Power Spectrum Slope (PSS) toolkit User Manuel

1. What does PSS toolkit do?

The PSS toolkit will provide estimation for each voxel according to the power spectrum. After image preprocessing (**do not filter the data**), the power spectrum of each voxel's time series was produced via fast Fourier transformation (FFT). The very low frequency (< 0.01 Hz) was filtered out. We set the default upper frequency bin to 0.25 Hz because most of the fMRI data is 2s TR. Before fitting, we divided the power y of each voxel's signal by the average amplitude across the chosen frequency range (from 0.01 Hz to 0.25 Hz) to normalize the scale of power. We computed both the linear coefficient and the slope of power-law fit. For linear coefficient, we used

$$y = bx + a \quad (1)$$

where y is the normalized amplitude of the signal power after FFT, x is the corresponding frequency bin (e.g. from 0.01 to 0.25 Hz) and b is the linear coefficient.

For power-law fit, we used

$$y = a'x^{b'} \quad (2)$$

This equation can be transformed into:

$$\ln(y) = \ln(a') + b'\ln(x) \quad (3)$$

where the slope b' is the power-law slope.

2. How to use PSS toolkit?
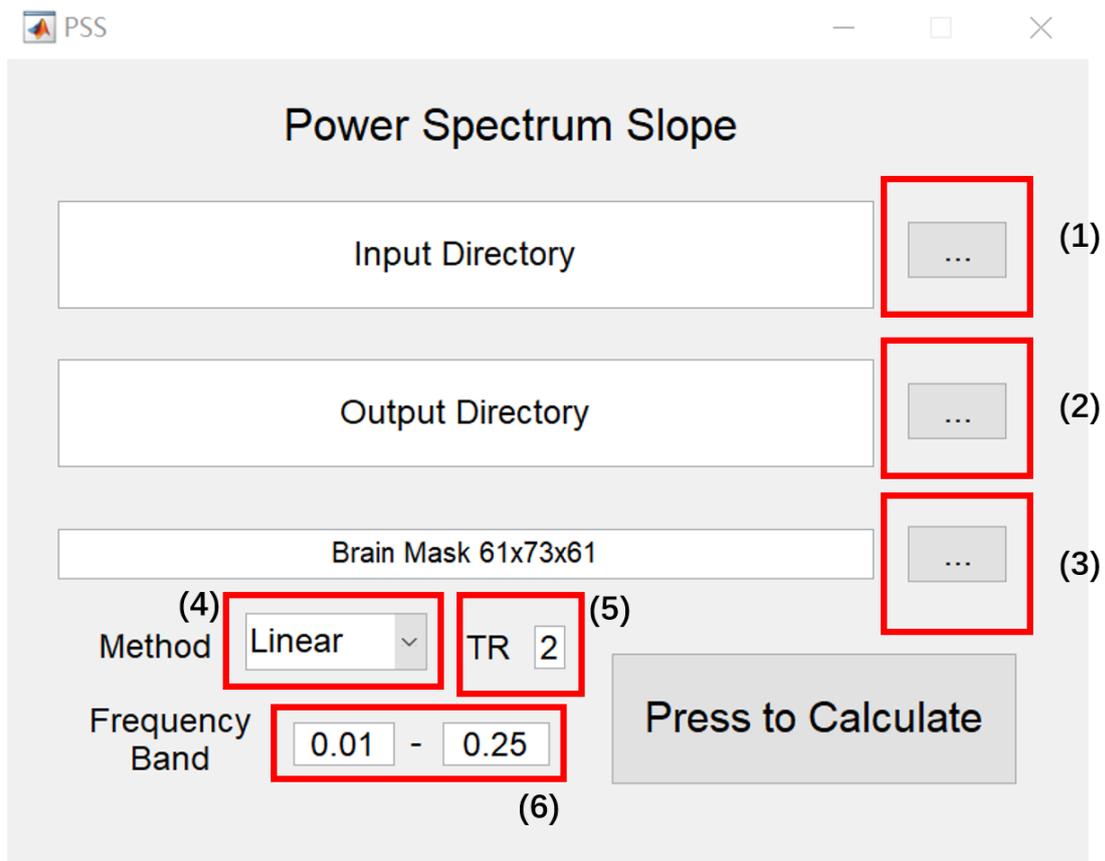
Before clicking the calculate button, make sure to check (1) - (6).

- (1)-Click on the … button and select the **input directory:**

Example D:\PSS\FunImgARWSC\, FunImgARWSC is your input directory.

Arrange folders for each subject's 4-D preprocessed images in the **input directory**. Only one 4-D file is needed for each subject:

- (2)- Click on the … button and select the **output directory. Please make sure the output directory is empty.**

- (3)- Click on the … button and select the **mask. The default mask is the 61*73*61 brain mask. Mask should be the same dimension of your data.**

- (4)-Method selection. Currently, PSS supports two methods: the linear coefficient b and the power-law slope b'. The default method is Linear, which represents the

linear coefficient b.

- (5)-Set TR.
- (6)-Set frequency bin: PSS requires the lower and upper frequency to estimate the slope of the power spectrum. The default setting is 0.01-0.25 Hz because 0.25 Hz is the upper frequency for 2s TR fMRI data.

3. Output images of PSS toolkit

For "**Linear**" method, PSS generates a pair of images with "Linear" prefix including the original coefficient b images and the Z-transformed images:

Linear_results_subj1.nii	2022/1/26 16:41
Linear_results_subj2.nii	2022/1/26 16:41
Linear_zResults_subj1.nii	2022/1/26 16:41
Linear_zResults_subj2.nii	2022/1/26 16:41

For "**Plaw**" method, PSS generates a pair of images with "Plaw" prefix including the original power law sloe b' images and the Z-transformed images.

For group comparison, we recommend Z-transformed images.

Here is an example of output image using "Linear" method:
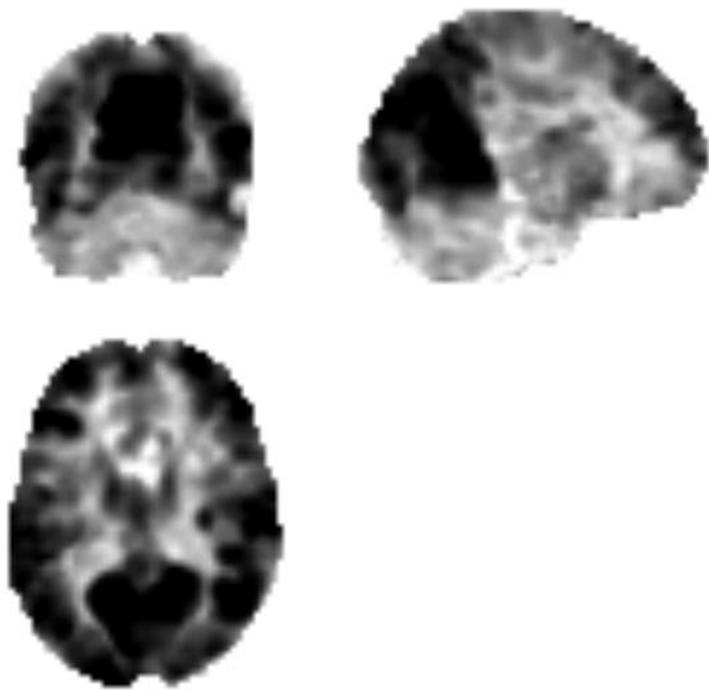
We welcome any questions:

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