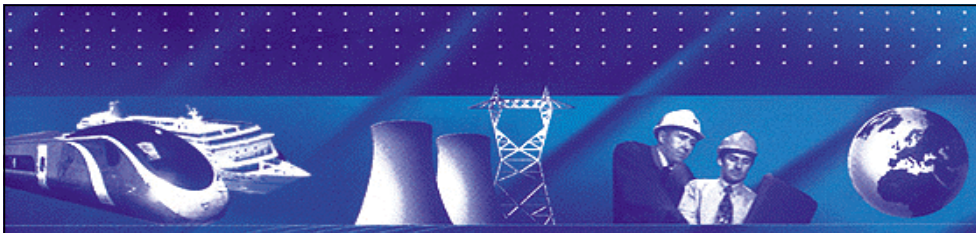

15th European Workshop on
Thermal and ECLS Software
ESTEC, The Netherlands
October 9-10, 2001

ARTIFIS / TOPIC / ThermXL

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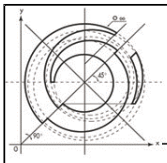
ALSTOM

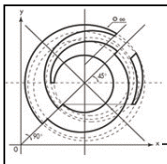


ARTIFIS – Thermal Analyser

ALSTOM

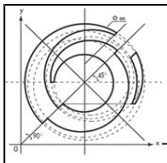
A.R.T.I.F.I.S.: *'Accurate Reference Tool for Incident Fluxes Impinging on Spacecraft'*

- Presented at ESTEC in 1996 (ECLS Workshop)
- Benchmarked with handbook *'Spacecraft thermal control design data'*
- Acted as reference to validate incident fluxes calculated by ESARAD v-3



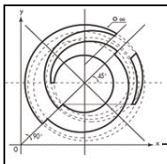
ARTIFIS – Features

- Pre-phase A in-house *thermal analyser*
  - Fast and easy to use
  - Same ‘concept’ as ESARAD
  - Simple orbiting surfaces
  - Batch process, MS-DOS / Unix
- Incident fluxes calculated by means of analytical expressions
  - Accurate and reliable results
  - One single orbit



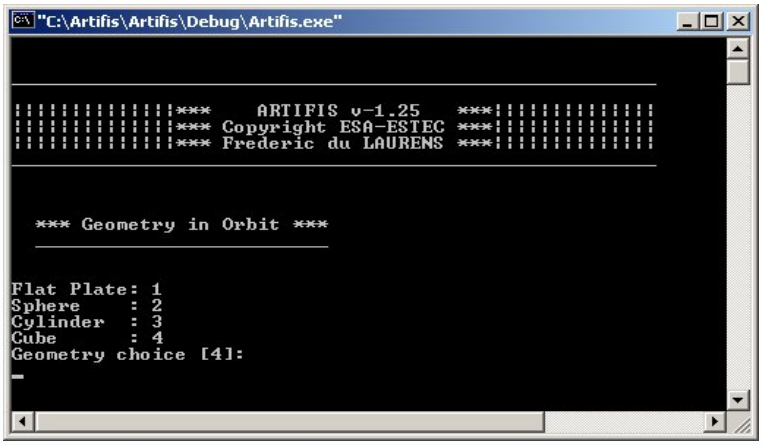
ARTIFIS – Current Developments

- Already in use at ESTEC since 1998
- First version distributed with ESARAD v-4.2 earlier this year
- Improvements carried out over the last year by Duncan Gibson (ESTEC)
  - New code standards
  - CPU improvements
  - No new major functionality

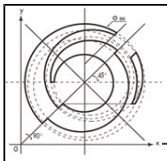


ARTIFIS – Geometry

- Flat plate
- Cylinder
- Sphere
- Cube



- Spin available for flat plate and cylinder
- Coating is assumed to be black paint



ARTIFIS – 'Kernel'

- Same standards as ESARAD v-3
  - One single orbit
  - LOCS – planet or 'Sun' oriented
  - Euler angles – φ, ψ and ω
- Incident fluxes calculated by means of analytical expressions
  - Simpson's integration method
  - Accurate and reliable results

ARTIFIS – Ouput

- Output Files
  - FluxResults.rpt
  - FluxResults.GFF

FluxResults.rpt - WordPad

File Edit View Insert Format Help

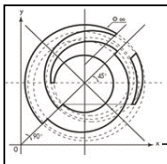
```
ARTIFIS v-1.0 REPORT
--------------------

Flat Plate.

Flat plate area=1.00 m2
LOCS: Planet oriented.

Euler angles:  phi=0.0 deg  psi=180.0 deg  omega=0.0 deg

E=1360.0 W/m2      delta=23.00 deg
Rp=6371.0 km       gc=9.80655 m/s2
Temp=288.0 K       Albedo=0.300

Za=800.00 km       Zp=800.00 km
a=7171.00 km       e=0.000000  i=98.0 deg
alpha=0.0 deg      Omega=135.0 deg

Beta=36.17 deg     Eclipse: Yes


  ANGLE          TIME            IS            IP            IA       IS+IA+IP

   0.00           0.00         0.000       307.928         0.000       307.928
  18.83         316.39         0.000       307.928         0.000       307.928
  19.33         324.79       620.285       307.928         0.000       928.212
  45.00         755.95       166.733       307.928         2.371       477.032
  90.00        1511.90         0.000       307.928       152.023       459.951
 135.00        2267.85         0.000       307.928       254.024       561.952
 180.00        3023.80         0.000       307.928       207.221       515.149
 225.00        3779.76         0.000       307.928        41.401       349.329
 268.14        4504.39       620.285       307.928         0.000       928.212
 268.64        4512.79         0.000       307.928         0.000       307.928
 270.00        4535.71         0.000       307.928         0.000       307.928
 315.00        5291.66         0.000       307.928         0.000       307.928
 360.00        6047.61         0.000       307.928         0.000       307.928

 AVERAGE                      76.499       307.928        81.959       466.386
```

For Help, press F1

ARTIFIS – Quick Demo

"C:\Artifis\Artifis\Debug\Artifis.exe"

```
Number of orbital positions, N [8]:
60
Number of orbital positions = 60

Shadow offset, offset [0.50 deg]:

Shadow offset = 0.50

   *** LOCS Orientation ***
   ------------------------


PLANET ORIENTED: 1
SUN ORIENTED   : 2
LOCS orientation choice [1]:
1
PLANET_ORIENTED. Please wait...

Solar flux:
0   10   20   30   40   50   60   70   80   90   100%
!----+----+----+----+----+----+----+----+----+----!
************************************************** Completed!

Planet flux:
0   10   20   30   40   50   60   70   80   90   100%
!----+----+----+----+----+----+----+----+----+----!
************************************************** Completed!

Albedo flux:
0   10   20   30   40   50   60   70   80   90   100%
!----+----+----+----+----+----+----+----+----+----!
**********
```

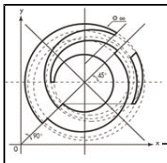


TOPIC – Thermal Designer

ALSTOM

T.O.P.I.C.: *'Thermal and Orbital Propagated Information Calculator'*

- Presented at ESTEC in 1998 (ECLS Workshop)
- Built on top of ARTIFIS
- Benchmarked with handbook *'Spacecraft thermal control design data'*



TOPIC – Features

ALSTOM

- Pre-phase A in-house *thermal designer*
  - Fast and easy to use
  - Simple Earth-orbiting surfaces
  - Analysis performed throughout a mission timeline
  - J_2 perturbation, Sun-synchronous orbit
  - Batch process, MS-DOS / Unix
- Incident fluxes calculated by means of analytical expressions
  - Accurate and reliable results

TOPIC – Current Developments

- Already in use at ESTEC since 1999
- First version distributed with ESARAD v-4.2 earlier this year
- Improvements carried out over the last year by Duncan Gibson (ESTEC)
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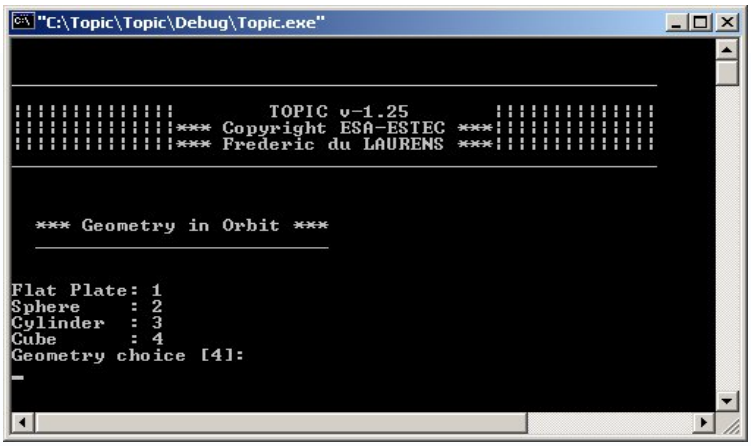
- Flat plate
- Cylinder
- Sphere
- Cube



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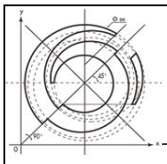

TOPIC – Thermal Design

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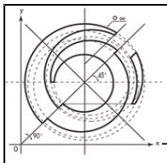


TOPIC – Ouput Files

- FluxDetails.rpt
  - Flux values in detail, each orbital position
- Thermal.rpt
  - Fluxes, eclipse, β angle, solar constant...
- Solar.rpt
  - Equation of time, Julian date, solar declination...
- MinMaxESH.rpt
  - Min and max values, ESH...
- Orbits.rpt

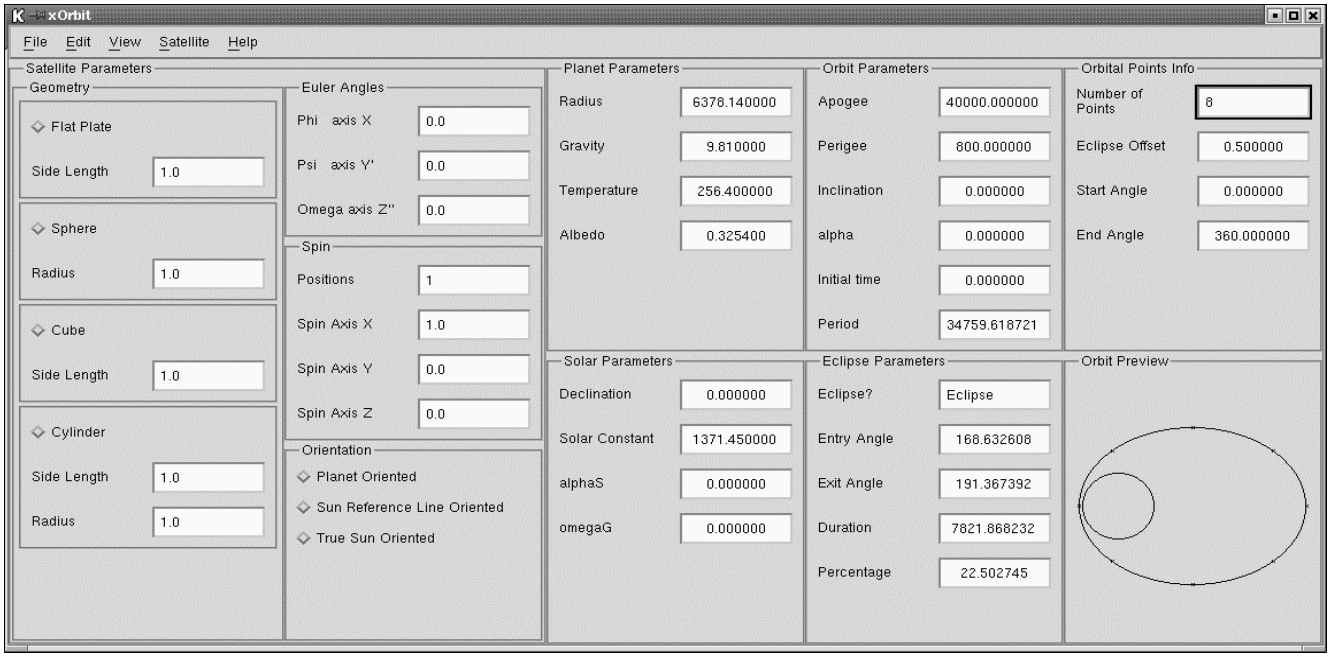
TOPIC – Quick Demo

ALSTOM

```
"C:\Topic\Topic\Debug\Topic.exe"

  *** Points in Orbit ***
  ------------------------

Number of orbital positions, N [8]:
16
Number of orbital positions == 16
Shadow offset, offset [0.50 deg]:
Shadow offset, offset, == 0.50
  *** Mission Definition ***
  --------------------------

No : 0
Yes: 1
Mission from input file [0]:
1
Reading mission information from input file
File name [Orbits.rpt]:
WARNING: Orbits.rpt has been taken as default value.
Reading file Orbits.rpt
Please wait...
File read successfully.
0   10   20   30   40   50   60   70   80   90   100%
|----+----+----+----+----+----+----+----+----+----|
**********
```


TOPIC – Future Developments

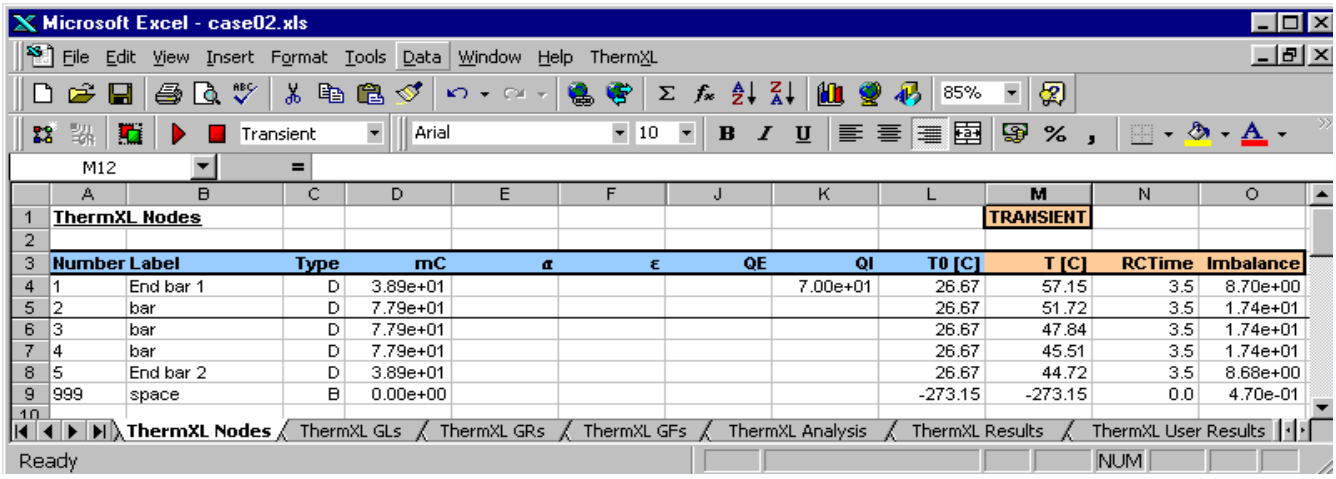
ALSTOM



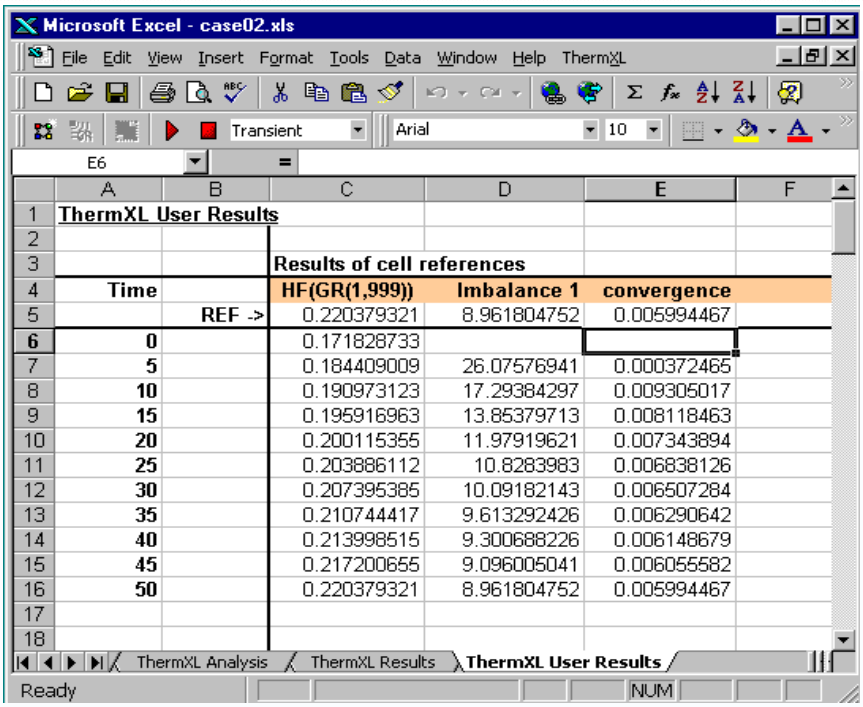
ThermXL v-2.0 – Status

- Final testing currently on-going
  - Actual release expected late October 2001
- Four major enhancements
  - Heat balance calculation for each node
  - Worksheet ‘User Results’ automatically generated
  - ESATAN file export
  - Possibility of using Visual Basic (macros...)

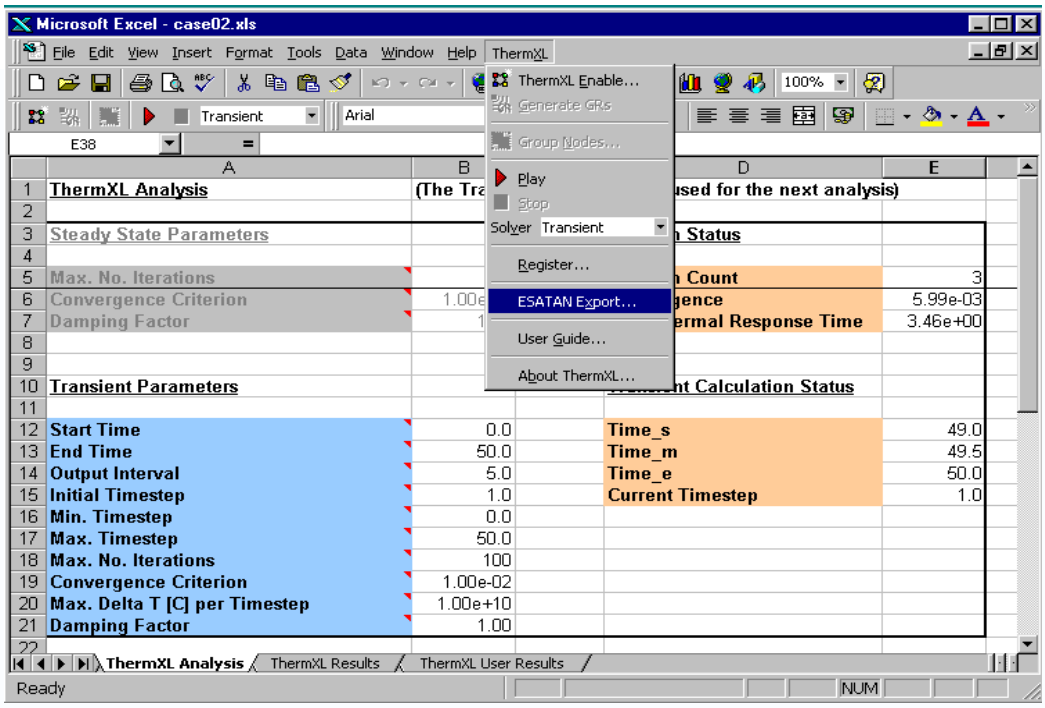
ThermXL v-2.0 – Imbalance



ThermXL v-2.0 – User Results



ThermXL v-2.0 – ESATAN Export



ThermXL v-2.0 – VB Macros