the front image and the second one as the back image. Similarly is "Left – Right" is selected the second image will be stitched to the left of the first one. The available stitching orientation are: Front – Back; Back – Front; Left – Right; Right – Left; Top – Bottom; Bottom – Top.
3. Overlap detection method: slice-by-slice, block-by-block or Determined
4. Split: Number of times the stack is splitter for the block-by-block detection method. To choose an accurate splitting parameter, the user may refer to the following table.

Split	Feature and suggested situation
1	Slow computation, this value should be used only in case of big tilting
2	Fastest splitting parameter, to be privileged unless the sample meets one of the other condition of this table
5	Slower than splitting parameter 2 but better estimation of the overlap position. This value must be used if the computed overlap position is too far from the real one
Number of sections in the substance	Same as slice-by-slice overlap detection. This must be used with a small number of iterations in case of small tilting for a very precise overlap detection

5. Overlap size: estimation of the number of slices within the overlap to reduce the computation time of the slice-by-slice comparison method.
6. Start/End of overlap: estimation of start/end of area of registration after quality measure to reduce the computation time of the slice-by-slice comparison method.
7. Additional channels: as a scientist often wants to analyze multichannel images, this plugin offers the possibility to apply the transformation model computed from the previous images to up to two extra channels.

- 3D Registration parameter: Our plugin can be used in 2D for non-tilted images or in 3D for tilted images.

8. Number of iterations: number of loop of the algorithm
9. The MIP size must be chosen as a trade-off between computing time and quantity of signal on the partial MIP image. By increasing this value the computation will be faster but a signal saturation in the partial MIP image will lead to a decrease of accuracy.

- SIFT parameters: The following parameters are used for the transformation model computation.

10. Minimum size of structure: size of the smallest structure within the area of registration (bloc, estimated overlap, estimated area of registration)
11. Maximum size of structure: size of the biggest structure within the area of registration (bloc, estimated overlap, estimated area of registration)
12. Filtered image selection: according to the purpose, the user might want to register data not perfectly suitable for this software method (low or sparse signal...). Pre-processing (contrast, intensity enhancement, filters...) can help to improve the quality of registration, but might not be needed for further study. In this case, the user can apply those transformations on the working images: the registration model will be computed using those files and applied to the image stack channel 1 to 3.
13. The fusion method: four fusion methods are available (linear blending, average, minimum and maximum) and must be carefully chosen by the user to preserve the continuity at the stack seam.

4. References

Lowe, D.G. (1999). Object recognition from local scale-invariant features. Proc. of the International Conference on Computer Vision.

Lowe, D.G. (2004). Distinctive image features from scale-invariant keypoints. International Journal of Computer Vision, 60(2), 91-110.

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