

EM 406 Vibrations

LAB 5: Using the RT-Pro and the Photon

Objectives

1. Understand the RT-Pro interface and to be able to set it up for a project
2. Take data for a plate and look at:
 - a. Effect of hammer tip
 - b. Effect of different windowing
 - c. Effect of the number of points and sample frequency
3. Be able to export data and load it into Matlab.
4. Have a basic understanding of
 - a. Linearity tests
 - b. Reciprocity tests
5. Compare the FRF from two different accelerometers.

For you to do in lab:

Create a new project called Lab5. In the project have two input channels with the force on channel one and one accelerometer on channel 2. You should have watched the Flash video of Dr. Avitabile discussing the setup of RT Pro. Set up the following for your project (it is easiest to use the buttons as shown in Figure 1):

1. **Units** (under “setup”): Check to make sure they are English
2. **Signals**: make sure you have time capture and power spectrum on channels 1 and 2. Under the “cross channel signals” tab be sure excitation is channel one and FRF and COH are calculated for channel 2.
3. **Analysis**: Start with 800 lines (This will be the number of output frequencies). Note that the number of points automatically changes to 2048 points). Change the frequency to 2000 Hz.
4. **Window**: Start with no windowing.
5. **Channel**: Start with max volts of 1 on the input and 10 on the output. Input the calibration factors. **NOTE: This is very important! Make sure the coupling is ICP.**
6. **Trigger**: Use Analog input, auto arm every frame, and -10 pre/post points. Click “start preview” and make sure you can see a hammer hit. Try starting with a level of 2%.
7. **Average**: Use linear averaging in the frequency domain. Start with 5 averages and stop at frame number 5. Under “accept/reject” select “auto reject overload”

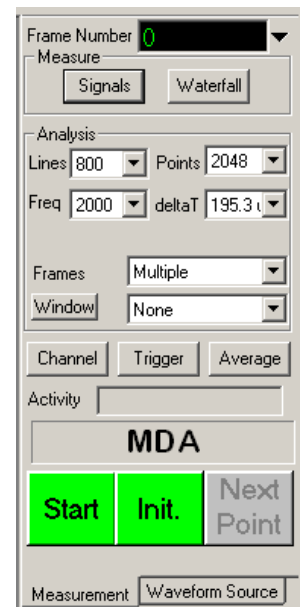


Figure 1

Use a four frame window so that your screen looks like the one in Figure 2. Plot the time histories of your input and output in the top two figures and the FRF and coherence on the bottom two.

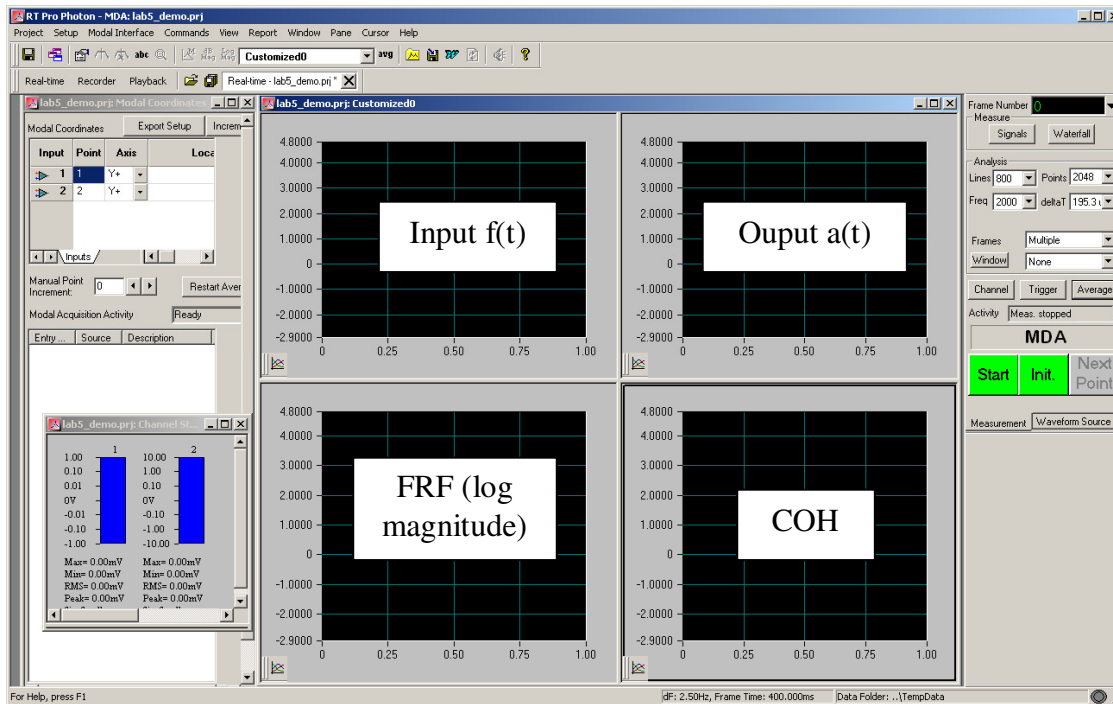


Figure 2 – RT Pro layout I'd like for lab 5.

Be sure to save your set-up frequently. Now, I want you to try and get a good FRF with a good coherence. Some of the things you can try:

1. Try different hammer tips. What happens? Bring up a new window and look at the input spectrum (G11). What happens to the spectrum if the tip is harder?
2. Change the frequency to be larger and smaller. What happens? Why do you think the coherence is generally poor at high frequencies?
3. Change the number of lines. What happens?
4. Try windowing. If you window (it may not be necessary) you should use the Force/Exponential. Set the start point equal to zero and make the change the damping value to something more appropriate. **What happens if you try something like a Hanning window? Never actually do this in an impact test!**

A pretty good FRF and coherence are shown in Figure 3. Notice that you want the coherence to be equal to one. The coherence will often drop off at antiresonances since there is little or no response at these frequencies.

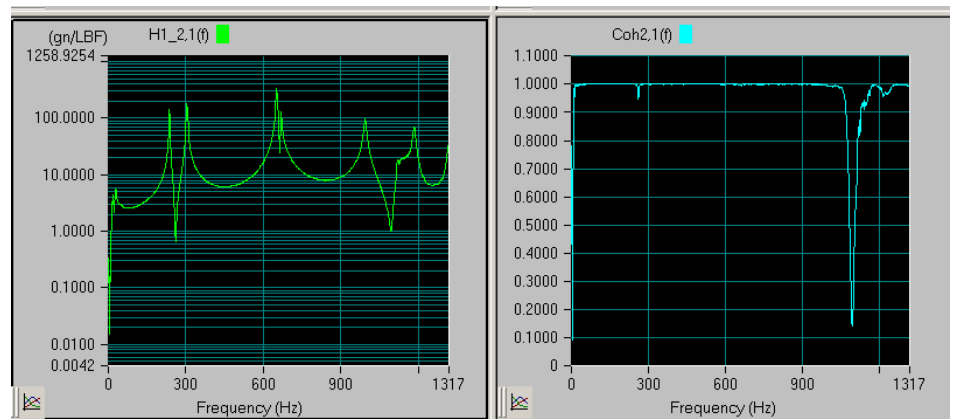


Figure 3 – A pretty good FRF and Coherence

When you have good data take a snapshot of your screen and paste it into a Word document. . In this document also answer the questions asked above.

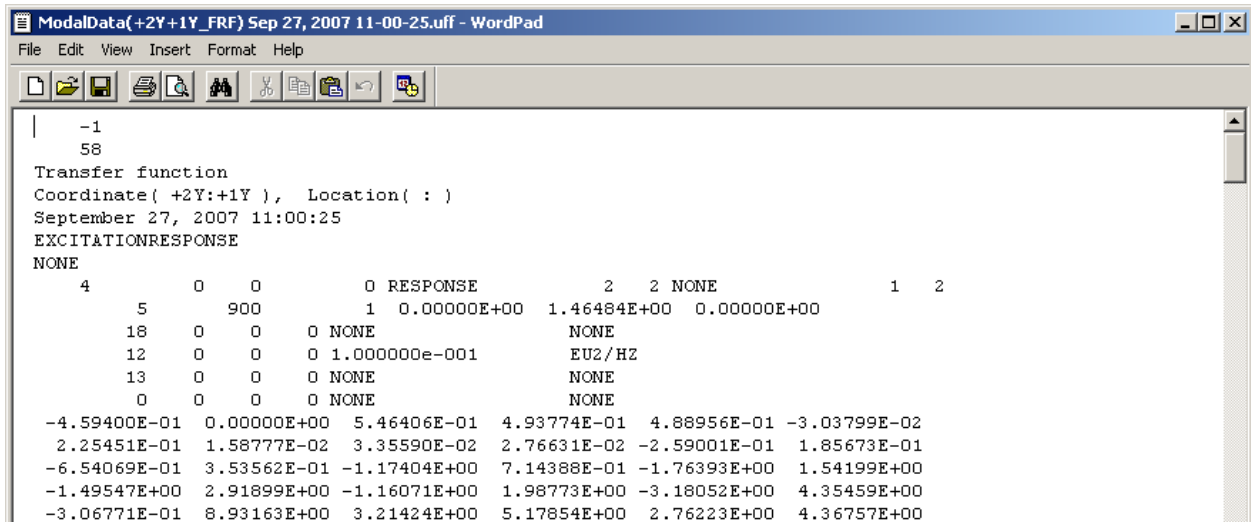
Let's now look at how we export data.

1. Under "setup/signal save settings" select "prompt data folder". Later on when we do a modal test under the "signal file management" we will append the signal number to the file name.
 - a. Now when you hit "start" you will be prompted for a file location. Select a convenient folder to put your data (you may need to create a new one) then hit "continue".

After you take the data you should have two files in your folder that look like this;



Notice that it shows the type of data (COH or FRF), and the time the data was taken. Open up the FRF file in Wordpad. It should look something like this:



This is called a universal file. There are many different types and information for each can be found at: <http://www.sdrl.uc.edu/universal-file-formats-for-modal-analysis-testing-1>

One problem you will often face is taking data out of one program and importing it into another. You could write an m-file to do this, but to save time I will provide one for you later.

Universal File 58 - Measurements

```

-1
58
(anything can go here)
(anything can go here)
(anything can go here)
(anything can go here)
(anything can go here)
4      0      0      0 NONE      2      2 NONE      1      2
6      2048      1 0.00000E+0 4.88281E-1 0.00000E+0
18 0 0 0 NONE NONE
12 0 0 0 NONE NONE
13 0 0 0 NONE NONE
0 0 0 0 NONE NONE
(data then follows as real/imaginary for all the frequency lines of the analyzer)
-1

```

 Point and direction is shown in red for input and output
 Number of spectral lines of resolution is shown in red along with frequency resolution
 The '12' and '13' relate to force and acceleration; the '18' refers to frequency data

The two last topics I want to talk about today are **linearity** and **reciprocity**. Before any modal test (and next week we will perform a modal test) you should make sure your system is linear. To do this you will want to check the linearity and reciprocity.

Linearity Test:

A linearity test involves testing the structure at two different levels for the input (large and small). If the structure is linear the FRF shouldn't depend on the amplitude of the input. Therefore, you simply apply different magnitude inputs and overlay the resulting FRFs. NOTE: Don't hit the impact hammer too hard – we don't want to damage the force transducers!!! **In fact, just to be safe, let's not do a linearity test for this structure.**

Reciprocity test:

Another way to make sure a structure is linear is to check reciprocity. What this means is if you apply an input at Point 1 and measure at Point 2 you should get the exact same FRF if you reverse the locations of the inputs and outputs as shown in Figure 4. It is generally common for people to only check the reciprocity of the structure and not the electronics.

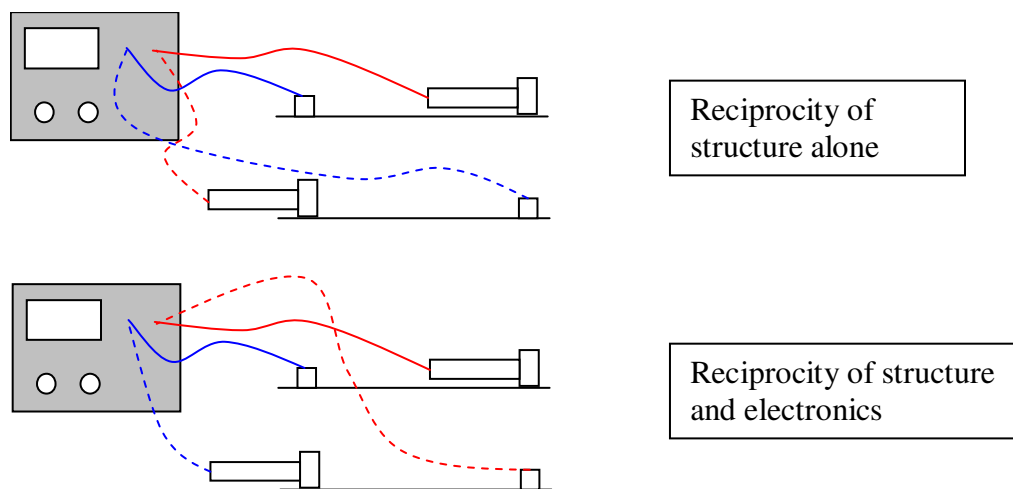


Figure 4 – Reciprocity tests

Perform a linearity and reciprocity check on your structure. **For your project you should include a plot of the resulting FRFs on top of each other.** The easiest way to do this (without exporting to Matlab) is to right mouse click on the FRF window and select "Export to Excel"

Take the data into Excel and make overlay plots to show me your reciprocity.

Different accelerometers.

Modify your project so you use both of the accelerometers. Give the project a new name like "lab5_2accels.prj". Attach the accelerometers to the plate right next to each other and see how the resulting FRFs compare. **How do the FRF's compare?**

Turn in the plots and your answers to the questions.