Depict v1.0 Manual

April 3, 2017

1 Requirements

Depict v1.0 requires:

- MATLAB (R2015a or successive versions)
- SPM12 (Wellcome Trust Centre for Neuroimaging, London, UK)
- g++ ($>$ 4.7)
- openmp (optional, required for rapid performance)

2 Installation

- Download the Depict package from GitHub:

```
michele@debian~$ git clone https://github.com/micheleallegra/Depict
```

- Go to your local SPM12 directory:

```
michele@debian~$ cd spm12
```

- Go the subdirectory Toolbox and create a directory for Depict:

```
michele@debian~/spm12$ cd toolbox
michele@debian~/spm12/toolbox$ mkdir Depict
```

- Copy the files from the GUI_Code subdirectory in the Depict direcotry to the SPM12/tooolbox directory:

```
michele@debian~/spm12/toolbox$ cp -r ~/Depict/GUI_Code\(DEPICT\)/*
./Depict/
```

- Go the Depict subdirectory and run the compilation scpit.
  - If you have openmp, execute the compile.sh script:

```
michele@debian~/spm12/toolbox/$ cd Depict
michele@debian~/spm12/toolbox/Depict$ ./compile.sh
```

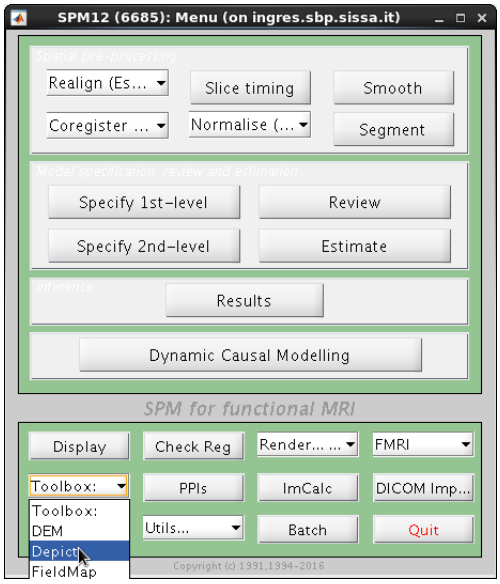
- If you do not have openmp, execute the compile_nomp.sh script:

```
michele@debian~/spm12/toolbox/$ cd Depict
michele@debian~/spm12/toolbox/Depict$ ./compile_noomp.sh
```

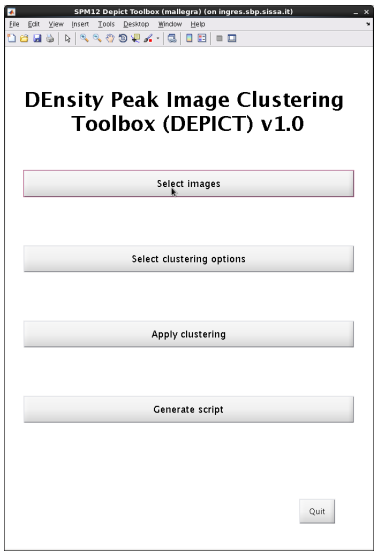
- Now you are ready to use Depict as an SPM Toolbox

3 Basic Usage

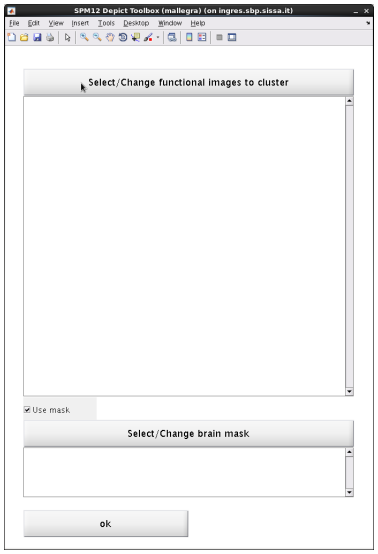
- In SPM12, select Depict in the Toolbox Menu:



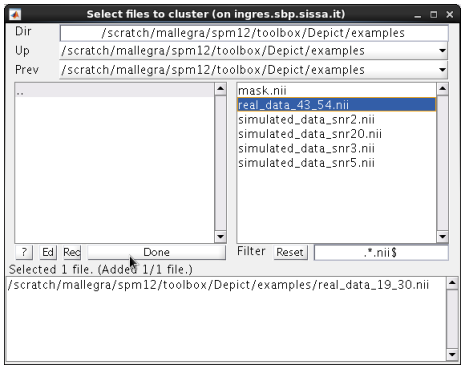
- The Depict Menu will appear. The first step will be selecting images:



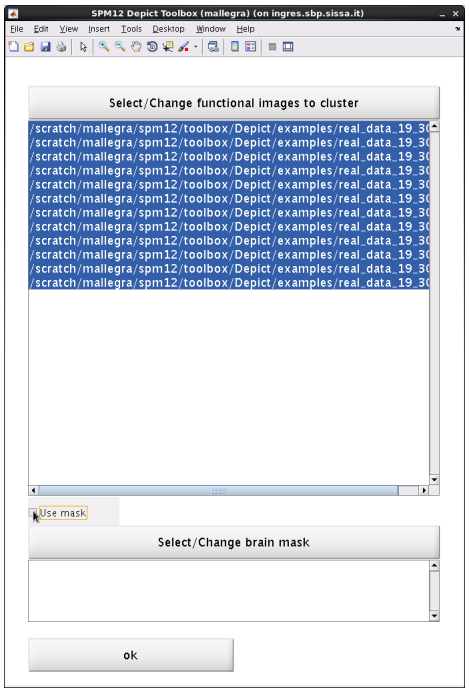
- You should fisrt selecting the functional images to be clustered:



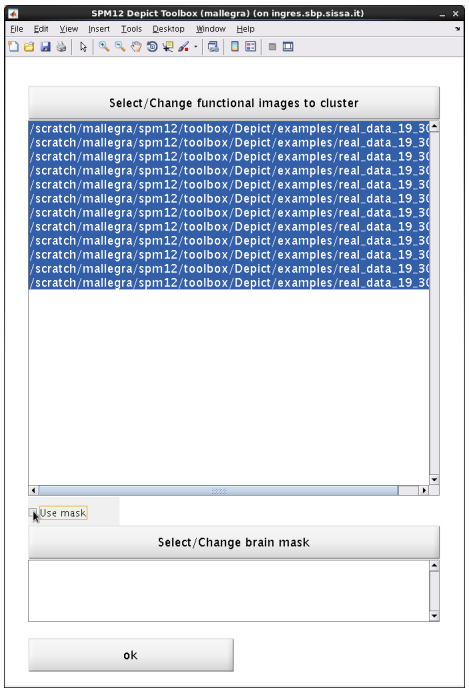
- Select the functional images (either a single 4D nifti or a list of several 3D nifti) and press 'done'.



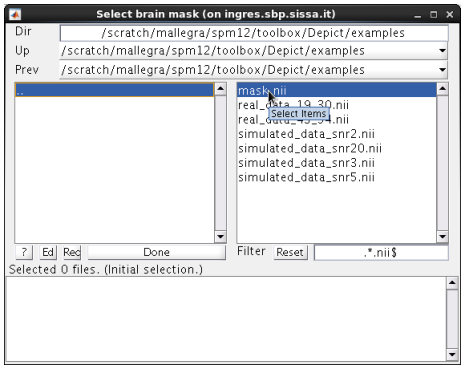
- The second step is to select a brain mask. The brain mask allows Depict to perform clustering only on some voxels in the images (typically, brain voxels or grey matter voxels). If you do not wish to use a mask, you can unselect the "use_mask" option:



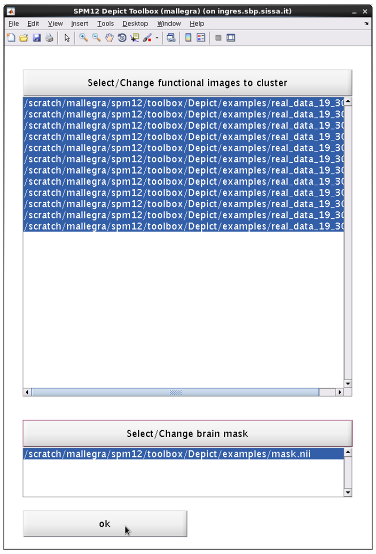
- Otherwise, select a mask. The mask must be a 3D nifti file with the same voxel number and sizes as the functional images. If you have a structural image of the subject, you can use the SPM "coregister" and "imcalc" tools to create a suitable brain mask.



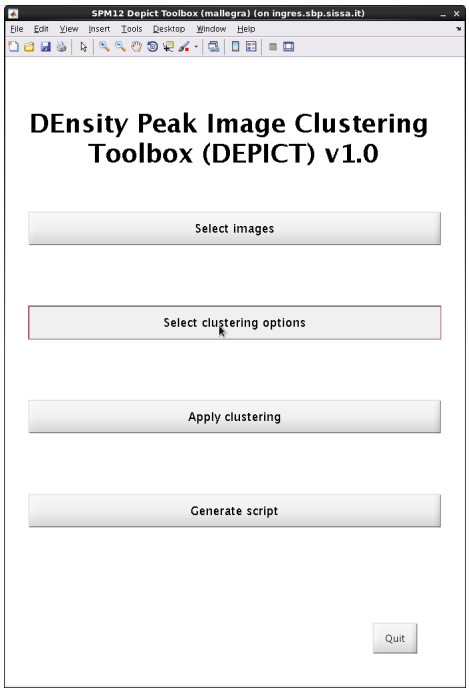
- Select the mask nifti and press 'done'



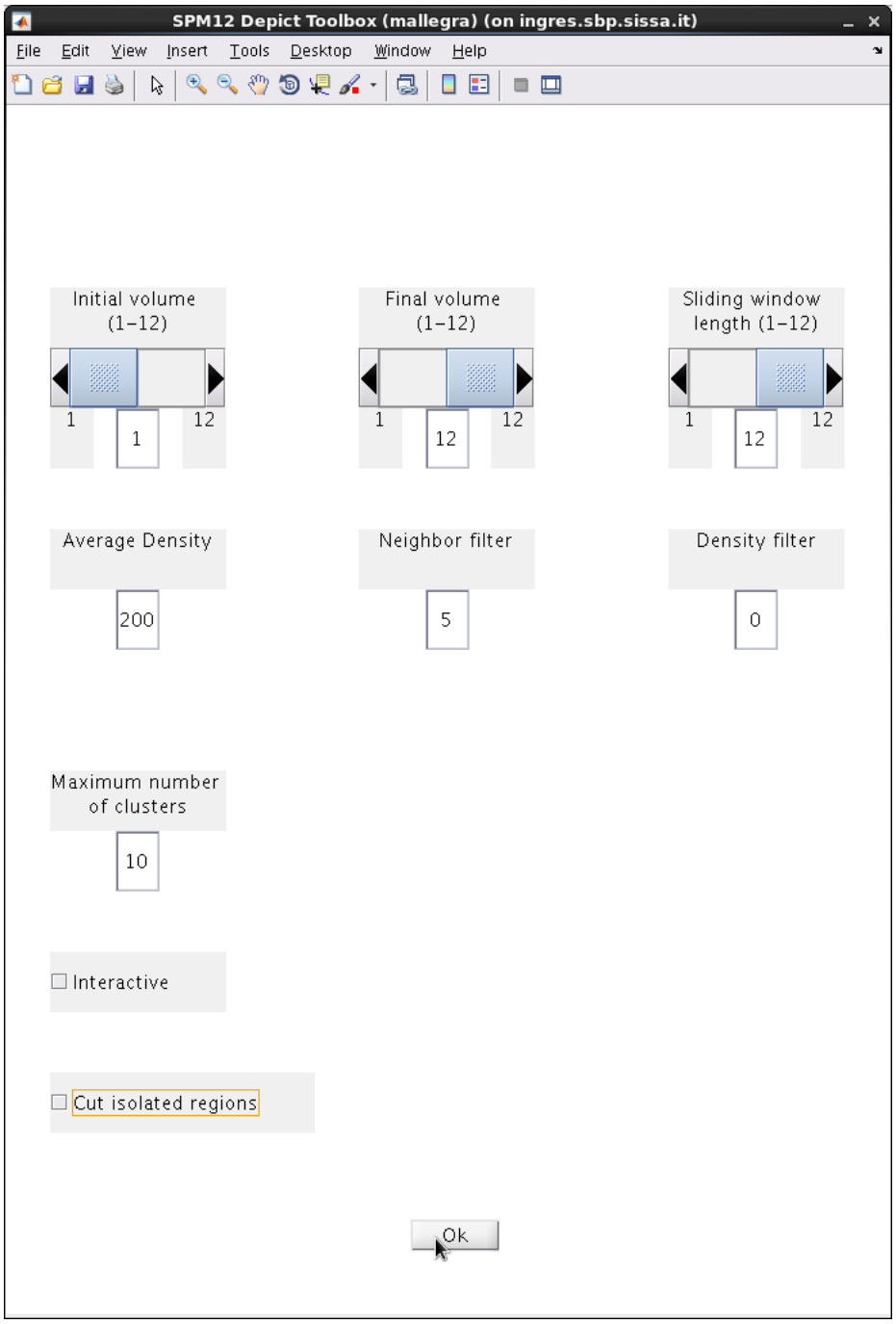
- Then press OK



- You can now regulate the clustering parameters

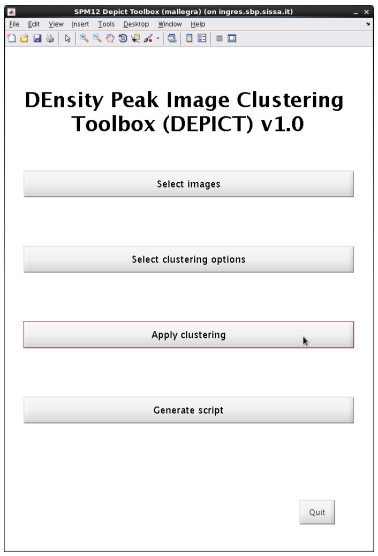


- Here you can tune a few parameters for the clustering:
  - **initial volume** and **final volume** are the first an last image to cluster, **sliding window length** is the length of the sliding window. For example, if *initial volume=1*, *final volume=20*, *sliding window length=12*, Depict will apply clustering to the chosen with sliding windows 1-12, 2-13, ..., 9-20.
  - **average density** regulates the computation of the density ρ, tuning the d_c for the density in such a way the average density is equivalent to a fixed value. A good value is *average density=200* and is advised not to change this parameter.
  - **neighbor filter** regulates the computation of the density ρ, by removing points that do not have a fixed number of spatially close voxels among the similar ones. Good values are *neighbor filter=4* or *neighbor filter=5* and is advised not to use other values.
  - **density filter** and **maximum number of clusters** determine which points in the decision graph are chosen as cluster centers. Depict will select as clusters centers the M =*maximum number of clusters* points with highest values of δ, excluding points that have $\rho <$*density filter*. Good values are *density filter=0-100, maximum number of clusters=5-10.*
  - **interactive** allows the users to tune the values of density filter and maximum number of clusters in each window upon inspection of the decision graph. Unless the user wants to focus on a single, specific window, it is advised not to use the interactive mode.
  - **cut isolated regions** removes from the clusters small groups of isolated voxels. This can be useful for visualization purposes, but unless the user wants to focus on a single, specific window, it is advised not to use this option.

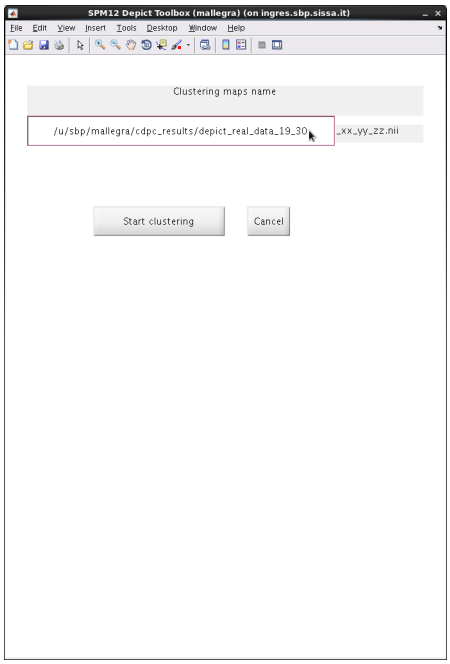


- When you have tuned the clustering parameters, press OK.

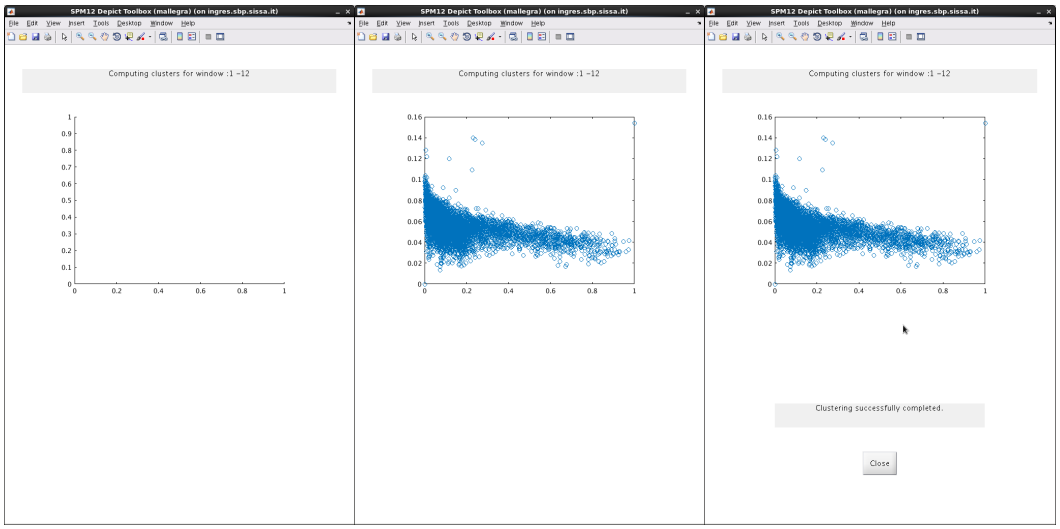
- Now you can proceed with the clustering.



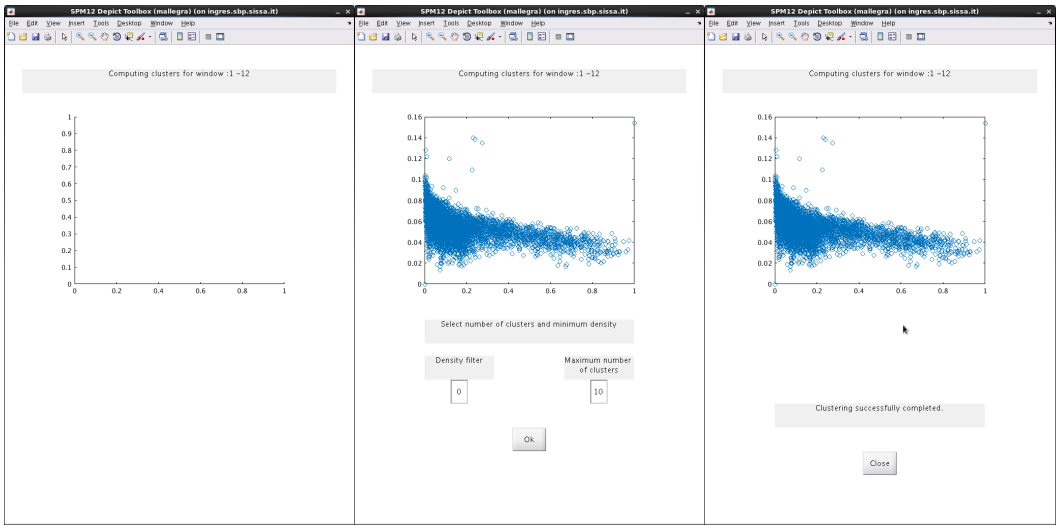
- Fist you have to select the directory and filenames for the Depict results. By default, Depict will save the output files in the same directory as the input, with names corresponding to the name of the input file preceded by "Depict...". You can change this by manually editing the output directory and the prefix of the output filenames.



- Upon choosing the output directory and filenames, press "Start clustering" to preoceed with the clustering. Unless you selected the "interactive" mode, you can wait until the clustering procedure is finished. Each time window will require from one to few ($<$10) minutes, depending on your processor type and whether you have openmp. For each window, the program will show the decision diagram but you will not be asked to perform any action. At the end of the clustering procedure, just press the OK button.

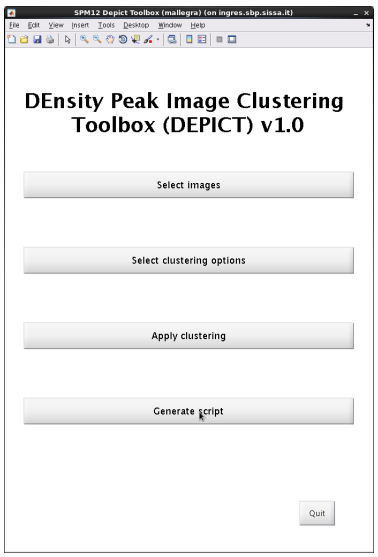


- If you selected the "interactive" mode, you will be asket, for each time window, to manually enter the parameters *density filter* and *maximum number of clusters* upon inspection of the decision graph. Depict will select as clusters centers the M =*maximum number of clusters* points with highest values of δ among those with $\rho <$*density filter*. Upon entering these parameters, press OK.



- The clustering procedure will generate several output files:
  - For each time window, Depict will generate a nifti with the clustering results. For the time window starting with volume *v1* and ending with volume *v2*, the file will have the name "depict_*_map_v1_v2.nii". In this file, image *1* corresponds to cluster *1*, with voxels weighted according to $\rho/\rho_{max,1}$ (the density rho divided by the maximum density of the cluster), and so on for images 2,3,...
  - Depict will generate an "overlap map" with name depict_*_overlap_map.nii". The value of each voxel corresponds to the fraction of time windows in which the voxel is clustered: e.g., if a voxel is clustered in 5 over 50 windows, the corresponding overlap value will be 0.1.
  - For each time window, Depict will generate EPS figures showing the BOLD signal of the voxels assigned to each cluster. These figures have names "depict_*_timecourses_*_*_cl*.eps". In the figure corresponding to cluster i, the red line is the BOLD signals the voxel with $\rho = \rho_{max,i}$, the blue lines red lines are the BOLD signals of voxels with $1 > \rho/\rho_{max,i} > 0.9$, the green lines are the BOLD signals of voxels with $0.9 > \rho/\rho_{max,i} > 0.75$, the grey lines are the BOLD signals of voxels with $\rho/\rho_{max,i} > 0.5$.

- If you click "Generate script" on the main menu, Depict will generate a MATLAB script performing clustering on the chosen images with the chosen options.



- By default, the script will be saved as "depict_script.m" in the same directory as the input files. You can change the filename and directory of the script manually, then press "generate script"