**ANSYS SIMULATION TUTORIAL**

***For use simulating Acoustic Wavenumber Spectroscopy Models***

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| **1)** | * Open ANSYS Workbench   + Image shows probable location of ANSYS Workbench   + May be named RunWB2.exe |  |
| **2)** | * Drag a *Harmonic Response* Analysis System into the project schematic |  |
| **3)** | * Double click *Engineering Data* |  |
| **4)** | * Select *Engineering Data Sources* * Select *General Materials*   + In the *Outline of General Materials* window, we can select our material and fine tune different properties * Once we have found our desired material, click the plus symbol in the *Add* column * When we are done adding our material, click back to the *Project* tab in the top left corner |  |
| **5)** | Back inside the project tab…   * It’s time to make our model. Basic ANSYS geometry tutorials can be found online. * Double-click the *Geometry* tab in the harmonic response module.   THINGS TO REMEMBER   * Scan surface must be located parallel to the xyPlane. It’s best to select this plane to begin your plate sketching * We must include a raised surface to apply the source excitation |  |
| **6)** | * Here is an example of a basic plate   + Notice the orientation of the surface. It is parallel to the xyPlane, but offset in the Z direction. This will be the surface that we will take our vibration data from   + Also included is a raised cylinder for the excitation source * Once done modelling the plate, close *DesignModeler* | Plate  Origin  Scan surface  Transducer |
| **7)** | * The rest of the simulation process will be done after double clicking any of the *Setup, Solution,* and *Results* options |  |
| **8)** | * Inside the Mechanical window, select *Geometry*, select *Solid,* and choose our material added earlier in the tutorial   + The question mark next to *Geometry* should become a green checkmark |  |
| **9)** | * Next, we will select the parameters for our mesh and preview it   + Under sizing, highlight the *Element Size* value   + Once a value is input into element size, right click *Mesh* in the outline window, and select update   + The number of nodes is listed in *Statistics* in mesh details. This is useful when trying to gage how long simulations will take. * Once the mesh is generated, there should be a green checkmark next to mesh |  |
| **10)** | * Now we will select the harmonic response parameters by selecting *Analysis Settings* in the outline window   + If we want only the response of a plate with a single excitation, set *Solution Intervals* to 1   + The *Range Minimum* can be set to anything below our desired excitation, which will be our *range maximum*   + *Solution Method* must be changed to *Full*   + Select *Damping Controls* and change *Constant Damping Ratio* to a desired value (usually 0.001-0.01) * There is still another step in establishing the *Harmonic Response*, so the question mark remains |  |
| **11)** | * Now we will establish the pressure which drives the excitation. After right clicking *Harmonic Response* 🡪*Insert*🡪*Pressure* click on our raised cylinder and click *apply* for the *Geometry* option   + Select a value for *Magnitude* (Usually around .1 mPa) * There should be a yellow lightning bolt next to *Harmonic Response* |  |
| **12)** | * Now we will create a surface solution. Right click *Solution*🡪*Insert*🡪*Deformation*🡪 *Directional*   + Select Z axis for the *Orientation* option |  |
| **13)** | * Now we will set up the export files. Right click *Solution*🡪*Insert*🡪*Commands.* Repeat until there are 3 *Commands (APDL)* objects under solution   + Copy and paste the scripts (starting with ‘/post’) at the end of this document into the corresponding command pages * There should be only yellow lightning bolts and green checkmarks in our outline |  |
| **14)** | * Click *Solve* located in the top menu |  |
| **15)** | * The output files are located inside the accompanying folder for your simulation, named *YourFile\_files*🡪dp0🡪SYS🡪 MECH   + These files can be uploaded into MATLAB for image processing |  |
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!Commands (ADPL)

/post1

set,,,1,1 ! Set the set number and Imaginary part

! Last Digit (0 = Real part, 1 = Imaginary Part)

\*get,NNUMMAX,node,,num,max ! Get max node number

\*del,NMASK ! Delete NMASK array if it exits

\*del,NARRAY ! Delete NARRAY array if ti exits

\*dim,NMASK,array,NNUMMAX ! Define NMASK array

\*dim,NARRAY,array,NNUMMAX,5 ! Define NARRAY array to hold results

\*vget,NMASK(1),node,all,nsel,-1 ! Get status of selected nodes

! 1 = selected, 0 = undefined, -1 = unselected

\*vmask,NMASK(1) ! Use NMASK as making array

! If NMASK(i) > 0.0, perform operation "1"

! If NMASK(i) < 0.0, do not perform on "i"

\*vget,NARRAY(1,1),node,all,loc,x ! Get LX for nodes & Fill first column

\*vget,NARRAY(1,2),node,all,loc,y ! Get LY for nodes & Fill seound column

\*vget,NARRAY(1,3),node,all,loc,z ! Get LZ for nodes & Fill third column

\*vget,NARRAY(1,4),node,all,u,z ! Get UZ for nodes & Fill forth column

\*vfil,NARRAY(1,5),ramp,all,1 ! Fill vector from 1 to NNUMMAX (node no.)

\*cfopen,imaginary,txt ! Create text file (Path is same with rst file)

\*vwrite ! Write headers (‘x’ tells how many spaces to put between headers)

('Node\_no.',2x,'x-loc',2x,'y-loc',2x,'z-loc',2x,'z-disp')

\*vwrite,NARRAY(1,5),NARRAY(1,1),NARRAY(1,2),NARRAY(1,3),NARRAY(1,4) ! Write the info from your array to the text file

(F10.0,2x,E15.8,2x,E15.8,2x,E15.8,2x,E13.5) ! Format the output

finish

\*cfclose,imaginary,txt ! Close the opened file

!Commands (ADPL) 2

/post1

set,,,1,0 ! Set the set number and real part

! Last Digit (0 = Real part, 1 = Imaginary Part)

\*get,NNUMMAX,node,,num,max ! Get max node number

\*del,NMASK ! Delete NMASK array if it exits

\*del,NARRAY ! Delete NARRAY array if ti exits

\*dim,NMASK,array,NNUMMAX ! Define NMASK array

\*dim,NARRAY,array,NNUMMAX,5 ! Define NARRAY array to hold results

\*vget,NMASK(1),node,all,nsel,-1 ! Get status of selected nodes

! 1 = selected, 0 = undefined, -1 = unselected

\*vmask,NMASK(1) ! Use NMASK as making array

! If NMASK(i) > 0.0, perform operation "1"

! If NMASK(i) < 0.0, do not perform on "i"

\*vget,NARRAY(1,1),node,all,loc,x ! Get LX for nodes & Fill first column

\*vget,NARRAY(1,2),node,all,loc,y ! Get LY for nodes & Fill seound column

\*vget,NARRAY(1,3),node,all,loc,z ! Get LZ for nodes & Fill third column

\*vget,NARRAY(1,4),node,all,u,z ! Get UZ for nodes & Fill forth column

\*vfil,NARRAY(1,5),ramp,all,1 ! Fill vector from 1 to NNUMMAX (node no.)

\*cfopen,real,txt ! Create text file (Path is same with rst file)

\*vwrite ! Write headers (#x tells how many spaces to put between headers)

('Node\_no.',2x,'x-loc',2x,'y-loc',2x,'z-loc',2x,'z-disp')

\*vwrite,NARRAY(1,5),NARRAY(1,1),NARRAY(1,2),NARRAY(1,3),NARRAY(1,4) ! Write the info from your array to the text file

(F10.0,2x,E15.8,2x,E15.8,2x,E15.8,2x,E13.5) ! Format the output

finish

\*cfclose,real,txt ! Close the opened file

!Commands (ADPL) 3

/post1

set,,,1,1 ! Set the set number and Imaginary part

\*get,NNUMMAX,elem,,num,max ! Get max element number

\*del,NMASK ! Delete NMASK array if it exits

\*del,NARRAY ! Delete NARRAY array if it exits

\*dim,NMASK,array,NNUMMAX ! Define NMASK array

\*dim,NARRAY,array,NNUMMAX,11 ! Define NARRAY array to hold results

\*vget,NMASK(1),elem,all,esel,-1 ! Get status of selected elements

! 1 = selected, 0 = undefined, -1 = unselected

\*vmask,NMASK(1) ! Use NMASK as making array

! If NMASK(i) > 0.0, perform operation "1"

! If NMASK(i) < 0.0, do not perform on "i"

\*vget,NARRAY(1,1),elem,all,node,1 ! Get node no for nodes & Fill first column

\*vget,NARRAY(1,2),elem,all,node,2 ! Get node no for nodes & Fill second column

\*vget,NARRAY(1,3),elem,all,node,3 ! Get node no for nodes & Fill third column

\*vget,NARRAY(1,4),elem,all,node,4 ! Get node no for nodes & Fill forth column

\*vget,NARRAY(1,5),elem,all,node,5 ! Get node no for nodes & Fill fifth column

\*vget,NARRAY(1,6),elem,all,node,6 ! Get node no for nodes & Fill sixth column

\*vget,NARRAY(1,7),elem,all,node,7 ! Get node no for nodes & Fill seventh column

\*vget,NARRAY(1,8),elem,all,node,8 ! Get node no for nodes & Fill eighth column

\*vget,NARRAY(1,9),elem,all,node,9 ! Get node no for nodes & Fill ninth column

\*vget,NARRAY(1,10),elem,all,node,10 ! Get node no for nodes & Fill tenth column

\*vfil,NARRAY(1,11),ramp,all,1 ! Fill vector from 1 to NNUMMAX (element no.)

\*cfopen,3\_Elements\_Information,txt ! Create text file (Path is same with rst file)

\*vwrite ! Write headers (#x tells how many spaces to put between headers)

('Element\_no.',2x,'node1',2x,'node2',2x,'node3',2x,'node4',2x,'node5', 2x,'node6',2x,'node7',2x,'node8',2x,'node9',2x,'node10')

\*vwrite,NARRAY(1,11),NARRAY(1,1),NARRAY(1,2),NARRAY(1,3),NARRAY(1,4),NARRAY(1,5), NARRAY(1,6),NARRAY(1,7),NARRAY(1,8),NARRAY(1,9),NARRAY(1,10) ! Write the info from your array to the text file

(F10.0,2x,F8.0,2x,F8.0,2x,F8.0,2x,F8.0,2x,F8.0,2x,F8.0,2x,F8.0,2x,F8.0,2x,F8.0,2x,F8.0) ! Format the output

finish

\*cfclose,3\_Elements\_Information,txt