MEEM5700 Laboratory Assignment #6 Fall 2015

THIS IS AN INDIVIDUAL ASSIGNMENT.

NO GROUP WORK WILL BE TOLERATED!

NOTE: There will be no second chance on this assignment since it is due Thursday, December 10.

Purpose:

The purpose of this lab is to become familiar with order tracking and to implement two different order tracking algorithms in Matlab.

Tasks:

1. Calibrate the accelerometer using the hand calibrator provided. The output of the calibrator is 159.2 Hz with an amplitude of 1.0g rms.
2. Mount the accelerometer on the plate where there is a large amount of vibration.

Acquire four sets of operating data on the rotating disc setup in room 601.

3. Set #1: Acquire a time history from the rig near the middle of the motor's operating speed. Acquire signals from the accelerometer and the tachometer signal.
4. Set #2: Acquire a time history from the rig of a very slow (45+ seconds) speed sweep from as slow as the motor will spin up to the full power of the motor. Acquire the acceleration and the tachometer signal.
5. Set #3: Acquire a time history from the rig of a fairly rapid (~20 seconds) speed sweep from as slow as the motor will spin up to the full power of the motor. Acquire the acceleration and the tachometer signal.
6. Set #4: Acquire a time history from the rig of a very rapid (~10 seconds maximum) speed sweep from as slow as the motor will spin up to the full power of the motor. Acquire the acceleration and the tachometer signal.

Analysis:

1. Process the steady state data into an average, at least 50 averages, autopower spectrum with a frequency resolution of 0.25 Hz. Process the tachometer signal from this dataset to obtain an average rpm for this test. Note what the dominant orders and frequencies are. Plot this autopower.
2. Process the tachometer signals from all three of the speed sweeps to obtain rpm vs. time with an rpm estimate at each delta_t. Plot the time vs. rpm profile for each speed sweep. Plot all three of these rpm profiles overlayed on the same plot.
3. Plot a colormap for each of the speed sweeps for the accelerometer with frequency on the x-axis, rpm on the y-axis, and color for amplitude. The accelerometer should be plotted in a linear format. The colormap should be made of at least 100 evenly spaced in rpm FFTs.
4. Track the 1st order and the next 2 highest amplitude orders from all three of the speed sweeps using both the FFT based order tracking and the TVDFT order tracking.
    a. Both FFT and TVDFT results should be computed using both a constant frequency bandwidth and a constant order bandwidth.
    b. All order slices that are estimated should include a minimum of 100 evenly spaced rpm amplitude estimates.
5. Make the following plots:
    a. Overlay for all three speed sweep conditions. Generate one plot with 7 curves for each of the two highest amplitude orders tracked. Use dashed lines for the FFT based results and solid lines for TVDFT based results.
        i. The seven curves on each plot are:
            1. Slow sweep, FFT constant order bandwidth
            2. Slow sweep, TVDFT constant order bandwidth
            3. Medium sweep, FFT constant order bandwidth
            4. Medium sweep, TVDFT constant order bandwidth
            5. Fast sweep, FFT constant order bandwidth
            6. Fast sweep, TVDFT constant order bandwidth
            7. Overall energy level at each rpm
        ii. Make the same plots for the constant frequency bandwidth data.

b. Make one plot for each of the speed sweep sets (slow, medium or fast) and have four lines, two each from the TVDFT and the FFT based method (one line is constant frequency bandwidth and one line is constant order bandwidth for each method gives a total of four lines). Again… dashed for FFT, solid for TVDFT. Only make this set of plots for the highest amplitude order.
c. On EVERY plot put the single point amplitude from the autopower acquired at steady state. This is one datapoint on the plot using the "*" symbol at whatever rpm the steady state data was acquired at.

6. Comment on any differences between the order slices for each order and how the order tracking results compare to the steady state datapoint.
7. Include all Matlab scripts including the tachometer processing, the colormap script, and the order tracking scripts.

Deliverables:

Submit a report discussing the behaviors of each method and why they behave as they do.

This lab assignment is to be completed by Thursday, December 10 at 5:00 PM.