**Frequency Domain Decomposition (FDD) MATLAB code**

The **Frequency Domain Decomposition** (**FDD**) is an output-only system identification technique popular in civil engineering, in particular in structural health monitoring. As an output-only algorithm, it is useful when the input data is unknown. FDD is a modal analysis technique which generates a system realization using the frequency response given (multi-)output data [[Reference: Wikipedia]](http://en.wikipedia.org/wiki/Frequency_domain_decomposition). The attached MATLAB code implements this technique for modal identification. In order to use this code, the processed (detrended, filtered etc.) time history data must be stored in an excel file (one column of data per channel). Check the “Accelerations.xlsx” for an example of the time history file.

Following command executes the MATLAB code and returns the identified modal frequencies (Frq) and the related mode shapes (phi).

[Frq,phi]=FDD(Input,Fs);

**Input:** name of the excel file that contains time history data

**Fs:** sampling frequency

**Frq:** identified frequencies

**phi:** identified mode shapes

**Example:**

**>> [Frq, phi] = FDD ('Accelerations.xlsx', 500);**

After executing this command, MATLAB starts computation of the Power Spectral Density (PSD) matrix. Note that, depending on the size of input data, this process might take some time. After computation of the PSD matrix, first singular values of the PSD matrix (Fig. 1) will be plotted and you can manually select the peaks of this plot.

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| Figure 1: Singular values of the PSD. |
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Following steps explains how to select the peaks.

1. Enter the number of desired peaks to be selected.
2. To select a peak, draw a rectangle around it while holding the mouse left key (Fig. 2). MATLAB will find peak of the curve in the selected range and will mark it with a blue circle
3. To keep the peak and continue peak selection, press ‘**space key**’. The selected peak will be marked with a green circle.
4. To ignore the peak, and continue peak peaking, press any other key. The peak will be ignored and marked with a red circle.

Fig. 3 shows the peak selection process.

MATLAB will number the selected peaks from left to right (Fig. 4) and will print the related modal frequencies and mode shapes (Fig. 5)

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| Figure 2: Selecting a peak by drawing a rectangle around it |
| C:\Users\mfrshchn\Desktop\Untitled.tif  Draw a rectangle around the peak |

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| Figure 3: Peak selection process |
| C:\Users\mfrshchn\Desktop\untitled.emf  Currently selected peak  Accepted peak  Ignored peak |

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| Figure 4: Result of peak selection |
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| Figure 5. Results of modal analysis |
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