Changes to Wfmm in Version 3.1

1   What's New in Version 3.1

- A Principal Components transform and two Principal Component/wavelet hybrid transforms have been included along with the standard wavelet transform. A custom transform type is also provided for user-supplied matrix transformations of the data.

- A rectangular two-dimensional discrete wavelet transform has been added to supplement the square 2d transform in previous versions.

- Highpass and lowpass parameters have been added to the wavelet transform to set the requested number of lowest levels or highest levels respectively.

- A matrix post-multiply operation on the fixed effects has been added to postprocessing that can specify linear combinations of the t samples. This provides a way to compute summary statistics on regions of interest in the fixed effect 1d functions or 2d images.

- Summary output Lbeta_p0 = 2*min [Prob{ beta(t)>0 }, Prob{ beta(t)<0 }] has been added, which approximates frequentist p-values in cases with vague priors .

- Simultaneous credible intervals and simultaneous band scores outputs have been added to summary outputs.

These notes describe important differences between version 3.1 and 3.0 that current users of version 3.0 need to consider when transitioning to 3.1.

2   Renamed Input Parameters

In wavespecs, the old parameter P that specifies wavelet compression has been renamed to alphawav. You will need to rename this if you specify this parameter in a .mat file that you run with 3.1.

3   Changes to wavelet processing

The **wavespecs** struct is still accepted but is deprecated. It has been replaced by **basis_specs** that supports additional transforms along with the discrete wavelet transform. The transformtype field selects the transform to be applied and has:

1) "wavelet", which is the existing dwt.
2) "PC", Principal Components, retain largest principal components as determined by parameter alphaPC.
3) "none", don't apply a transform,
4) "custom", user supplies a transform matrix,
5) "PCw" and "wPC", two hybrid wavelet/PC options.

The wavelet transform has new highpass and lowpass options for compressing the wavelet coefficients by discarding the most or least detailed levels of wavelet coefficients. New **highpass** and **lowpass** parameters specify how many levels to exclude.

The 2D dwt has a rectangular dwt option as well as the previous square transform. This allows each dimension to have a different wavelet basis, boundary, and number of levels. New parameter rectangular specifies rectangular option (1) or square option (0). **wavelet2**, **boundary2**, and **nlevels2** specify the second dimension if this option is chosen.

The wavelet option of "none", meaning no transform will be applied, has been moved to the transformtype field.

The manner in which partitions are specified has changed. Partitions are defined as contiguous subgroups of coefficients that are assigned a Pi and Tau parameter for smoothing. Partitioning is taken care of automatically for wavelets. Each level has its own Pi and Tau parameter. For other types of transforms, partitions can be specified manually by supplying a **partitions** vector. If this is not supplied, it checks for an **npartitions** parameter; if present, it splits the coefficients into npartitions number of equal partitions (remainder goes to the last partition). If npartitions is not supplied, it is assumed to be 1. For principal components, an automatic method is used if none of the manual methods are prescribed. Check the user guide for new parameters to use with these features.

4   Changes to PostProcessing:

4.1   LT Transform
An LT matrix can now be specified in PostProcessSpecs that postmultiplies beta to do inference on linear combinations of the t's. LT is a T x g matrix so postmultiplication of a pxT beta matrix, beta*LT, gives a p x g matrix on which additional statistical summaries are computed for the g regions of interest.

4.2   Beta_p0

Lbeta_P0 is computed from the contrast-transformed beta samples as:

$$P0 = 2*\min [\text{Prob}\{ \text{Lbeta}(t)>0 \}, \text{Prob}\{ \text{Lbeta}(t)<0 \}]$$

In cases with vague priors approximates the frequentist p-values.

4.3   Simultaneous band scores and credible intervals

Three new outputs have been added to support inference. Simultaneous credible intervals are computed from max(Zscore) over the T samples of each fixed effect sample, yielding n maxZscores sampeles. The quantile of maxZscore corresponding to a specified alpha is then combined with point-wise mean and standard deviation values to give the simultaneous credible interval for each fixed effect. Lbeta_simbas is defined as minimum significance level alpha at which the simultaneous credible band excludes zero.

5   Renamed and New Outputs

A number of outputs have been renamed in the Output file to remove ambiguity between the row beta samples and the outputs multiplied by the contrast matrix L. Scripts that use these output names will need to be modified to use the new names.

Old output name	New output name
beta_mean	Lbeta_mean
beta_quantiles	Lbeta_quantiles
beta_sd	Lbeta_sd
beta_peffects	Lbeta_peffects
betans_mean	Lbetans_mean

New outputs Lbeta_simbas, Lbeta_upperCI, and Lbeta_lowerCI have been added for simultaneous band scores and simultaneous credible intervals. A complete set of summary statistics LbetaLt_*statistic* for the output of the LT transform are included if matrix LT has been specified.

6   Supported Operating Systems

Executables are available for 64-bit Windows, 64-bit Linux, and OSX. A 32-bit Windows executable is also available on request.