Instructions for the use of IsoExp.m

Below are a few steps to guide the user during the initial runs with the program.

1. First make a backup copy of the file and place it somewhere other than the directory from which you plan to run the examples and your other horn problems.

2. After opening Matlab make sure you see the file listed in the 'Current Folder' section of Matlab (typically far left panel).

3. Double click on the file to bring the file up in the editor. This is not necessary to run the file, but will allow you to read more of the comments and to see the location of the items discussed in this part of the Instructions.

4. The Matlab function IsoExp.m consists of 250 lines which you should see in the editor numbered in the editor.

5. You will note that line 1 is the function definition line that reads

   [ft ,realZa1, imagZa1]=IsoExp(ST,SM,LHorn,N,ang)

   and is preceeded by the Matlab keyword 'function'. This alerts Matlab to the fact that this file is a Matlab m-file function. What is important to the inexperienced user is that the name of the file and the actual function name should be the same. So if you choose to modify the function call name, say to MyName(ST,SM,LHorn,N,ang), you must also save this file under the name MyName.m.

6. The bracketed portion [ft,realZa1,imagZa1] represents the 'return' variables that will be returned to the Matlab workspace area, and will be available for the user at the command line. So it is important to put the entire command starting from the left bracket until the right parenthesis followed by the semicolon at the command prompt and hit return to properly run the function (after first making sure you enter the correct values for ST,SM, etc).

7. The variable ft is n x 1 and the variables realZa1 and imagZa1 are n x 2 matrices, where the first columns of realZa1 and imagZa1 contain the frequencies used in the calculation (ft), and the second contain the real or

imag part of the input acoustic impedance of the horn model. They can be copied into a program like Excel and compared to other calculations, such as those produced by Hornresp (which allows export of csv files of its data). This is in fact how I produced the plot comparisons of the Matlab program and Hornresp.

8. When you run IsoExp.m it produces a plot of the real and imaginary portions of the input horn impedance over the frequency range you specified. This is essentially a plot of realZa1 and imagZa1 over the frequency range specified.

9. In addition to the inputs required in calling the IsoExp function, you have the option of changing the default frequencies, frequency interval and horn segment intervals. This is called out in the program on lines 42-50: 'Program Parameters That You Might Want to Change.' The default parameters are a Low frequency of 10 Hz a High frequency of 5000 Hz, a frequency interval of 1 Hz, and equal length horn sub-segments of length LHorn/N. The control of the sub-segment lengths is given by the variable z (a vector) and can be equal length (default) or of user specified length (see lines: 52-59.

10. The crux of the isophase calculation is covered in lines: 69-91, where the program defines and calculates the parameters needed to define the appropriate 'quasi-spherical' isophase surfaces, called AvgA in the program (see line 79) and the 'sub-segment length corrections', called dell in the program (see line 80). These are then used to calculate the sub-segment input and output areas (SegA: line 86) and sub-segment lengths (SegL: line 88).

11. The program proceeds to calculate the final total sub-segment product matrix, Ttot, (viz., see lines: 92-102) that is ultimately used to calculate the total horn impedance.

12. As mentioned earlier the program uses a 'piston in infinite baffle' acoustic impedance that is assumed at the output of the last sub-segment. Line 110 calculates the normalized acoustic impedance Zpn making use of a Struve H1 function approximation function courtesy of Robert McGough of

Michgan State University (see lines 227-243). This was necessary as Matlab in the most current version that I have (R2012b) does not include Struve functions in the functions it supplies with the code. The final output impedance Zp is calculated on line 141. The solid angle subtended by this impedance is specified by the ang variable in the initial call statement to the function; choices include 0.5, 1.0, 2.0, 4.0, with any other choice defaulting to the choice 2.0. This section is covered by lines 111-136 in the program. None of this section needs to be changed to run different horn examples.

13. Lines 143-155 perform the necessary steps to get the horn input impedance Za1 into the correct format.

14. Lines 156-193 perform the task of plotting the data and preparing the return matrices, realZa1 and imagZa1. Note: Lines 186-191 can be modified to change the output text and graphing limits. The program defaults to semilog plots, but could be changed to regular plots by changing ‘semilogx‘ to ‘plot’ on lines 178 and 180.

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P.S. For those new to Matlab, a useful introduction text is the one by Amos Gilat,

‘MATLAB: An Introduction with Applications’,4th Ed., Wiley Publications, 2011,

ISBN-13: 978-0-470-76785-6

This was the text used for an introduction to Matlab at the University of New Mexico.