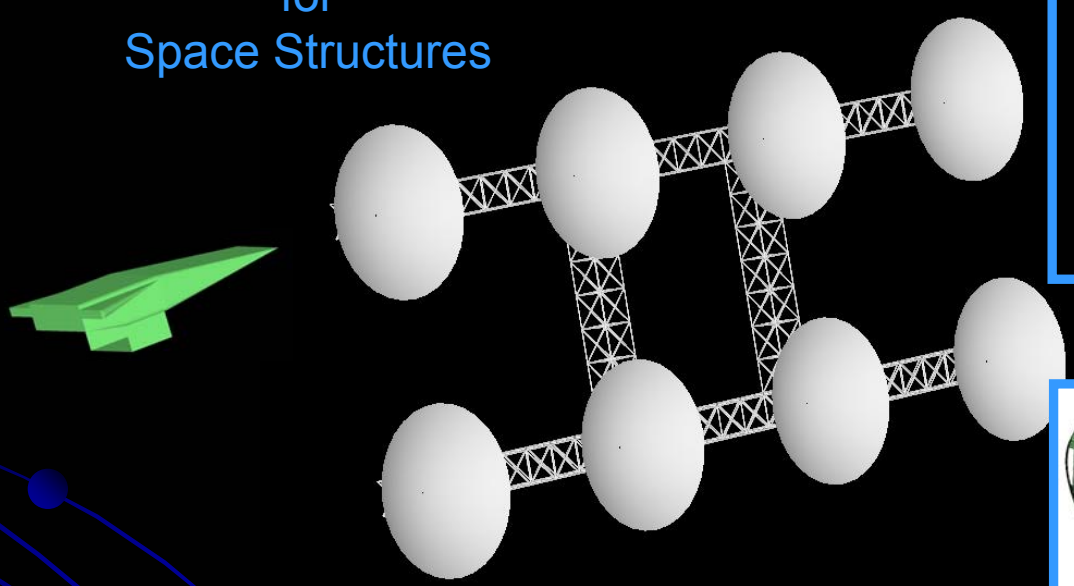
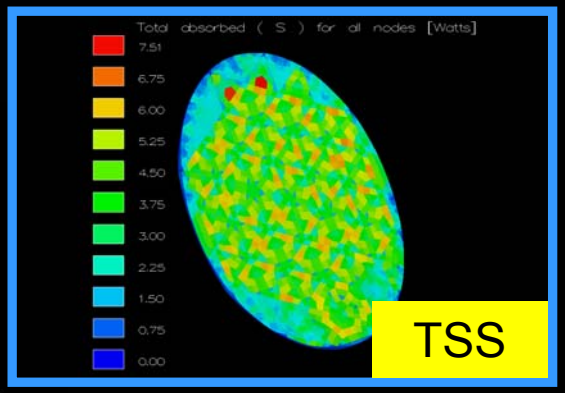
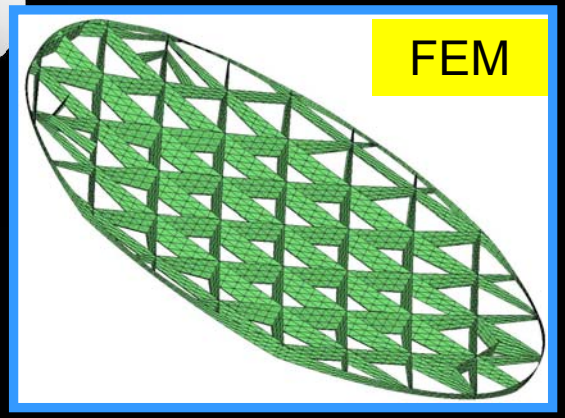
Spacedesign TSS and FEM

Enterprise Engineering Software
for
Space Structures







Spacedesign Corporation
Houston, TX
www.spacedesign.com

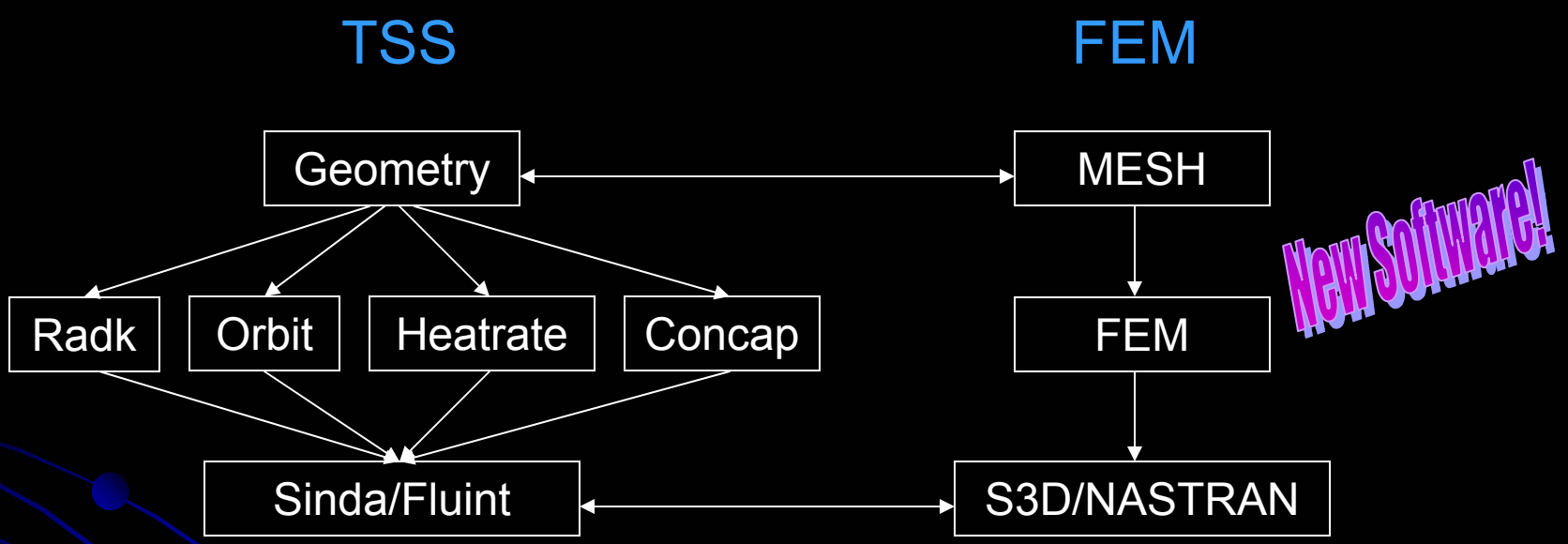
Spacedesign - TSS and FEM

- Spacedesign's products, that provide Enterprise Engineering Solutions, consist of the industry workhorse Thermal Synthesizer System (TSS) providing thermal analysis and two new applications called MESH and Finite Element Method (FEM) that provide structural analysis.
- The following enhancements and/or capabilities of TSS and FEM will be discussed
  - Computational Geometry in Thermal Analysis
  - Integrated Structural and Thermal Analysis
  - Thermal and Structural Part Analysis

Spacedesign Corporation
Houston, TX
www.spacedesign.com

Spacedesign TSS and FEM

Enterprise Engineering Software Solutions



Spacedesign Corporation
Houston, TX
www.spacedesign.com

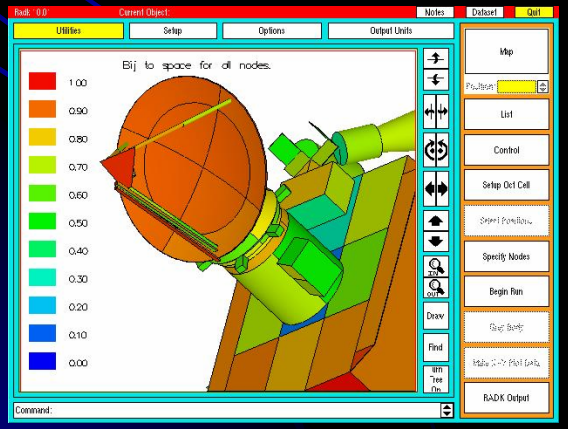
TSS Version 12.0 Enhancements

- Computational Geometry for Quadric Surfaces
  - Full Boolean Operations facilitates boundary representation with definition of surface contours
  - Any quadric surface can cut another (i.e. cylinder can cut sphere, cone can cut ellipsoid, etc.)
  - Surface and boundary representation
  - Boundary representation allows surface building from contours

TSS V11.01 Enhancement Summary

- Advanced Oct-cells - Advanced Oct-Cell method automatically optimizes the depth of the Oct-Cells. When combined with previous enhancements to the ray-tracing speed Spacedesign TSS will continue to be the fastest radiation analysis tool.

- Radk timing tests:
  - 1500 surface model

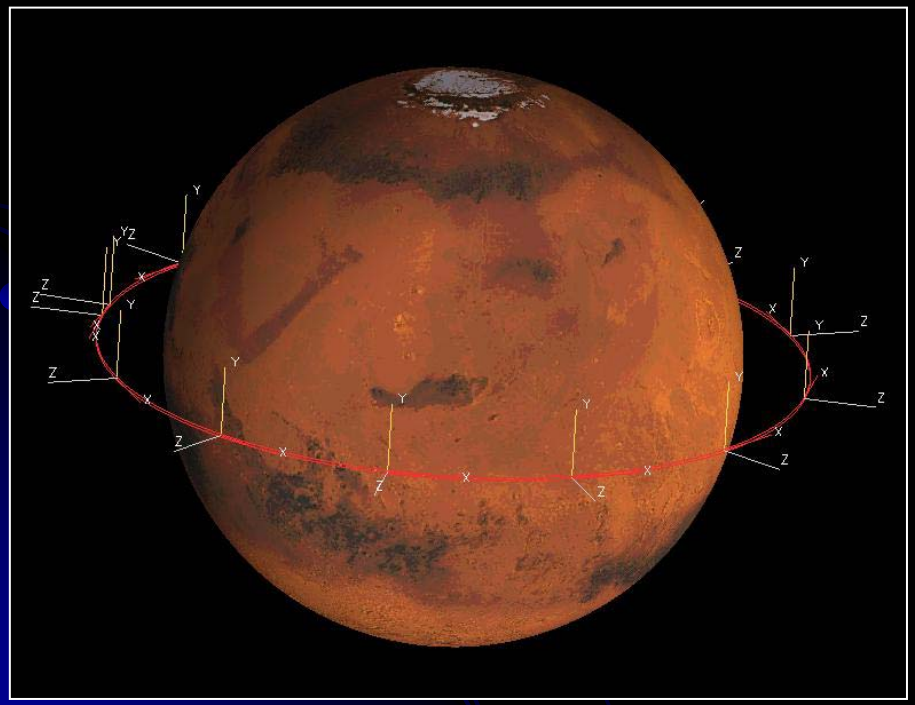


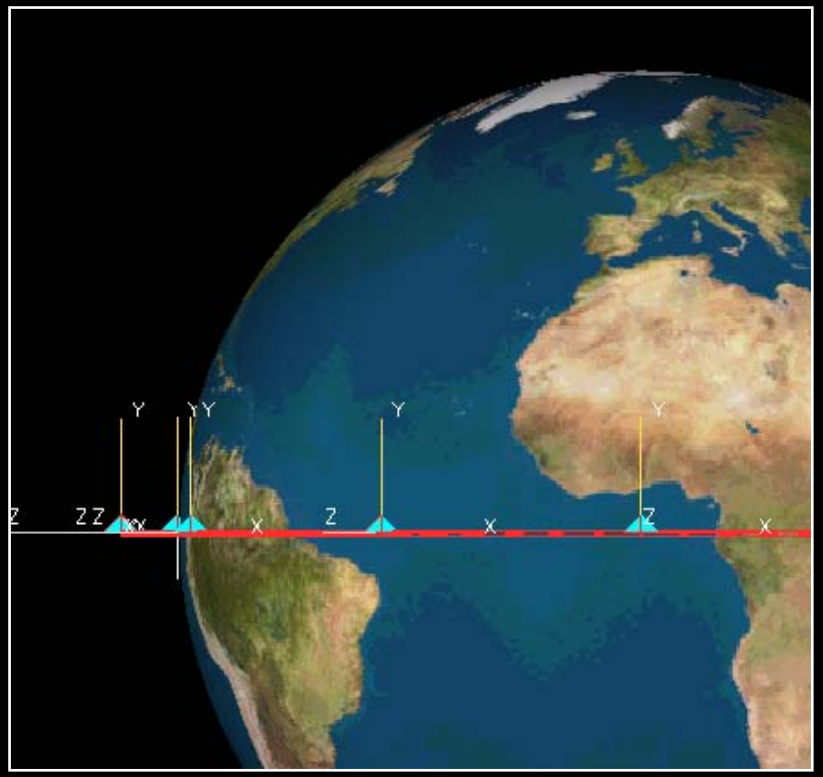
30% faster

	V10.01	V11.01
10,000 rays	3599.9 sec.	2524.5 sec.

TSS V11.01 Enhancement Summary

- Improved Visualization of All Planets (Earth, Mars, Jupiter, etc.) and Moon.





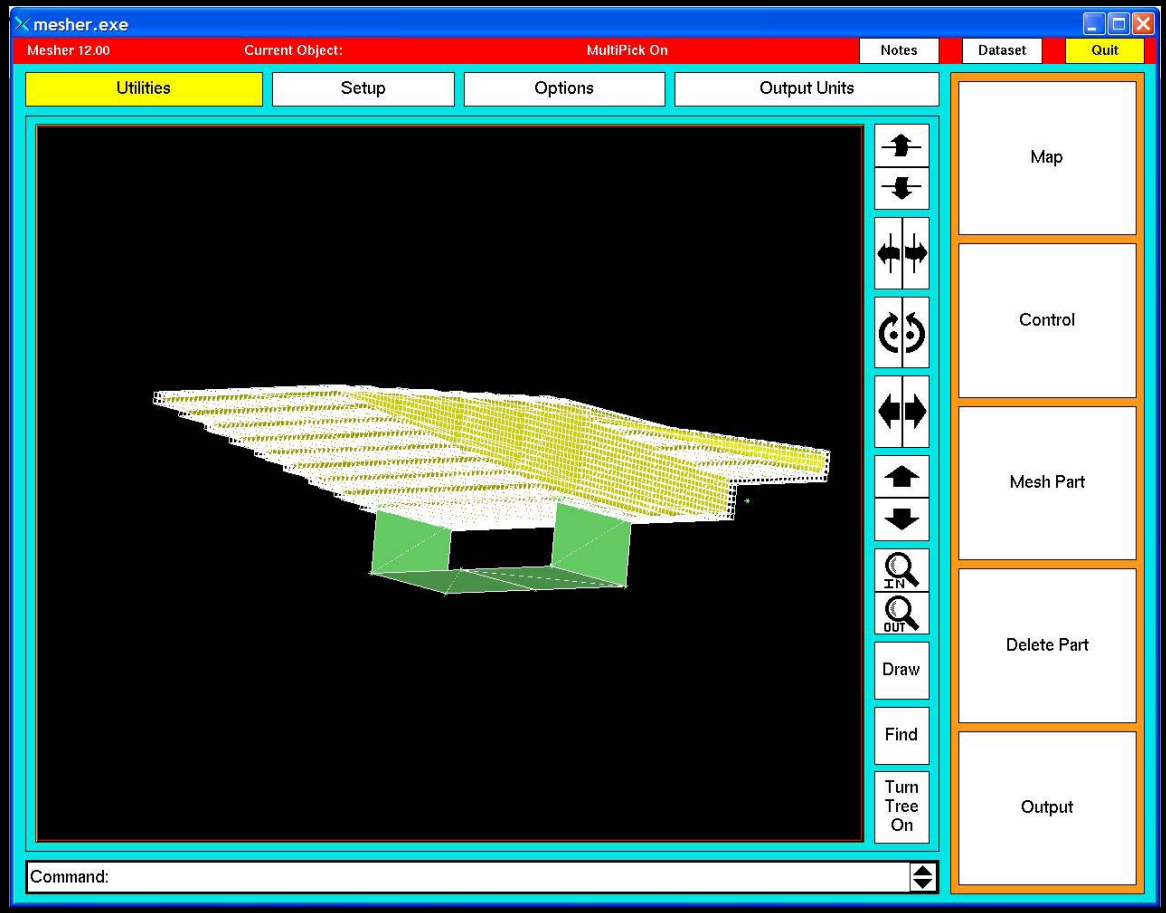
MESH Application

What is MESH?

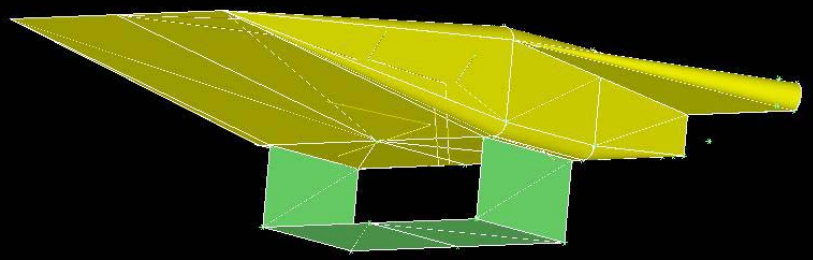
- Mesh creates solid mesh from TSS Geometry input.

- Outputs TSS Geometry or FEM input

- Currently supports hexahedrons (non-orthogonal bricks) and tetrahedrons



MESH Application

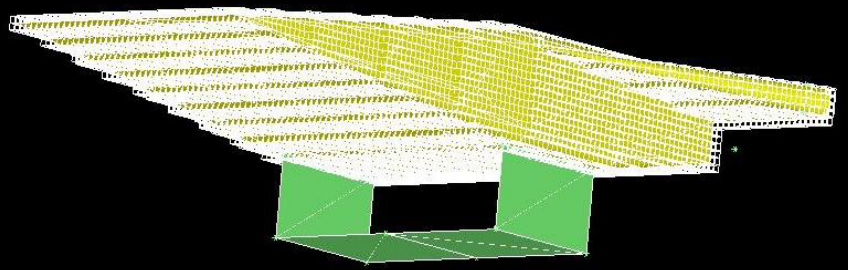


Creating Solid Mesh

1. Select enclosure

   - Demo through surface representation.
   - Final product will use boundary representation and calculate if selection is proper enclosure.

2. Specify part name
3. Specify smallest mesh dimension
4. Choose output to Geometry or FEM.



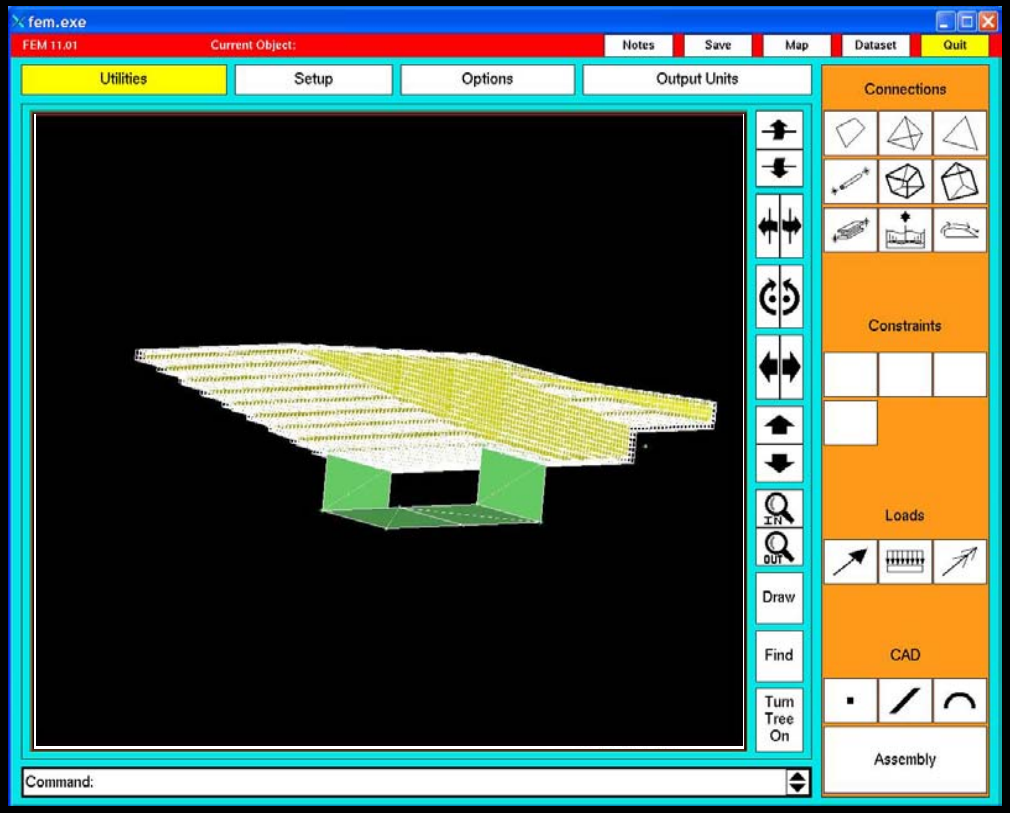
FEM Application

What is FEM?

- FEM is a front end (preprocessor) for S3D/NASTRAN.

- Uses command language like TSS for more distinctive representation of S3D/NASTRAN commands

- Provides database for FEM properties and structural models.

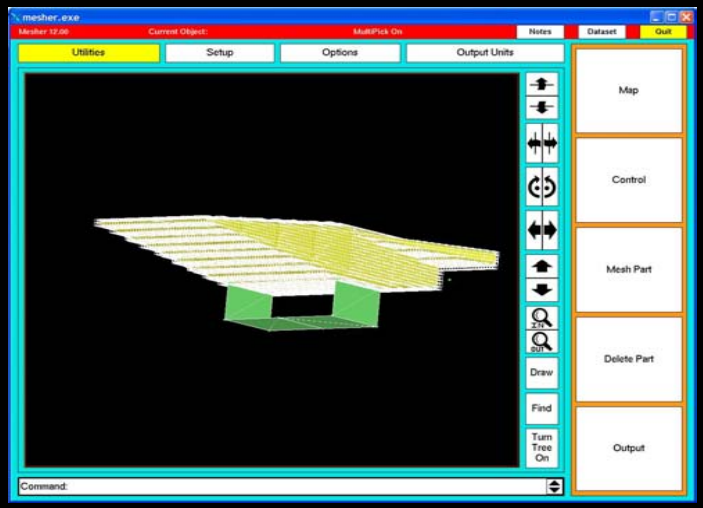


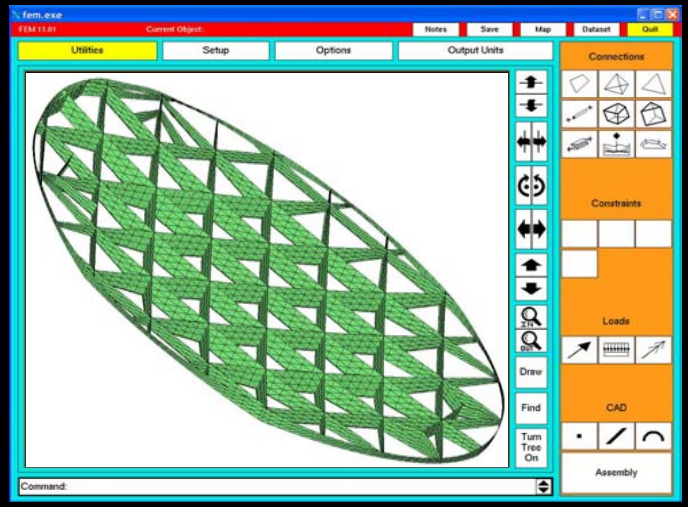
FEM Command Language

FEM Command Language

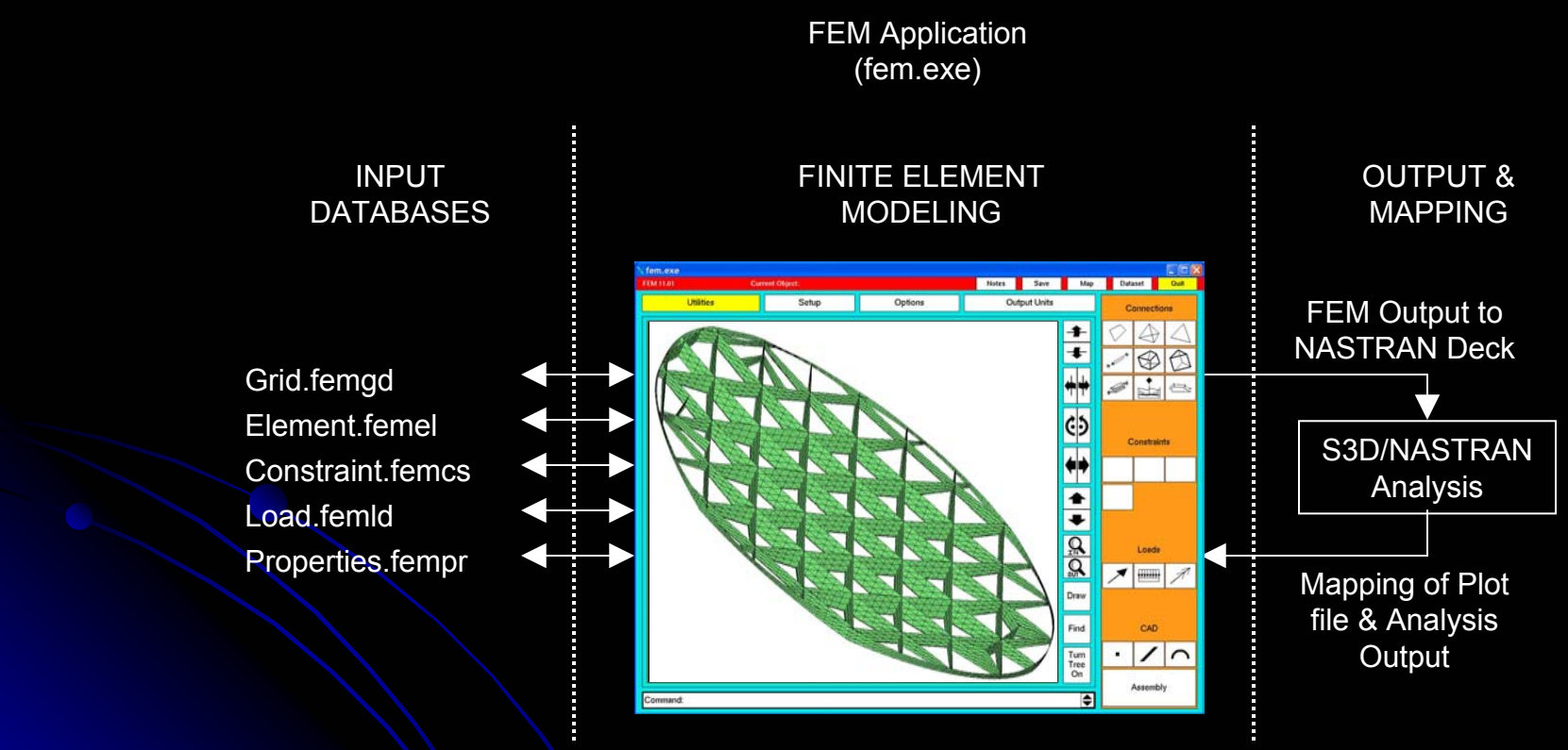
Provides advanced manipulation and programming constructs

```
assembly_fem name.1
        units = meter
        type=rectangular
        id_number=5
        point_A = 1.0, 0.0, 3.0
        point_B = 1.0, 0.0, 3.0
        point_C = 1.0, 0.0, 3.0
        Comment = “important assem”

grid_point name.4
      id_number=1001
      temp=NONE
      X1 = 1.0
      X2 = 2.0
      X3 = 3.0
      displace_assembly name.6
      constraint_coord name.7

connect_fem quadrilateral name.9
      id_number=11001
      property=aluminum.1
      etc.

end
```

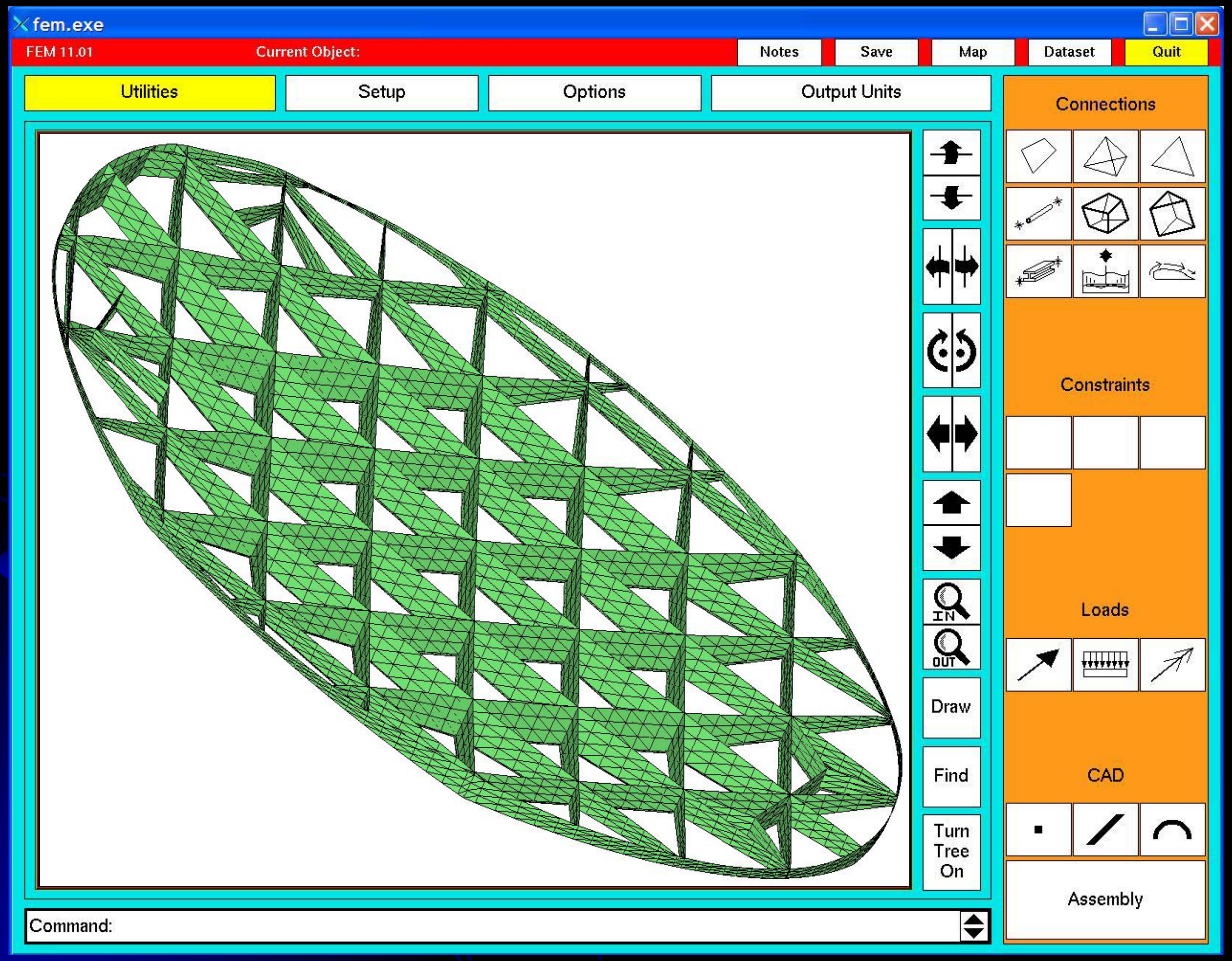




Finite Element Method (FEM) Flow



FEM Application



Connections

-Quadrilateral, Triangle
-Tetrahedron, Rod
-Hexahedron, Beam
-Wedge, Damper
- Aerodynamic

Constraints

- Single Point
- Multiple Point, etc.

Loads

- Force, Pressure, Moment

Point

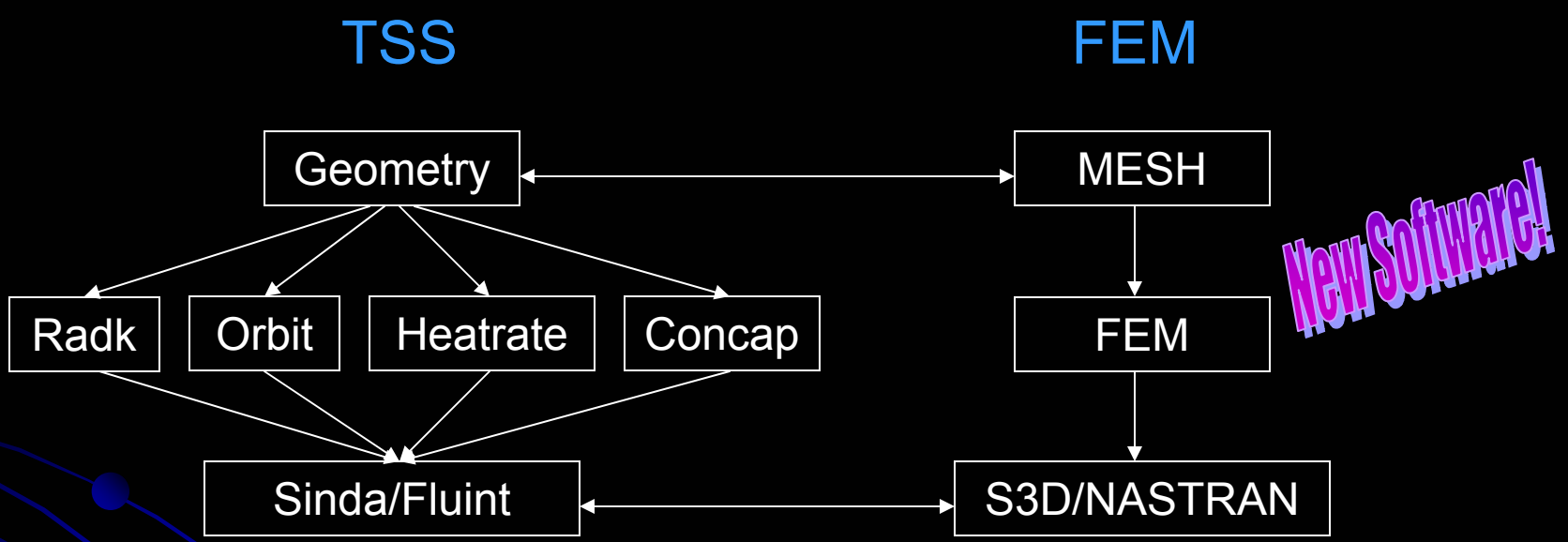
- Grid Point, Line, Curve

S3D/NASTRAN and Spacedesign Sinda/Fluint

- Space 3D is an integrated tool for structural and thermal analysis
  - Allows easy exchange of deformation from S3D/NASTRAN to radiation models and thermal loads from S3D Sinda/Fluint to structural models.
- Spacedesign Corporation Space3D (S3D) Sinda/Fluint 3.3 is integrated into TSS
  - Standard Sinda/Fluint finite difference solver.
  - Version 3.3 Enhancements
    - Symbols (variables) for more versatility for parametric Sinda/Fluint modeling
    - Double precision
- Spacedesign Corporation S3D/NASTRAN is integrated into FEM
  - Standard NASTRAN finite element solver.

Spacedesign TSS and FEM

Enterprise Engineering Software Solutions



Spacedesign Corporation
Houston, TX
www.spacedesign.com