Oct 2003

ESARAD v5.4

Bruno CASTELLI

ALSTOM

ESARAD v5.4

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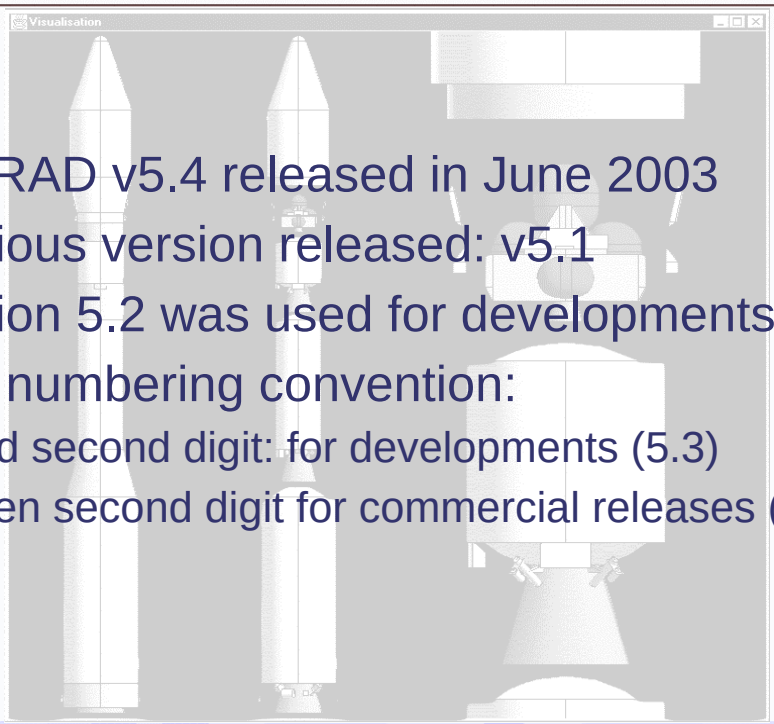

- ESARAD v5.4 released in June 2003
- Previous version released: v5.1
- Version 5.2 was used for developments
- New numbering convention:
  - odd second digit: for developments (5.3)
  - even second digit for commercial releases (5.4)

ESARAD v5.4

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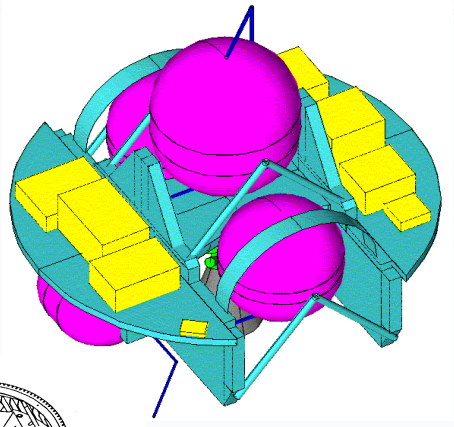
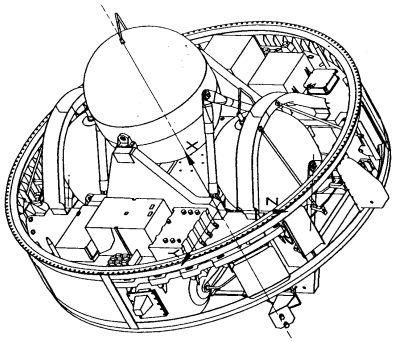
- List of new features
  - New Combine Shell
  - Recursive Attribute Editing
  - Spacecraft Orientation
  - Simplified Kernel Language
  - ACG
  - New Custom Menu
  - NASTRAN Converter
  - New HDF Data Format
- Short demo if time permitting





- Objectives -

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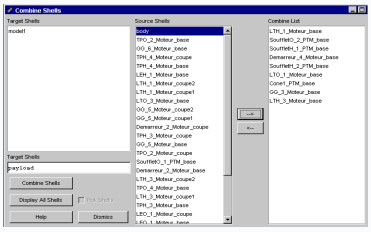
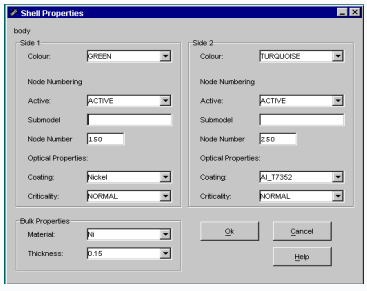
Geometry - New features

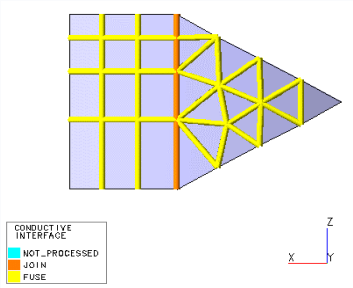


- New Combine Shell Dialog



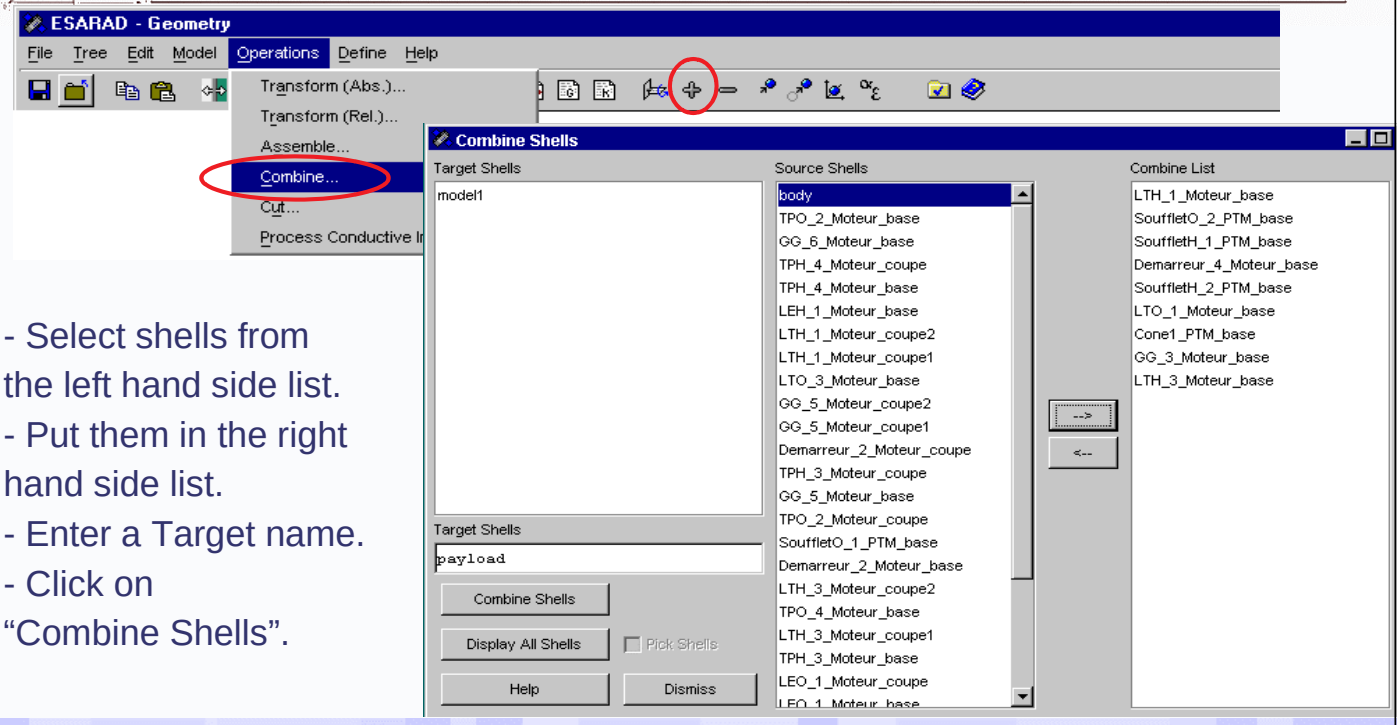
- Recursive Attribute Editing

- ACG



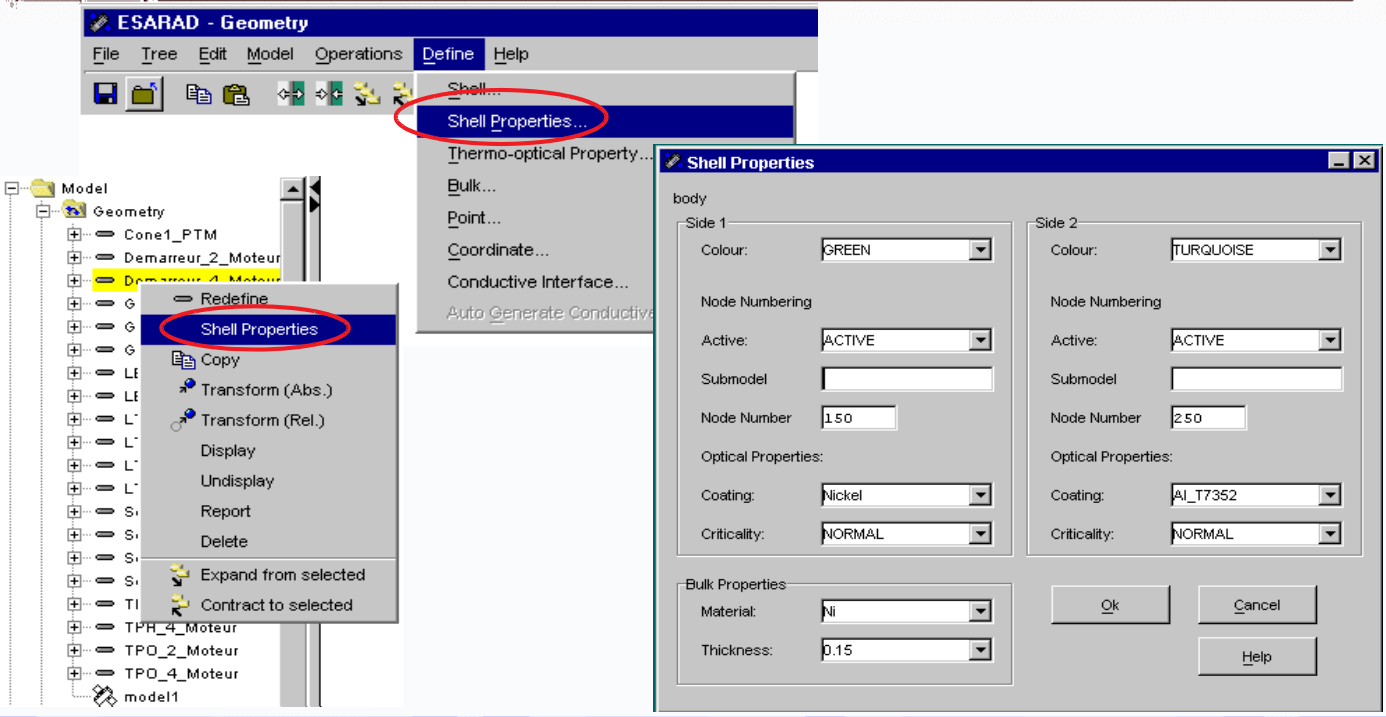
- Geometry Summary -

New Combine Shell Dialog



- Select shells from the left hand side list.
- Put them in the right hand side list.
- Enter a Target name.
- Click on “Combine Shells”.

Recursive Attribute Editing

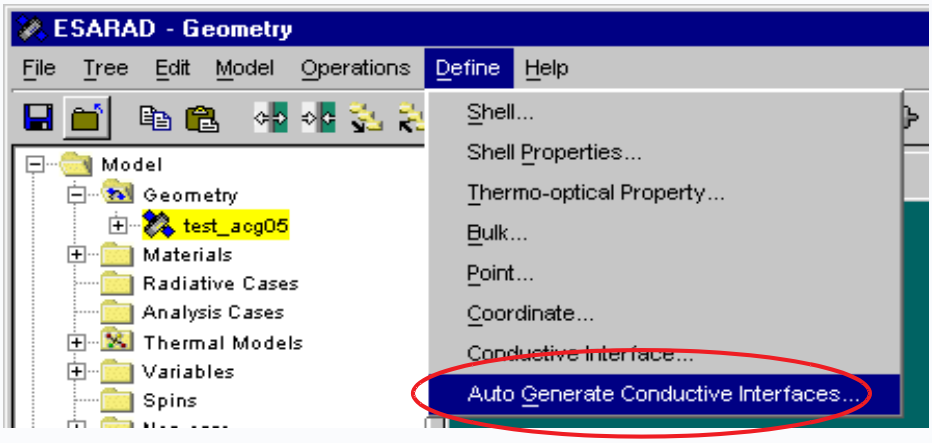


Automatic Conductance Generator

- Automate Calculations of Linear Conductances
- Recognise interface between two shells
- Output GL value to ESATAN file
- Works on uncut shell primitives
- Contact on common straight edge
- All intra GLs computed
- Inter GLs between Quads and Triangles only

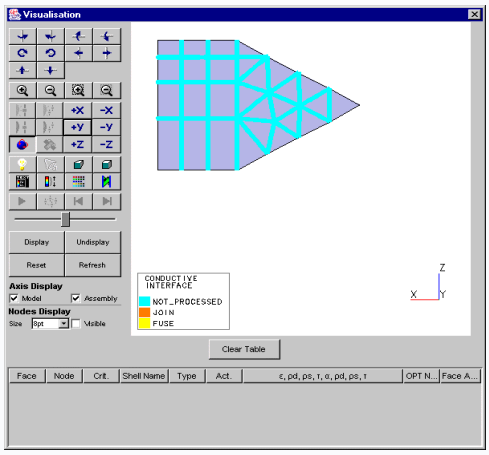
1st Option: Automatic

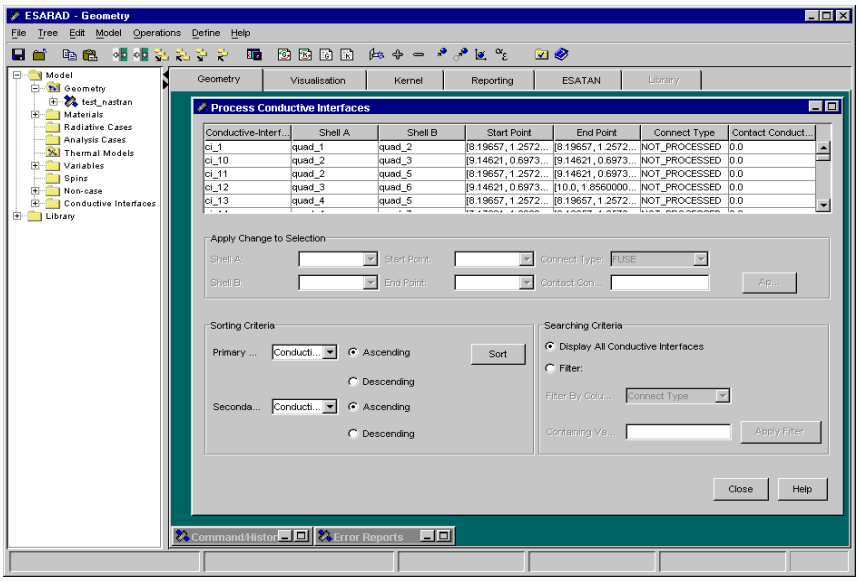
After having assigned the model, still in the Geometry workspace:



ESARAD will automatically detect the conductive interfaces, display them in the visualisation window and pop the dialog to process the interface type

1st Option: Automatic





The interfaces are default to NOT_PROCESSED

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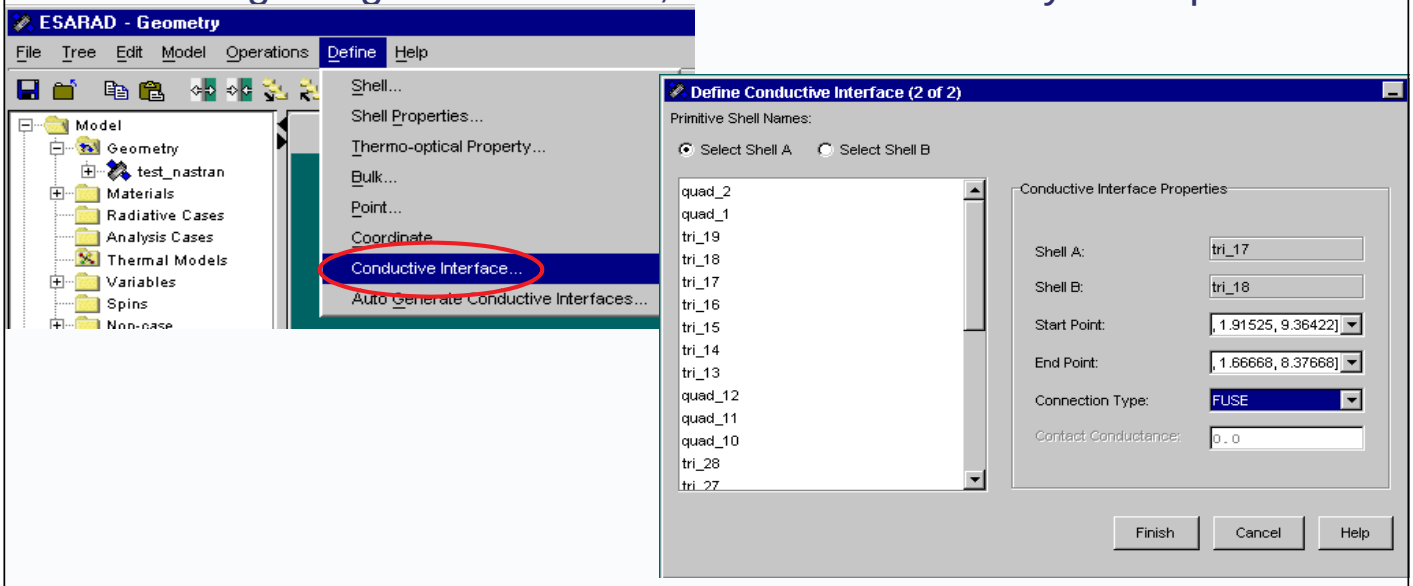
1st Option: Automatic

- The Connection type can then be changed to one of the following:
  - FUSE: two shells form a single continuous surface
  - JOIN: two surfaces are linked by a contact conductance
  - NOT_PROCESSED: default
  - NOT_REQUIRED

- The Connection type can then be changed by either:
  - Clicking in the visualisation window on a conductive interface
  - Selecting the interface from the list in the dialog

2nd Option: Manual

After having assigned the model, still in the Geometry workspace:



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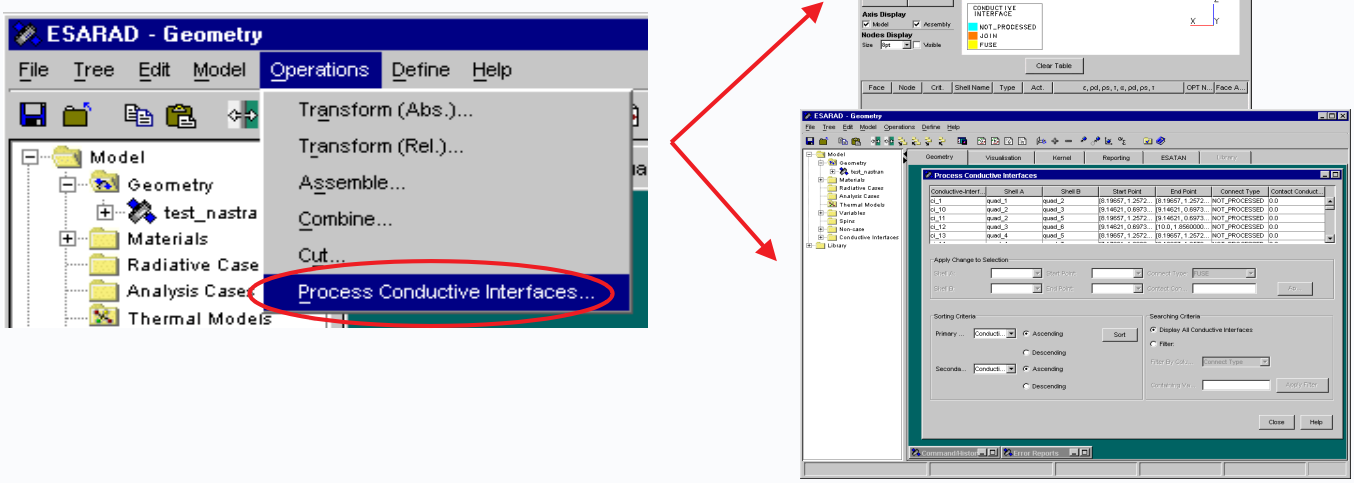
2nd Option: Manual

To visualise the Conductive Interfaces and their parameter:



- Geometry New Features -

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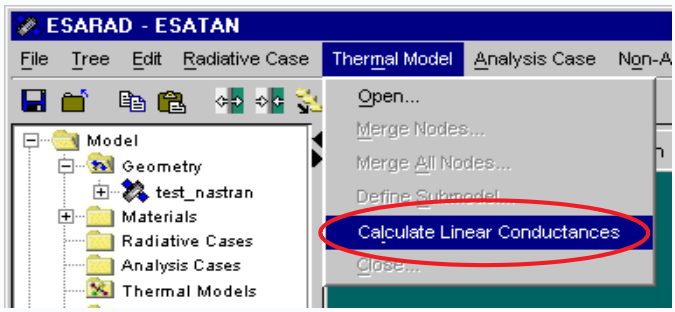
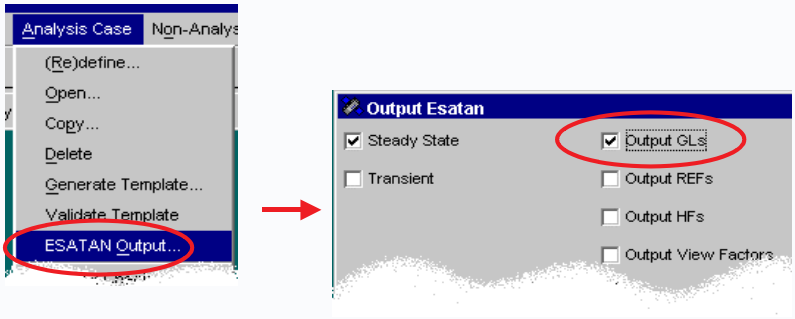
Outputting GLs to ESATAN

1. Calculate Linear Conductance in the Thermal Model Menu:



2. Click Output GL in the Analysis Case:



- Geometry New Features -

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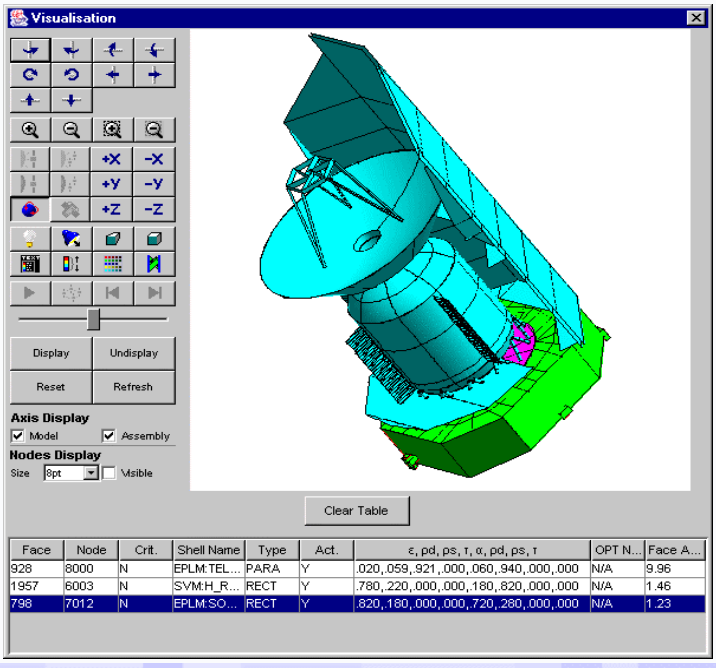
Visualisation - New features

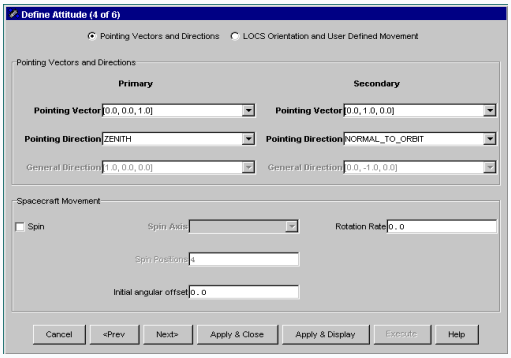
Background defaults to White



- Visualisation New Features -

Kernel - New features

- New Spacecraft orientation



- Simplified Kernel Language

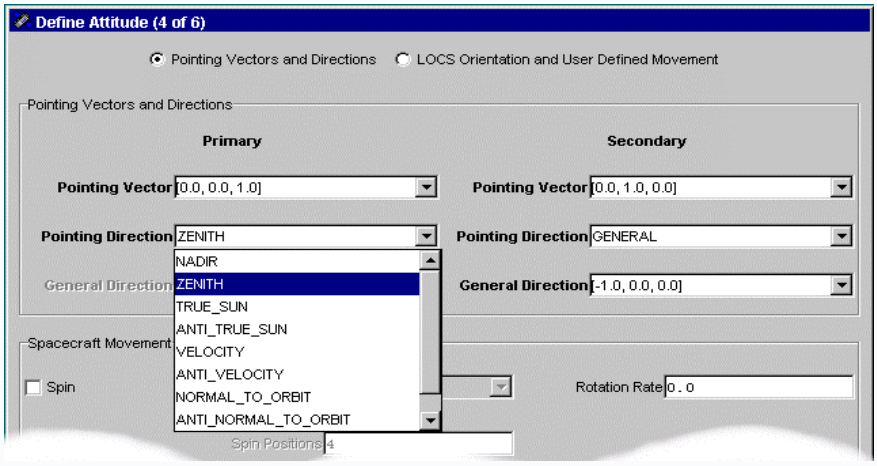
```
FOR (orbit_index = 1;
    orbit_index <= rcase.NUM_ORBIT_POSITIONS;
    orbit_index = orbit_index + 1)

    CALCULATE (
        radiative_case = rcase,
        calc_types = "REF, SDF, SAF",
        pos_index = orbit_index,
        eclipse_check = TRUE);
END_FOR
```


New Spacecraft orientation

- Primary and Secondary vectors make it easier to define the spacecraft orientation within the orbit

- Select vectors from the GUI



- Old LOCS Orientation method still working

Simplified Kernel Language

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All the previous calculate functions have been replaced with one new calculate method

CALCULATE_ORBIT_POSITION
CALCULATE_ORBIT_POSITION_WITH_SPIN
CALCULATE_PLANET_ABSORBED_FLUX_MATRIX
CALCULATE_PLANET_ABSORBED_FLUX_RAYTRACING
CALCULATE_PLANET_DIRECT_FLUX
CALCULATE_SOLAR_ABSORBED_FLUX_MATRIX
CALCULATE_SOLAR_ABSORBED_FLUX_RAYTRACING
CALCULATE_SOLAR_DIRECT_FLUX
CALCULATE_VIEW_FACTORS
CALCULATE_RADIATIVE_EXCHANGE_FACROTRS_MATRIX
CALCULATE_RADIATIVE_EXCHANGE_FACROTRS_RAYTRACING

} CALCULATE (…,…)

Simplified Kernel Language

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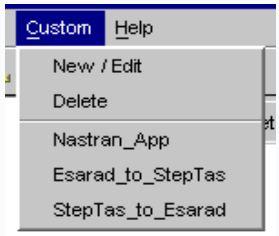
Example of a new CALCULTE method for a moving geometry:

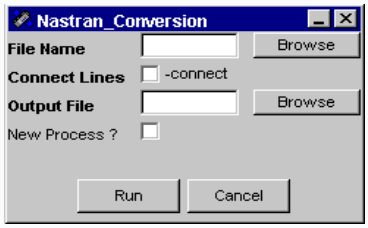
```
FOR (orbit_index = 1;
     orbit_index <= rcase.NUM_ORBIT_POSITIONS;
     orbit_index = orbit_index + 1)

     CALCULATE (
          radiative_case = rcase,
          calc_types = "REF, SDF, SAF",
          pos_index = orbit_index,
          eclipse_check = TRUE);
END_FOR
```

Library - New features

- New Custom Menu



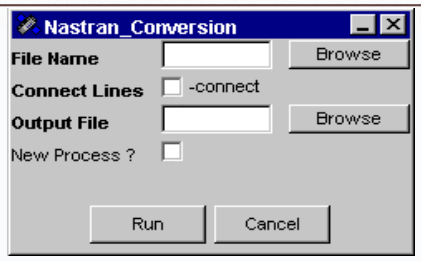
- NASTAN Converter



New Custom Menu

- Allows external process to be called from within ESARAD
- Can integrate user's application to work with ESARAD
- Can launch program or access system functions without needing to leave ESARAD
- Call NASTRAN converter
- Call STEP-TAS converter
- In the Library workspace

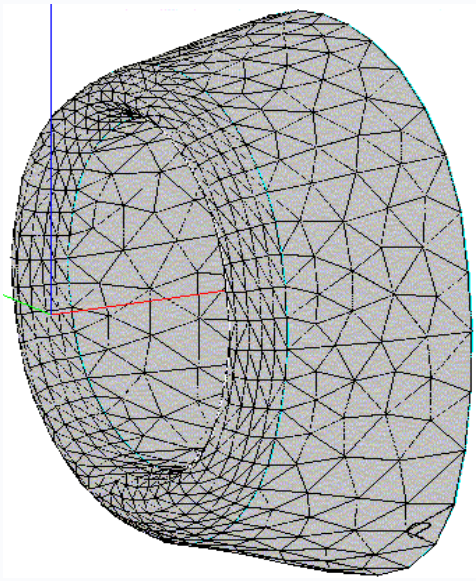
NASTRAN Converter



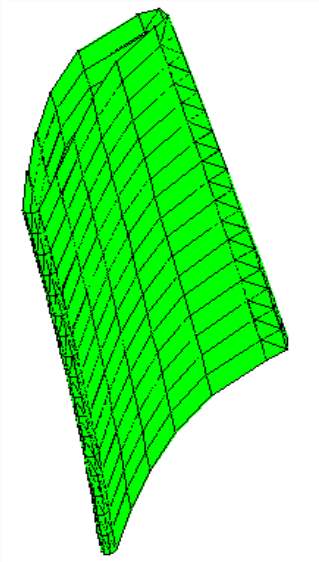
- Converts MSc/NASTRAN input files into ESARAD
- Only supports thin shells and elements (TRIA and QUAD)
- Maps GRID points ⇨ ESARAD Points Variables
- Maps FE elements ⇨ ESARAD shells
- Does not translate Material data yet
- Can be used with Combine Shells & Recursive Attribute

NASTRAN Converter

Examples



Nacelle Air-Inlet



Turbine Blade

- Library New Features -

Data Format - New features

- New Data Store HDF (Hierarchical Data Format)
- Neutral Binary
- Platform Independent
  - same model can be opened from any platform
  - can transfer a complete model (with all data) to another site
- Only compatible with ESARAD v5.4 onwards

Conclusion

Chris KIRTLEY will present future developments after the break.

ESARAD Demo

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ESARAD v5.4 Demo

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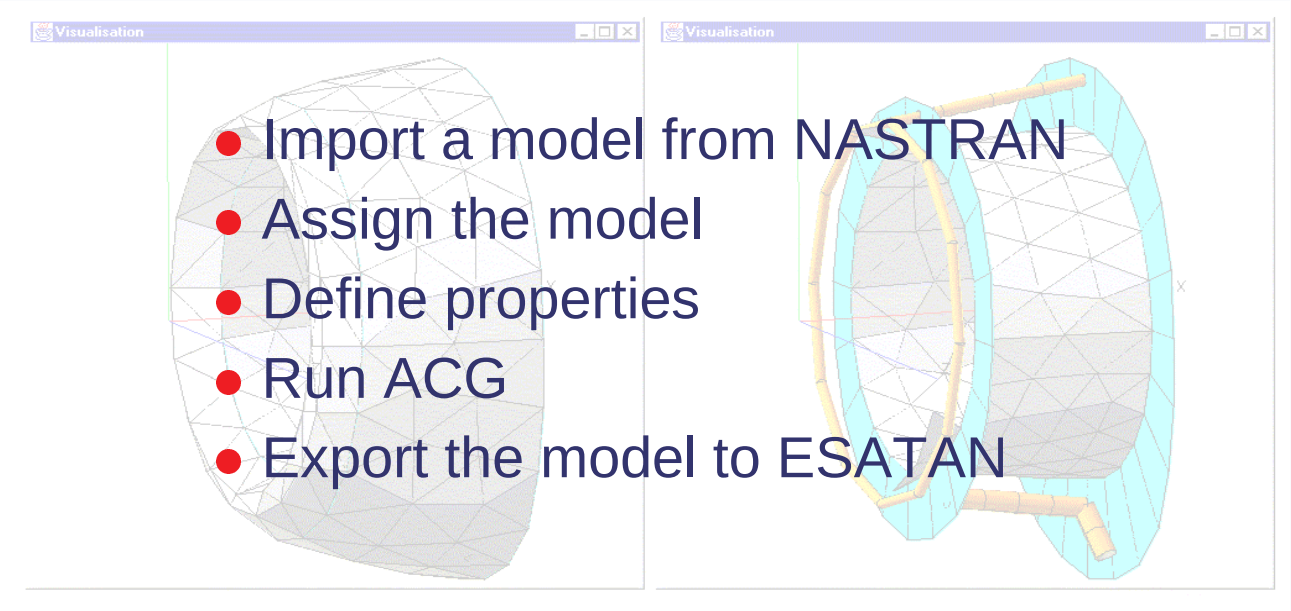


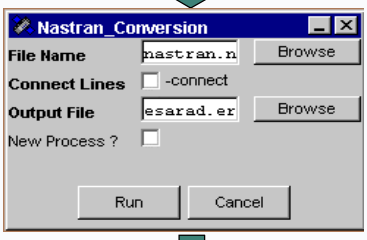
- Import a model from NASTRAN
- Assign the model
- Define properties
- Run ACG
- Export the model to ESATAN

- Demo Objectives -

Import from NASTRAN

```
$ Nacelle Model
$ Nodes of the Entire Model
GRID     1               84.392  .747553 284.677
GRID     2               84.4176 .230045 286.886
GRID     3               84.4584 .691363 289.099
GRID     4               84.5148 .131917 291.317
GRID     5               84.5866 .551467 293.538
GRID     6               84.6738 .949566 295.763
GRID     7               84.7758 .325148 297.992
GRID     8               84.8929 .676673 300.222
GRID     9               85.0255 .004253 302.455
GRID     10              85.173  .307992 304.692
GRID     11              85.3344 .587392 306.928
(...)
CTRIA3   1       1       55      37      56
CTRIA3   2       1       38      56      37
CTRIA3   3       1       37      19      38
CTRIA3   4       1       20      38      19
CTRIA3   5       1       19      1       20
CTRIA3   6       1       2       20      1
CTRIA3   7       1       56      38      57
CTRIA3   8       1       39      57      38
CTRIA3   9       1       38      20      39
CTRIA3   10      1       21      39      20
CTRIA3   11      1       20      2       21
(...)
CQUAD4   103     1       163     145     146     164
CQUAD4   104     1       145     127     128     146
CQUAD4   105     1       127     109     110     128
CQUAD4   106     1       109     91      92      110
CQUAD4   107     1       91      73      74      92
CQUAD4   108     1       164     146     147     165
CQUAD4   109     1       146     128     129     147
CQUAD4   110     1       128     110     111     129
CQUAD4   111     1       110     92      93      111
CQUAD4   112     1       92      74      75      93
CQUAD4   113     1       165     147     148     166
CQUAD4   114     1       147     129     130     148
CQUAD4   115     1       129     111     112     130
CQUAD4   116     1       111     93      94      112
$ Referenced Coordinate Frames
ENDDATA a594743b
```

NASTRAN .ns file

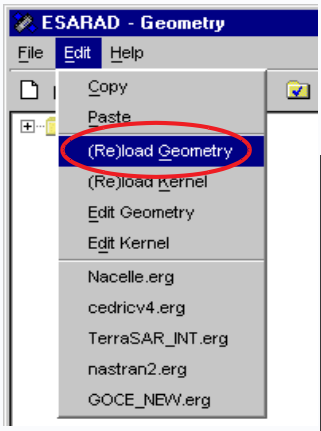


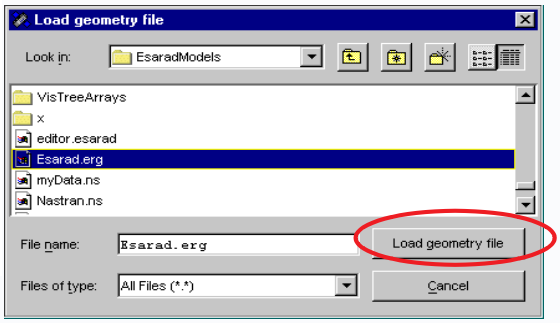

```
BEGIN_MODEL  Nacelle   ESARAD_NODE_NUMBERING ESARAD_GENERATED

 POINT  POINT_20 = [7.756000e-001, 6.174700e-001, -2.798000e-001];
 POINT  POINT_21 = [7.756000e-001, 5.199400e-001, -4.438000e-001];
 POINT  POINT_22 = [7.756000e-001, 3.691100e-001, -5.603000e-001];
 POINT  POINT_23 = [7.756000e-001, 1.904300e-001, -6.276000e-001];
 POINT  POINT_24 = [5.406600e-001, 0.000000e+000, 6.219500e-001];
 POINT  POINT_25 = [4.807400e-001, 1.548600e-001, -6.002000e-001];
 POINT  POINT_26 = [4.748900e-001, 4.778000e-001, -4.199000e-001];
 POINT  POINT_27 = [6.381200e-001, 1.237600e-001, -6.272000e-001];
 POINT  POINT_28 = [6.023300e-001, 1.513800e-001, 6.185200e-001];
 POINT  POINT_29 = [6.219700e-001, 3.094500e-001, 5.714600e-001];
 POINT  POINT_30 = [4.446300e-001, 1.248900e-001, 5.994100e-001];
(...)

SHELL quad_1;
quad_1 = SHELL_QUADRILATERAL (
   point1 =  POINT_144,
   point2 =  POINT_1,
   point3 =  POINT_3,
   point4 =  POINT_145,
   colour1 = "CYAN",
   colour2 = "CYAN",
   label = "Fwd Bulkhead",
  nbase1 = 109,
  nbase2 = 119,
   opt1 = AMS4911_coat,
   opt2 = AMS4901_coat,
   bulk = AMS4901_mat,
   thick = Ti32_thick);
(...)

SHELL tri_43;
tri_43 = SHELL_TRIANGLE (
   point1 =  POINT_3,
   point2 =  POINT_1,
   point3 =  POINT_25,
   colour1 = "WHITE",
   colour2 = "WHITE",
  nbase1 = 209,
  nbase2 = 209,
  side2 = "INACTIVE",
   opt1 = Al2219_coat,
   bulk = Al2219_mat,
   thick = Al63_thick);

PURGE_MODEL ();
END_MODEL
```

ESARAD .erg file

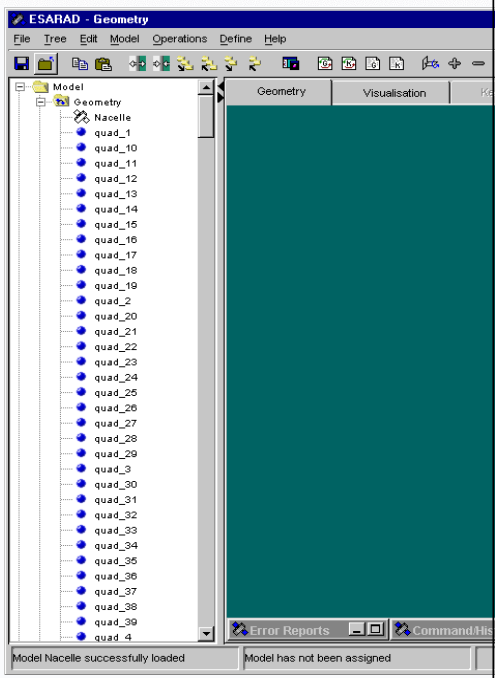
- Demo -

Import .erg file





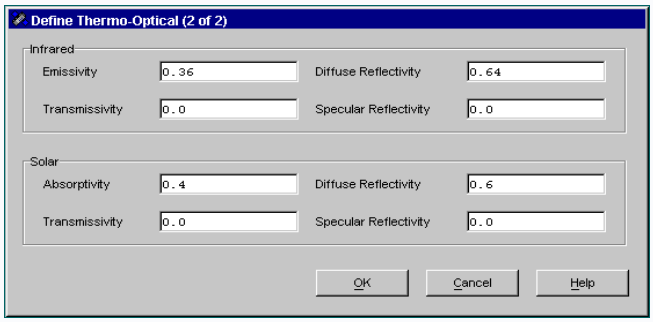
Create et open the model in ESARAD



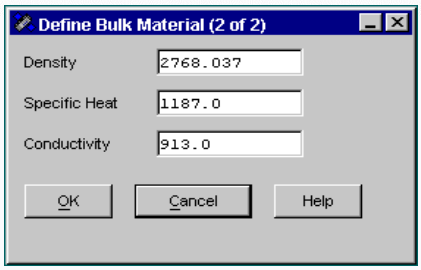
- Demo -

Assign the model

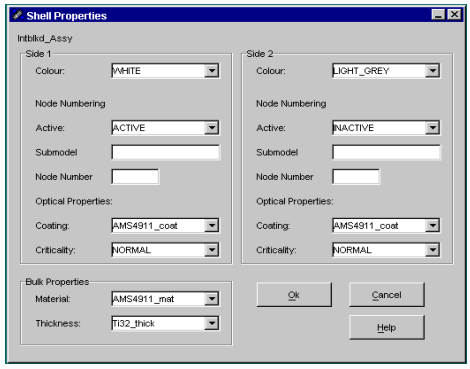
1. Define Optical Properties



2. Define bulks

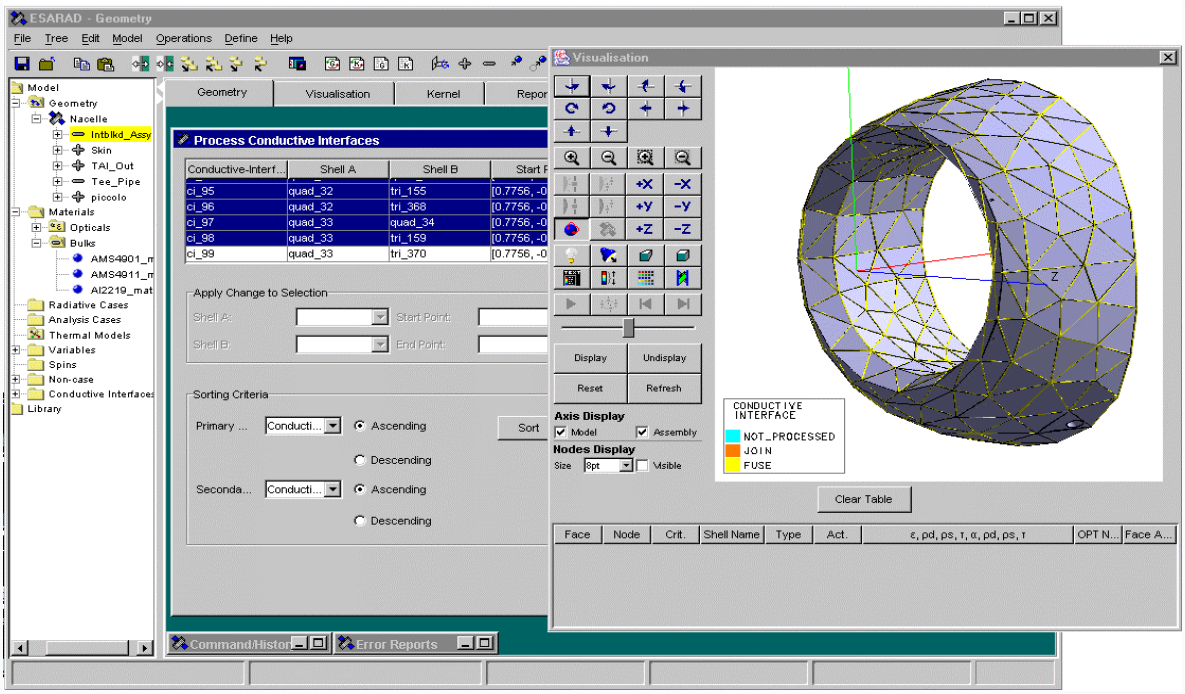


3. Assign properties



- Demo -

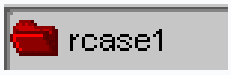
Run ACG



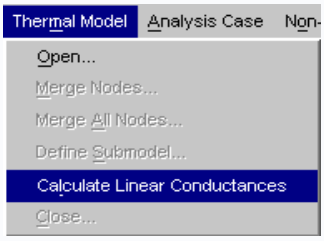
- Demo -

Export model to ESATAN

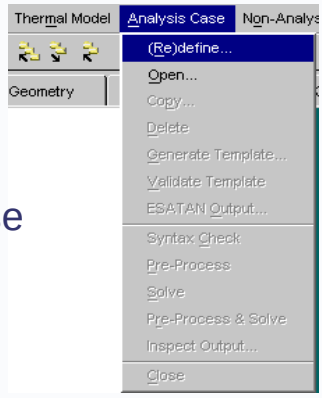
1. Run a kernel

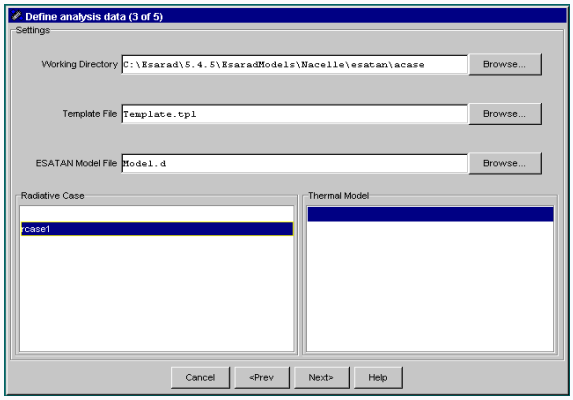


2. Calculate Linear Conductances



3. Open an Analysis Case

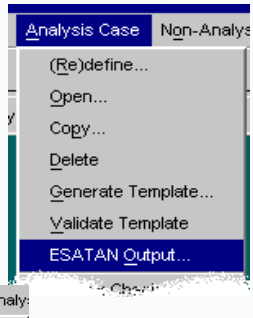


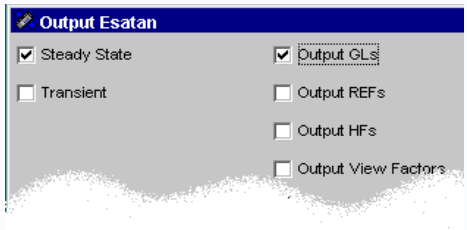


- Demo -

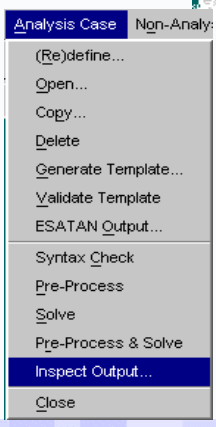
Export model to ESATAN

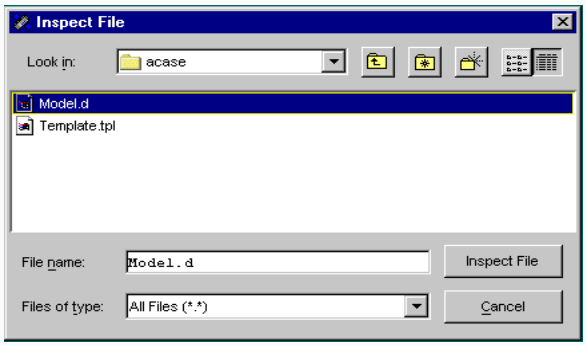
4. Output to ESATAN





5. Inspect Output





- Demo -

Inspect ESATAN Input File

```
# Esarad version 5.4.5, run date 11:40 Mon 20 Oct 2003
# Model name: Nacelle          Analysis case: acase
$MODEL Nacelle_acase
  $LOCALS
  $NODES
    D1 =  'Piccolo', T = 0.000000,
     A = 0.021944, ALP = 0.400000, EPS = 0.360000;
    D2 =  'Piccolo', T = 0.000000,
     A = 0.021944, ALP = 0.400000, EPS = 0.360000;
(...)

  $CONDUCTORS
    GR(204, 205) = 0.000447918;
    GR(204, 206) = 0.000167911;
    GR(204, 207) = 0.000107477;
(...)

    GL(203,204) = k_Al2219_mat * 0.00744496;
    GL(267,287) = k_Al2219_mat * 0.00426211;
    GL(281,290) = k_Al2219_mat * 0.00555827;
(...)

  $CONSTANTS
    $REAL
      # Material data for 'AMS4901_mat'
      Cp_AMS4901_mat = 0.000000;
      Dens_AMS4901_mat = 4511.900000;
#
      # Material data for 'AMS4911_mat'
      Cp_AMS4911_mat = 0.000000;
      Dens_AMS4911_mat = 4428.859000;
#
      # Material data for 'Al2219_mat'
      Cp_Al2219_mat = 0.000000;
      Dens_Al2219_mat = 2768.037000;
#
      # Conductivity from bulk 'Al2219_mat'
      k_Al2219_mat = 120.000;
```

```
  $ARRAYS

  $SUBROUTINES
      SUBROUTINE QCYCLC LANG = MORTRAN
        RETURN
      END
      SUBROUTINE QAVERG LANG = MORTRAN
        RETURN
      END
      SUBROUTINE RCYCLC LANG = MORTRAN
        RETURN
      END

  $INITIAL
      C101 = 0.000019 * Cp_AMS4901_mat * Dens_AMS4901_mat
      C102 = 0.000038 * Cp_AMS4901_mat * Dens_AMS4901_mat
      C103 = 0.000037 * Cp_AMS4901_mat * Dens_AMS4901_mat
(...)

  $VARIABLES1
       IF (SOLVER(:2) .EQ. 'SS') THEN
          CALL QAVERG
       ELSE
          CALL QCYCLC
          CALL RCYCLC
       END IF
  $VARIABLES2
  $EXECUTION
  # Steady State Solution
       RELXCA=0.001
       NLOOP=1000
       CALL SOLVIT
  # Transient Solution
       TIMEND=PERIOD
       DTIMEI=TIMEND/100.0
       OUTINT=TIMEND/10.0
       CALL SLFWBK
  $OUTPUTS
       CALL PRNDTB(' ','I,T,QS,QE,QA,C',CURRENT)
       CALL DMPGFF(' ',CURRENT)
$ENDMODEL #Nacelle_acase
```

- Demo -

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