Nonlinear Analysis Restarts and Nastran

The Challenge:

You have run a nonlinear analysis in Nastran. You would like to do a couple of things, but do not want to have to rerun the analysis every single time from the very beginning.

Perhaps you require:

• Additional analysis results;

• To add a new load at a particular point in the analysis sequence, or

• Wish to change the number of load steps by which you've applied your loading.

The Example:

To explain how this can be done, we describe the following through example. We have a model with various subcases to sequentially apply various loads. The loads are applied in separate subcases so that parameters can be altered for efficient solution and manipulation.

Further, the loads are applied separately as they actually occur.

In general and Nastran terminology, the loading is applied through three sequential Subcases. They are:

• Subcase 1: Force in X-Direction

• Subcase 2: Force in Y-Direction

• Subcase 3: Force in Z-Direction

We obtain results for Subcase 1 and Subcase 2, but want additional results for Subcase 3. What to do?

The Methodology:

Note the instructions now talk about using Femap and the Femap menu commands. However, the gist of what is required should be understood by all Nastran users even if they model with Patran or other pre/post finite element processors. The example model has three (3) load sets and a single constraint set. Each load set requests four (4) increments, with intermediate output switched on (via Model | Load | NonLinear Analysis).

You can use Model | Analysis to inspect the analysis setup.

1. Analysis Set 1 is linear - you can ignore this as it was only there so we could figure out how big the loads needed to be to create some non-linear effects.

2. Analysis Set 2 is the non-linear "cold start" analysis.

It is like any typical multi-step non-linear analysis except that "Save Databases for Re-start" has been ticked.

Most important

In order to minimise headaches with re-startable and non-restartable information in the Nastran files, ALWAYS FIRST do a backup of the .DBALL and .MASTER files of the (semi-) successful analysis from which you would like to commence a re-start.

In our case, we simply highlight the two files in Windows Explorer and press Ctrl-C and Ctrl-V to make a copy of those files.

If our re-start fails for whatever reason, or we wish to re-start from some other point, we simply rename those copies to their original names and make another copy - so we always are guaranteed to have an un-modified version of the .DBALL and .MASTER files.

Note that these files are modified whenever used, so if you don't re-name/use your originals each time you do a re-start, then you have to worry about which "version" of information in these files is the one you are able to use. That is possible, but for most more complicated to have to concern oneself about.

3. Analysis Set 3 has the interesting characteristics. a) Analysis Set 3 was created simply by copying Analysis Set 2 in Femap, and then modified as described below.

Note that you must be very careful about the existence or non-existence of cumulative loads in multi- case non-linear analysis.

In this example, the effect of the 3 "independent" loads is that the first load is applied, but because it does not exist in Subcase 2, then it is progressively removed in Subcase 2.

Similarly the Load in Subcase 2 is progressively removed in Subcase 3.

When doing re-starts, Nastran is checking for changes to the analysis, therefore it is easiest/best to have the setup for the re-start identical to the cold-start analysis, except for those things which specifically need to be changed.

      b) In the Executive section, "Restart Previous Analysis" is ticked. The "From" box needs to show the .MASTER file that was created in the cold start run.

      c) In the "Nastran Bulk Data Options" dialog, press "Start Text" to see the extra text that is used to tell NX Nastran at what point you would like the re-start to commence. By inspecting the .f06 file from the cold start run, the file shows each SUBID and LOOPID which is successfully converged/saved and thus can be used. In the example model, we have chosen to re-start from LOOPID 29, which is the end of Subcase 2. NOTE THAT: "PARAM,SUBID,3" indicates the new Case number to be used beyond the SUBID from which you are re-starting. So we are re-starting from the existing Subid 2, therefore we have set PARAM, SUBID to 3 to start in Case 3.

      d) The next dialog box of interest is the Master Output Requests. Re-starts are often used to get additional results information from part/all of analysis if the results weren't originally requested. In this example, we are not interested in getting a complete re-write of all the analysis results, so we switch off all the results in the Master Output Requests.

e) For Case 3 (the one we are actually interested in), we switch on the results we want. The choice of what to do in Step (d) and (e) depends on whether you would prefer all the results in a single result file, or only the additional results from the Subcase you are adding or "tweaking".

f) If you run the cold start in Step 2 above (Analysis Set 2), the analysis will produce a total of about 42 results steps for the 3 Cases. Running the re-start (Analysis Set 3) will produce another 10 result sets, which will effectively be a repeat of the results sets from the end of Cases 2 to 3.

g) As an additional step, we change the setup for Load Set 3 (Model | Load | Set -> Set 3, then Model | Load | Non-linear Analysis) eg. to change the number of increments to 20. This changes the data on the NASTRAN NLPARM bulk data entry. This time 20 new results sets will be created, representing the results for the new number of increments specified for Case 3. Prior to analysing, make sure you have re-copied your original .DBALL and .MASTER as described in the highlighted MOST IMPORTANT section.