CDH

OPTRAN
CAE Process Optimization

Release Version 4.2

Release Note

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A) New Features and Enhancements in CDH/OPTRAN Version 4.2

- **Intel/MKL, Intel C++ compiler and RHEL 6.2+**

Optran v4.2 now uses the Intel MKL library for its compute-intensive matrix tasks. Our testing has found that it is mostly equivalent to Goto BLAS (our earlier library) but on occasion, for higher number of cores, it is a bit faster. The required libraries are supplied during the new installation and the user has no settings to fix or alter. The change should be seamless. Furthermore, we have moved forward to supporting RHEL 6.2+ and left behind RHEL 5. Again, the switch to RHEL 6.2+ should be seamless. We have tested Optran v4.2 on RHEL 6.2, 6.3, 6.6, 6.7, 7.3 as well as SLES v11 and v12. Finally, our switch to the Intel C++ compiler should be seamless and bring a few performance benefits.

- **Easy Frequency Dependant CBUSH and CELAS with FastFRS**

(Important: User <u>must</u> use AMLS/FastFRS 5.1.r235+ for this to function)

FastFRS has a special path to handle frequency dependant CBUSH and CELAS elements. In the case the number of these frequency dependant elements is relatively small, FastFRS provides a substantial performance improvement for computing the modal solution. The new Optran v4.2 connection to this FastFRS feature requires no user intervention and involves no intermediate steps. Optran detects frequency dependant CBUSH and CELAS automatically and creates the appropriate matrices for FastFRS.

As a default, Optran makes these matrices outside Nastran. This provides a substantial performance improvement over having Nastran make them. Only certain CBUSH types are supported for this part. These are types that were found in models made available to us by several NVH departments. If the user has a type that is not supported, the user must revert to Nastran making these frequency dependant matrices, use "param fdmatrix Nastran" *in the request file.*

The following graph depicts the speed improvement for using the new frequency-dependent matrix generation with FastFRS. It is suprising and it is fantastic.

Frequency Dependant CBUSH benchmark
Total elapsed seconds
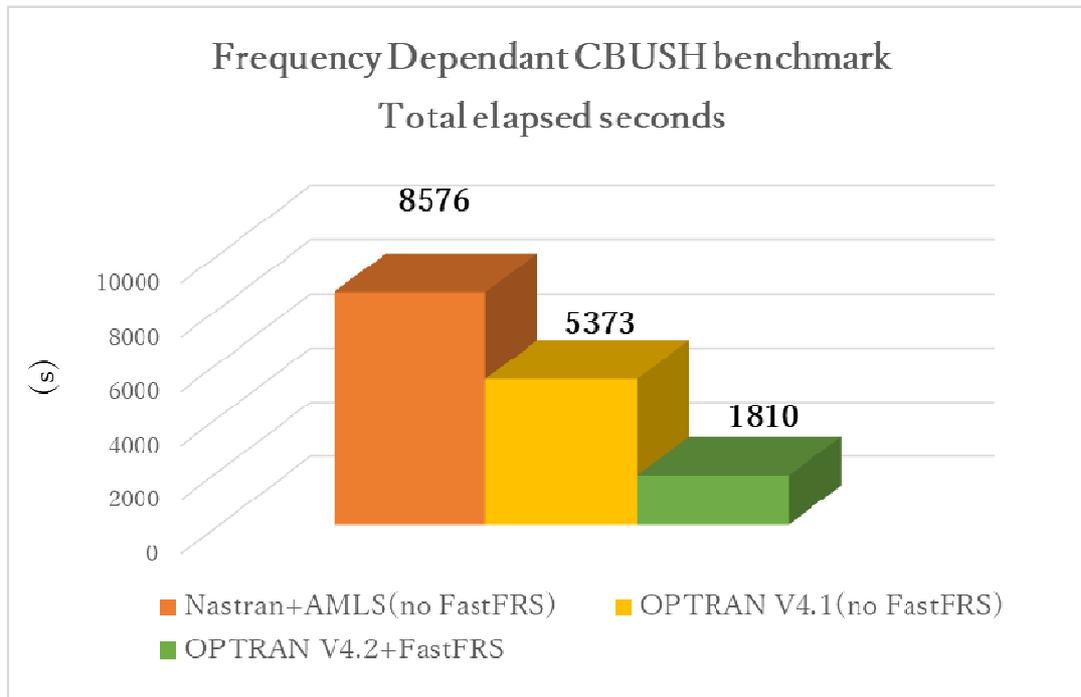
- **NVELOCITY (type ERP) Supported**

NVELOCITY refers to the complex normal velocity at a grid (normal to the surface defined by shell elements). It can be used in estimating noise radiation. Optran outputs magnitude of the NVELOCITY in bof and op2 formats. Averaging over frequency range is automatic.

The choice of grids at which nvelocity is computed comes from the definition of the ERP panels in the MSC Nastran deck (or PANELS in case of NX Nastran). If the user has defined ERPPNLs in his MSC Nastran deck then the following request will produce the normal velocities at the union of ERPPNL grids for every dload and frequency:

```
nvelocity  panel=all   freq=all  dload=all
output op2
```

The output is only available in bof and op2 formats at present and is the frequency averaged magnitude of the normal velocity. In above example, user would get 1 real fringe plot for each dload. The user may specify a reference dB using refdb= on the nvelocity request line.

The formula used is

20 * log10("average of magnitude of normal velocity" / refdb).

The user can do this computation for certain dloads by specifying the dload id as in dload=1001. And if the frequency range is other than "all", then that can be specified with something like freq=30:100 to refer to the range from 30Hz to 100Hz. The averaging then takes place over that frequency range. To use a subset of all the ERPPNL panels defined, the user would have to use

```
panelset  200 = window  door
nvelocity panel=set200  freq=all  dload=all
```

To get the averaged dB result over two frequency ranges, the user would use two request lines:

```
nvelocity  panel=all   freq=100:300  dload=all   refdb=1.0E-6
nvelocity  panel=all   freq=300:500  dload=all   refdb=1.0E-6
```

The restriction at the present time is that all the nvelocity requests in a run must refer to the same panel set.

- **Gnuplot Defaults**

With the change in licensing for gnuplot, we can now deliver the gnuplot executable/library for use by Optran. It is delivered as a separate executable called by Optran. The user no longer needs to install and configure gnuplot on his machine (One exception: In case the operating system is SUSE12, user must ensure that libpng12 and libjpeg62 are installed on his system). Default png – jpeg – emf – eps plots have new default styles that are more presentable (see pictures below).

The default configurations (line styles and dash types) are in a text file in the config subdirectory of the Optran installation directory. If the user wishes to change these configurations, he can create his own copy of these files locally and point to it during the Optran run. To point to user-made settings files use the plot config section which has been enhanced for that purpose. An additional line must be added in the plot config section of the form:
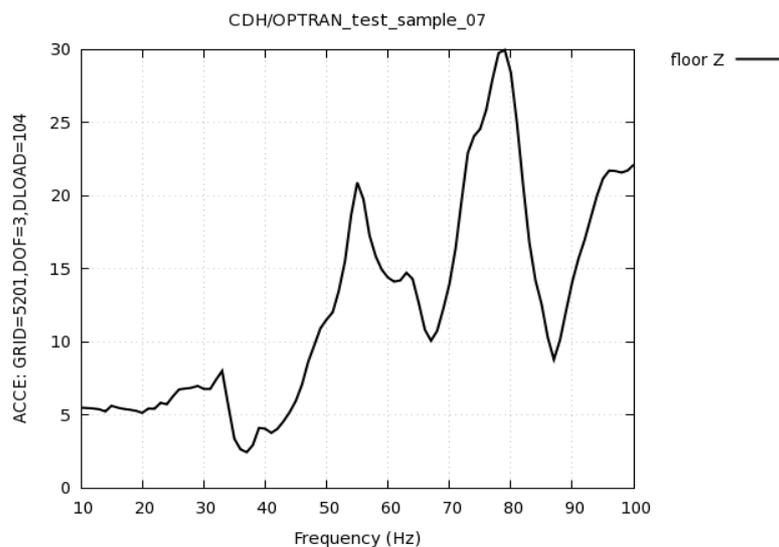
set png "/user/home/my_pngcairo_setting.gp"

The x-y plot will pick up this setting when the plotid= is used to point to this plot config. If the user wishes to put this personal setting for all his graphs, he can add it to the plot config universal section.
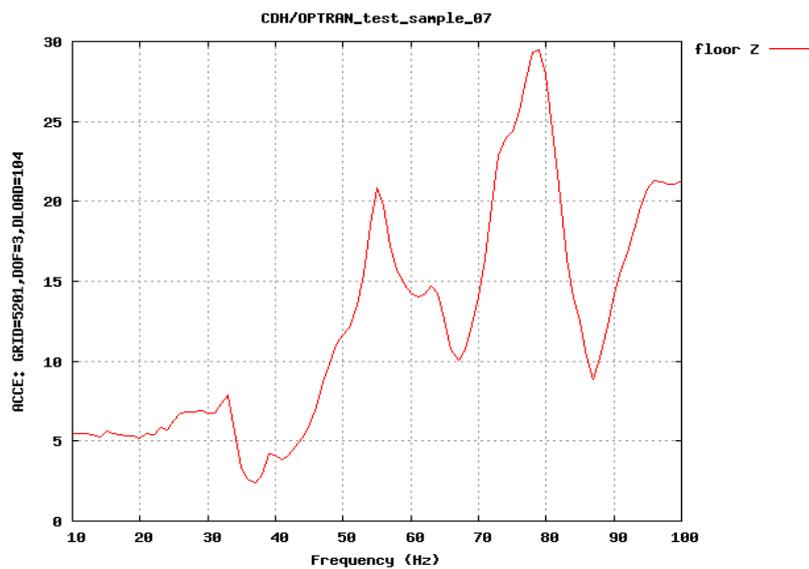
Default for v4.1 (old)

Default for v4.2 (new)

▪ **SOL 103 SUPPORTED**

A SOL 103 Nastran run now be run in Optran. The only permitted requests are mshape (mode shape) and strain – kinetic energies for these mshapes. Note that a SOL 103 Optran run can be used to restart into a regular Nastran-AMLS SOL 111 but cannot be used to restart into an Optran 111 run. A SOL 111 run with Optran can already output Mode shapes.

▪ **Dynamically chosen mode shapes**

The user can ask for mode shapes near a peak of a response by using mshape=(n,m) on a response request line. "n" stands for the number of peaks and "m" stands for the number of modes desired. Those "m" nearest – nearest in the sense of frequency – are recovered by Optran for eventual animation.

▪ **Case Control Modifications Removed**

Prior to Optran 4.2, there were several aspects of the Nastran bdf file that controlled what Optran was to compute. For instance, the user had to ensure that grids for response output were referenced in the Nastran Case Control section. To make opshapes in early versions of Optran, the user had to specify PARAM, OPSHAPE, YES in the Nastran bdf. To compute panel participation factors at a fluid grid using Optran, one had to ensure that that fluid grid was in the Case Control DISP(PLOT) set. None of this is required for Optran v4.2+.

All information needed by Optran is determined from the Optran request file. For instance, the user can write DISP(PLOT)=ALL or DISP(PLOT)=NONE and in either case, the user can compute the operational shapes or any panel participations equally efficiently.Thus, the new design is that the **Optran request file** now enforces how Nastran and AMLS combine to produce the data that Optran eventually needs to produce the op2, punch, and png output files. All of the above holds in a case of non-restartable run. For runs that will be restarted, Nastran bdf parameters are still relevant as only the user knows the purpose of the restarts.

To allow for different data recovery during restarts (CHKPNT1, CHKPNT2, and SAVE options), parameters in the Nastran .bdf are specified to control the saving of data required for restart recovery:

OPSHAPE (YES/NO) – Save for Operational shapes
MSHAPE (YES/NO) – Save for Mode shapes
SMPF (YES/NO) – Save for Structure Mode Participation Factors
SENRGY (YES/NO) – Save for Element Strain Energy
KENRGY (YES/NO) – Save for Element Kinetic Energy
GPPF (YES/NO) – Save for Grid Point Participation Factors
SGPPF (YES/NO) – Save for Structure Grid Point Participation Factors
ELFORCE (YES/NO) – Save for Element force data recovery
ERP (YES/NO) – Save for Equivalent Radiated Power
PANEL (YES/NO) – Save for Panel particpation factors
ALLDR (YES/NO) – Save for All of the above
For example, to save data for strain energy calculations on a restart run, specify PARAM,SENRGY,YES in the Nastran bdf file. ALLDR is also a parameter on the command line.

- **OUTPUT XYPUNCH**

XYPUNCH is a particular Nastran output format which is now supported for response output. The user must include "xypunch" on the output request line. The default is to do magnitude and phase. To get real and imaginary output, use "xypunch(real)" with no spaces from "x" to ")".

- **Forcing Frequencies Varying by Subcase**

Prior to Optran v4.2, it was assumed that the user had a single forcing frequency list for all subcases in his Nastran run. In effect, the FREQ= case control command could be specified above all subcases. Subcase-dependant forcing frequencies resulted in an error. In case of subcase-dependant forcing frequencies, the workaround suggested was to make a dummy first subcase that includes the union of all the forcing frequencies. In v4.2, user will no longer need this workaround. The program recognises that forcing frequencies vary by subcase and makes a common frequency list. This might not be ideal for performance but it gets the job done for the few cases when this is important.

- **Complex Grid Point Participation Factors**

Requesting GPPF (fluid grid point participation) or SGPPF (structure grid point participation) gives real projected grid participation factors. The output is in bof, op2 or punch format. In some situations, the unprojected complex grid point participation factors are required. To get these, make a request

for GPPFC or SGPPFC. That is add on a "c" to the end of the word. This forces the unprojected participation factors to be output.

- **Strain/Kinetic Energies with Nastran i8 delivery**

Prior to Optran 4.2, Strain and Kinetic Energies were unavailable for MSC Nastran i8 versions. In v4.2 this limitation is removed. Moreover, strain and kinetic **energy densities** are now computed and output to the op2 for viewing.

- **Dynamic Stiffness response**

Dynamic stiffness is now a full-fledged response request. To get the x-y plot in gnuplot, csv or punch user can use "dstiff" exactly like he would use "disp":

Dstiff   grid=set100   dof=3   dload=all

The run-time options of opshape=n and smpf=(n,m) are available and functional as well.

- **SCRATCH DIRECTORY SPECIFICATION**

This OPTRAN scratch directory can now be specified from the Optran command line. Earlier specification of scratch location was available in the CDHOptran.defaults file only.

- **PARAM, AGGROT**

This is a new parameter for the Nastran bdf. Its value is YES/NO. It specifies whether the rotational dofs in the acoustic coupling matrix are to be retained (YES) or not (NO). Default is YES.

B) Error fixes

1) Multiple "outmodes=" or "outmodef=" resulted in an error that outmodes did not get used. This has been fixed.

2) Request= on the command line was creating additional files during the run. This has been fixed.

3) Autorequest: Many omissions/corrections in autorequest identified by a few users were fixed and autorequest made more robust.

4) Upstream superelements are properly included in the analysis model.

5) Param,Wtmass is now included for Kinetic Energy computations.

6) Outmodes= did not affect the MSHAPE request. Now outmodes replaces the mshape request. There can only be 1 mshape request.

7) Crash in case of missing tabler2 (for target in case of smpf=(i1,x)) fixed and missing tabler2 id identified.

8) If panels are not involved in the acoustic coupling but are defined as panels anyway, Optran may give 0 answers. This has been fixed. In case of very large models, this requires the latest version of AMLS 5.1.r235+ as well.

Baseline file format change

Baseline files made with v4.1 and earlier are incompatible with v4.2. This change has been made to fix a consistency problem for the response output. A consequence is that the data structures saved in the baseline are no longer the same.

Auxiliary parameters available in request file

a) There are three memory usage patterns for computing ERP: methods a, b or c.   Method *a* requires the most memory and is the fastest. Method *b* requires less and may be slower. Method *c* requires the least memory but is likely the slowest. To force Optran to use a certain method, user can use the request line --

<div align="center">

erp force method a
erp force method b
erp force method c

</div>

b) In case of frequency dependant celas or cbush elements, Optran will now make the frequency dependant terms by default. It will bypass Nastran DMAP for these frequency dependant terms. To force Optran

to go back to using Nastran to compute these matrices, the user may use the request line –

param fdmatrix nastran

C) Supported Nastran Versions and CDH software

MSC.Nastran^{TM}
MSC.Nastran Version 2014.1 (i4/i8); 2016.1 (i4/i8), 2016.1.1 (i4/i8); 2017.1 (i8); 2017.1.2 (i8)

NX-Nastran^{TM}
NX-Nastran Version 11.0 (i4/i8)

CDH Software:
CDH/AMLS & CDH/FastFRS Version 5.1r235

D) Contact Information
For any technical problems associated with CDH/OPTRAN program, please contact local CDH office or send e-mail to support@cdh-ag.com.