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The EPSA to PATRAN Interface

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ABSTRACT

This report describes the development and use of two computer programs that (1) translate an EPSA input file into a PATRAN neutral file and (2) translate EPSA global output request files into PATRAN results files. Sample PATRAN sessions for reading in the PATRAN neutral file and for displaying EPSA analysis results are shown.

ADMINISTRATIVE INFORMATION

This report is submitted in partial fulfillment of milestone 1, Task 1 of the Survivability/Hull Strength Project (RB23S22) of the Submarine Technology Block Program (ND3A/PE0602323N). The work described herein was sponsored by the Office of Naval Technology (ONT-233) and performed by the Computational Signatures and Structures Branch (Code 1282) of the David Taylor Research Center.

INTRODUCTION

The EPSA[1] finite element analysis computer program is capable of computing the large deformation, elasto-plastic, dynamic behavior of structures. At DTRC, an interface did not exist between EPSA and PATRAN,[2] a widely used finite element pre- and postprocessing computer program. With PATRAN, wire-frame and hidden-line plots of EPSA finite element models and analysis results could be made, providing an engineer more insight into the models and results. Thus, an interface between EPSA and PATRAN has been developed.

The interface between EPSA and PATRAN consists of two computer programs. The first program, **EI2PN** (**E**psa **I**nput to **P**atran **N**eutral file), reads an EPSA input file and generates a PATRAN neutral file. The PATRAN neutral file is input to PATRAN and the EPSA model can be displayed.

The second program, **EO2PR** (**E**psa **O**utput to **P**atran **R**esults file), reads an EPSA global output request file and generates PATRAN results files. Along with the PATRAN neutral file, the PATRAN results files can be used to create many different types of results plots, including plots of the deformed finite element mesh and contour plots of stress or strain.

EPSA INPUT FILE TO PATRAN NEUTRAL FILE (EI2PN)

EPSA INPUT

EI2PN recognizes the EPSA inputs listed in Table 1. The corresponding PATRAN neutral file entities are also listed in Table 1. Structural nodes and elements are numbered SSSIIJJ where, SSS is the sheet number, II is the ith node or element in the i sheet direction, and JJ is the jth node or element in the j sheet direction. All other elements (ISTIFF, JSTIFF, FLUELM, CMASS, SPRING, NLSPRG, SNUBER) have element numbers between 1 and 10100.

RUNNING EI2PN

EI2PN is an interactive computer program. The user is prompted for the name of an EPSA input file. EI2PN informs the user which sheets are being processed and which EPSA inputs were not translated. EI2PN creates two output files whose file names are generated from the name of the input file. The first file (*_neu) is the PATRAN neutral file. The second (*_ids) is a file of node and element ids that must be input to EO2PR.

Table 1. EPSA inputs recognized by EI2PN

EPSA input type	EPSA input	PATRAN neutral file
Sheet Separation	SHEET	Coordinate frame id, element and material property id
Shell Geometry	SCYLIN SCONE SORPAR SSPHER SORELP SORHYP SCAP SPLATE SENPL	
Coordinate System Definition	COORSY	Coordinate frame
Nodal Point Coordinates	ICOORD JCOORD ICOOR1 JCOOR1 COORDN	Structure nodes and elements
Variable Grid	ROWDBL	
Lump Mass	CMASS	Mass elements
Stiffeners	ISTIFF JSTIFF	Bar elements*
Fluid Elements	FLUELM	4-noded elements
Linear Springs	SPRING	Spring elements
Nonlinear Springs	NLSPRG	Spring elements
Snubbers	SNUBER	Bar elements
Material	MATL	Material properties
Shell Thickness	THICK	Element properties
Loads	CLOAD ULOAD	Nodal forces,** element pressures
Supports	SUPORT	Nodal displacements, set 1
Prescribed Motions	PCDISP	Nodal displacements, set 2
Moment Connections	MOMCON	MPCs, set 1
Pin Connections	PINCON	MPCs, set 2
Water Surface	FLUSUR	Coordinate frame 1000
Rigid Body Motion	RGCOOR	Coordinate frame 1001
Charge Location	CHRLOC	Node 1
Title	TITLE	Title

* Bar elements in PATRAN can only be plotted between nodes. However, ISTIFF and JSTIFF are element stiffeners. Therefore, in PATRAN the stiffeners are plotted at the adjacent nodes.

** When plotted in PATRAN, the force vectors (CLOAD) will not point in the correct direction because EI2PN does not have enough data to write out the correct PATRAN neutral file records. The force vectors can be used to check that they were applied to the correct nodes.

SAMPLE PATRAN SESSION

Figure 1 contains a sample PATRAN session for reading the PATRAN neutral file and plotting several features of the EPSA model. When reading in the neutral file, PATRAN might issue a warning message about some of the MPCs (MOMCON, PINCON). The warning message can be ignored and is relevant only if the PATRAN neutral file was of a NASTRAN finite element model. This PATRAN session and the PATRAN session in the next section can be used with PATRAN version 2.5. The PATRAN sessions will have to be modified for PATRAN version 3.0.

PATRAN input	Explanation
G	start
1	open new database
SET,BIGE,ON	allow for big element ids
SET,BIGN,ON	allow for big node ids
SET,LABEL,OFF	turn most labels off
SET,RMPC,3.	set radius of MPC circles to 3
VI	change the current view
1	absolute rotation
23,-34	view angles
NEU	go to neutral file menu
2	read in neutral file
test.in_neu	file name
N	do not offset ids
Y	read the file
CORD,1T#,ER	erase all coordinate systems
CORD,1000,PL	plot coordinate system 1000 (FLUSUR)
SET,RNODE,3.	set radius of nodes to 3
SET,LABN,ON	turn node labels on
NO,1,PL	plot node 1 (CHRLOC)
SET,LABN,OFF	turn node labels off
SET,RNODE,0.	set radius of nodes to 0
EL,1T10100,ER	erase elements 1 thru 10100 (FLUELM, etc.)
PL	plot
RUN,HIDE	hidden-line plot
PL	plot
BAR,1T#,PL	draw all bar elements (ISTIFF, JSTIFF)
MPC,1T#,ER	erase MPCs (MOMCON, PINCON)
SET,RDISP,3.	set radius of displacement set circles to 3
DISP,1,PL	plot supports (SUPORT)
SET,LABPRES,OFF	set pressure labels off
PRES,1,PL	plot pressure loads (ULOAD)
SET,ACTIVE,NONE	erase everything
EL,1T10100,PL	plot elements 1 thru 10100 (FLUELM, etc.)
ST	stop

Fig. 1. Sample PATRAN session to input a neutral file

EPSA GLOBAL OUTPUT REQUEST FILES TO PATRAN RESULTS FILES (EO2PR)

RUNNING EO2PR

PATRAN results files will be generated by EO2PR only if at least one of the global output requests (SVDEFM, SVVELO, SVDISP, SVSTRN, SVSTRS) is included in the EPSA input. EO2PR is run in the Cray batch job immediately after running EPSA. Figure 2 is a sample Cray batch job to run EPSA and EO2PR. As part of the Cray batch job, a three-line EO2PR input file is created. After running EO2PR, the user must move (dispose) the PATRAN results files to the Cray front-end computer. For each type of global output request, there is one PATRAN results file for each time step. Once the PATRAN results files have been disposed, they can be used for PATRAN postprocessing. The PATRAN results files are ASCII files and can be converted to binary files, to save disk space, with the PATRAN utility program READER.

```
#USER=xxx PW=xxx ACID=xxx
#QSUB -eo -lM 2MW -lT 1500 -q pzero -r epsa2
msacces -p xxx
# run EPSA
fetch TAPE5 -t 'test.in'
msfetch -n TAPE50 TAPE50
msfetch -n EPSA -u pujm -p WEIDLNG EPSA
chmod +x EPSA
EPSA
dispose TAPE6 -t 'test.out'
# get EO2PR source code and create an executable
fetch eo2pr.f -t 'eo2pr.f'
cft77 eo2pr.f
segldr -o eo2pr eo2pr.o
chmod +rx eo2pr
# get file from EI2PN containing node and element ids
fetch file_ids -t 'file_ids'
# create EO2PR input file eo2pr.in with cat command
# 1st line - name of node and element id file from EI2PN
# 2nd line - user-defined title used in PATRAN
# 3rd line - file prefix for PATRAN results files
cat > eo2pr.in << '/EOF'
file_ids
EPSA TEST PROBLEM
test
/EOF
# run EO2PR with eo2pr.in input file
eo2pr < eo2pr.in
# dispose PATRAN results files, where
# PREFIX is text string in the 3rd line of the EO2PR input
# NNN is the total number of time steps requested by a global output request
# EXT = defm for deformation results files (SVDEFM)
#       = velo for velocity results files (SVVELO)
#       = disp for displacement results files (SVDISP)
#       = strn for strain results files (SVSTRN)
#       = strs for stress results files (SVSTRS)
dispose PREFIX_ts001.EXT -t 'PREFIX_ts001.EXT'
dispose PREFIX_ts002.EXT -t 'PREFIX_ts002.EXT'
                    .
                    .
                    .
dispose PREFIX_tsNNN.EXT -t 'PREFIX_tsNNN.EXT'
```

Fig. 2. Sample Cray batch job to run EPSA and EO2PR

SAMPLE PATRAN POSTPROCESSING SESSION

Figure 3 contains a sample PATRAN session for performing some simple EPSA results postprocessing. The session assumes that a PATRAN database has already been created.

PATRAN input	Explanation
G	start
2	open existing database
patran.dat	database name
RU,DEFORM	plot deformed shape
test_ts003.disp	results file name for displacements
RU,CONT,DISP,0	contour displacement magnitude
2	current file
1	auto assignment of colors
RU,HI,FRI,DEFORM	hidden-line plot of deformed shape with contours
E	end hide menu
RU,AS,COL,1	assign results in column 1 to elements
test_ts003.strn	results file for assignment
1	auto assignment of colors
RU,HI,FILL	hidden-line plot with elements color-coded
ST	stop

Fig. 3. Sample PATRAN session to do results postprocessing

PATRAN RESULTS FILE COLUMNS

Each PATRAN results file contains data in columns. The column numbers are needed for the PATRAN RUN,CONTOUR and RUN,ASSIGN commands. Each column corresponds to a different result component, which in turn corresponds to the components for each EPSA global output request. For example, column 2 of a strain results file corresponds to EYY, the strain in the y direction at the element mid-thickness.

REFERENCES

1. "EPSA Reference Manual," Weidlinger Associates, Inc., New York, NY, 1991.
2. "PATRAN Plus User Manual," PDA Engineering, Costa Mesa, CA, 1987.

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