

N94-22355

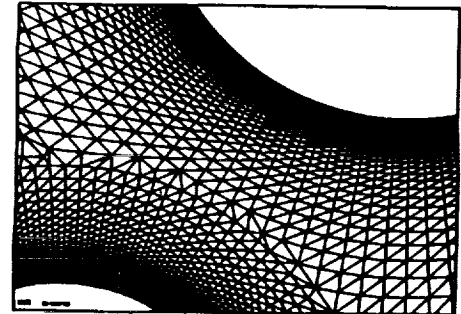
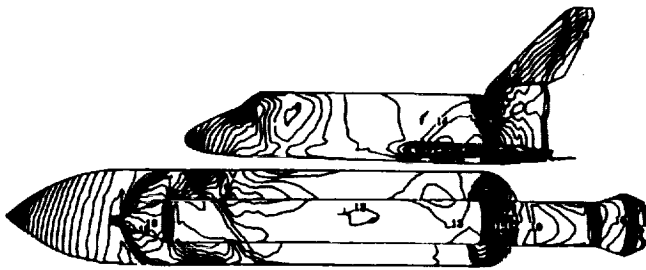
**JOHNSON SPACE CENTER CFD GRID
GENERATION REQUIREMENTS**

**FRED MARTIN
JOHNSON SPACE CENTER**

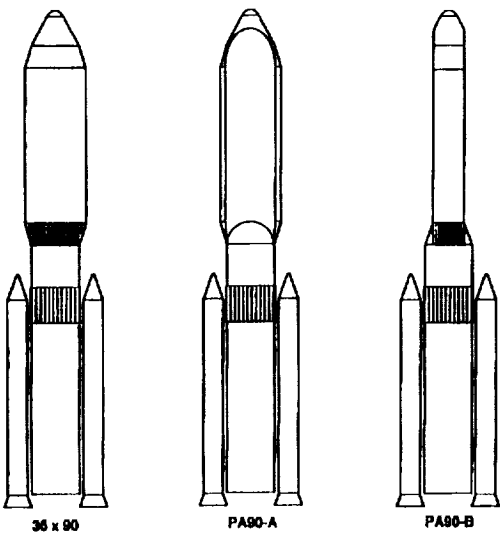
PRECEDING PAGE BLANK NOT FILMED

- Thomas Wey/ LESC
 - Grid Generation & Inviscid Solver
 - THREE-DIMENSIONAL UNSTRUCTURED GRID GENERATION — ANGLE-BASED ADVANCING FRONT METHOD.
 - THREE-DIMENSIONAL EULER SOLVER — POINT-JACOBIAN, UP-WIND, GRID ADAPTATION.
 - HIGH REYNOLDS NUMBER VISCOUS UNSTRUCTURED GRID GENERATION — CUT AND PASTE, ANGLE-BASED ADVANCING FRONT METHOD.
 - TRIANGULATION OF OVERLAPPED SURFACE GRIDS — SURFACE PROPERTY INTEGRATION FOR CHIMERA SCHEME.

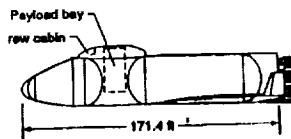
- Jay Lebeau/EG3
 - Studied Under Tayfun Tezduyar at the University of Minnesota



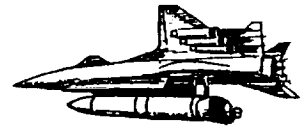
- Requirements Are Driven By :
 - JSC Structures Division's Need for **VERY** Accurate Aerodynamic Loads
 - Program Office Need For CFD Results That Meet **THEIR** Schedule
- Launch Vehicles
 - Very Complex Geometry
 - Parallel Configurations
 - Attach Hardware
 - Plumbing, Cable Trays, Structural Stiffeners, etc.
 - Engine Bells
- Entry Vehicles
 - Complex Geometry
 - Control Surfaces - Gaps
 - RCS Scarfed Nozzles



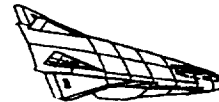
Early HLLV Configurations.



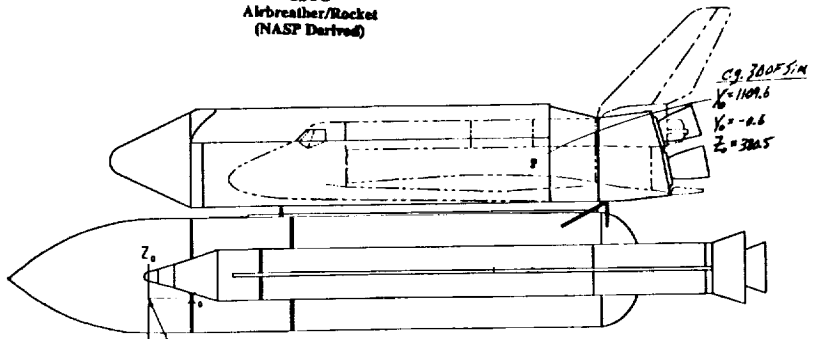
SSTO Rocket



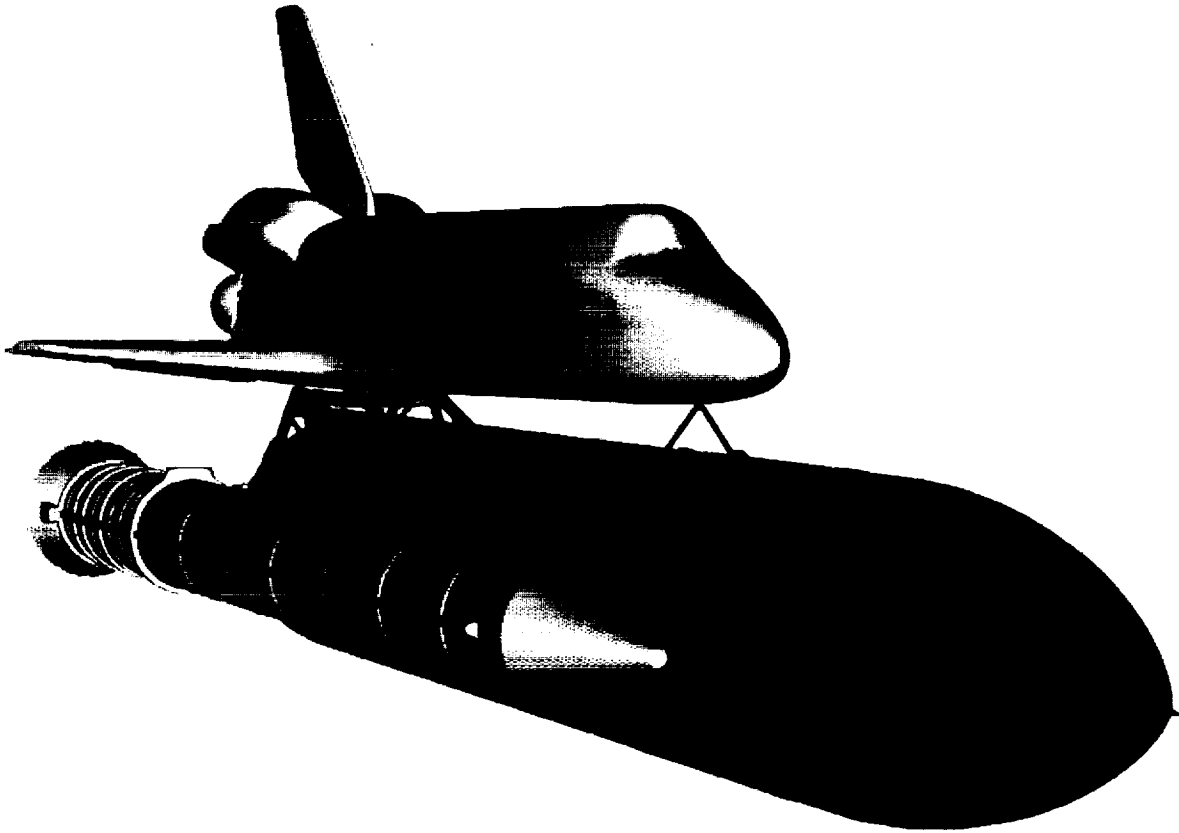
TSTO Airbreather/Rocket



SSTO Airbreather/Rocket (NASP Derived)



SINGLE LAUNCH STATION



GOAL: Create a High Fidelity Grid/Flow Field That Meets Accuracy Req.

- **5% of Orbiter Wing Limit Load**

1st November, 1990

- Evaluate and Search for Tools (Rockwell, Space Division using ICEM)
- ICEM-CFD Demo Version Installed - Evaluated for 2 Months
- Initiated Purchase of ICEM-CFD
- Coordinated Transfer of External Tank CAD Definition from Martin Marietta

1st May, 1991

- IGES Transfer of Computer Vision, Wire Frame, (4 months)
CAD Models From Martin Marietta

1st September, 1991

- Conversion of Wire Frame to Surface Model (4 months)

1st January, 1992

1st January, 1992

- Approximate Geometry, As Required (6 months)
- **CREATE SURFACE GRIDS in ICEM-CFD**

1st July, 1992

- **CREATE SURFACE GRIDS IN HYPGIN (ARC, Buning, Chan) (1 month)**

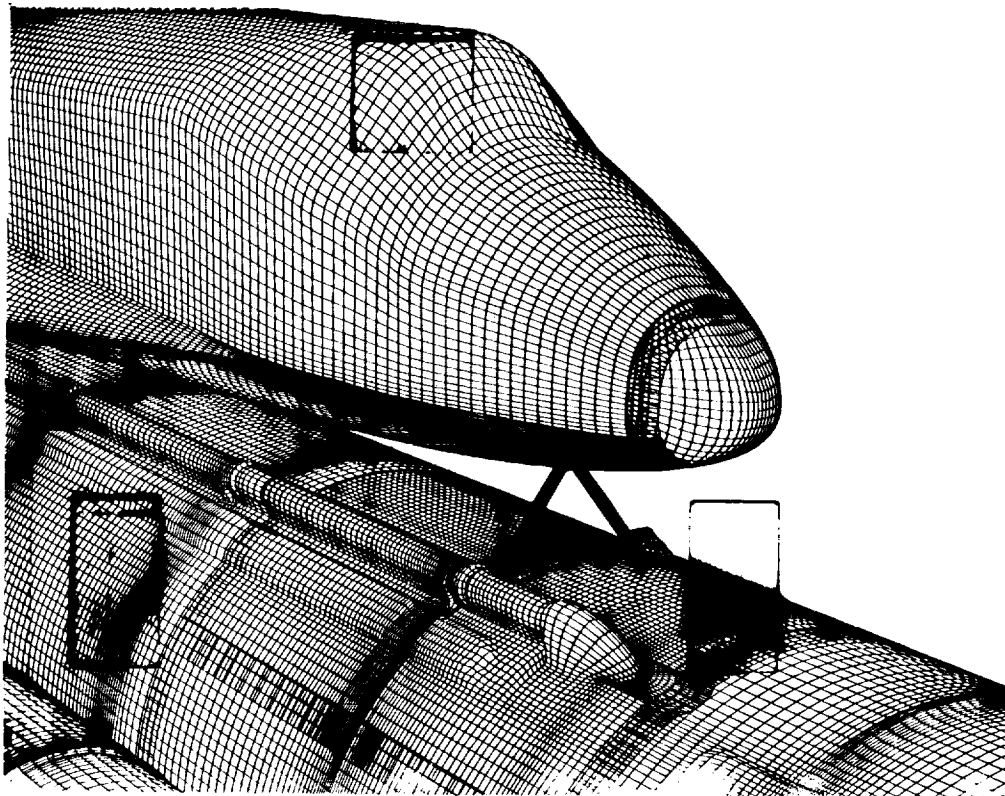
1st August, 1992

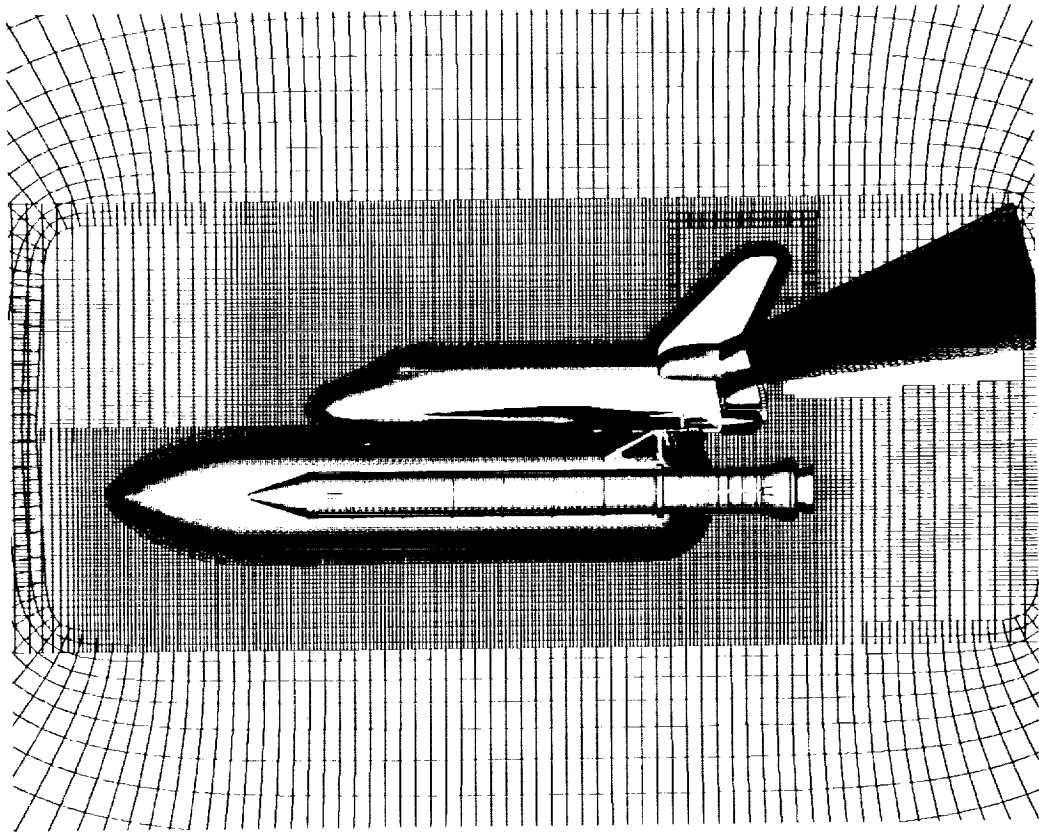
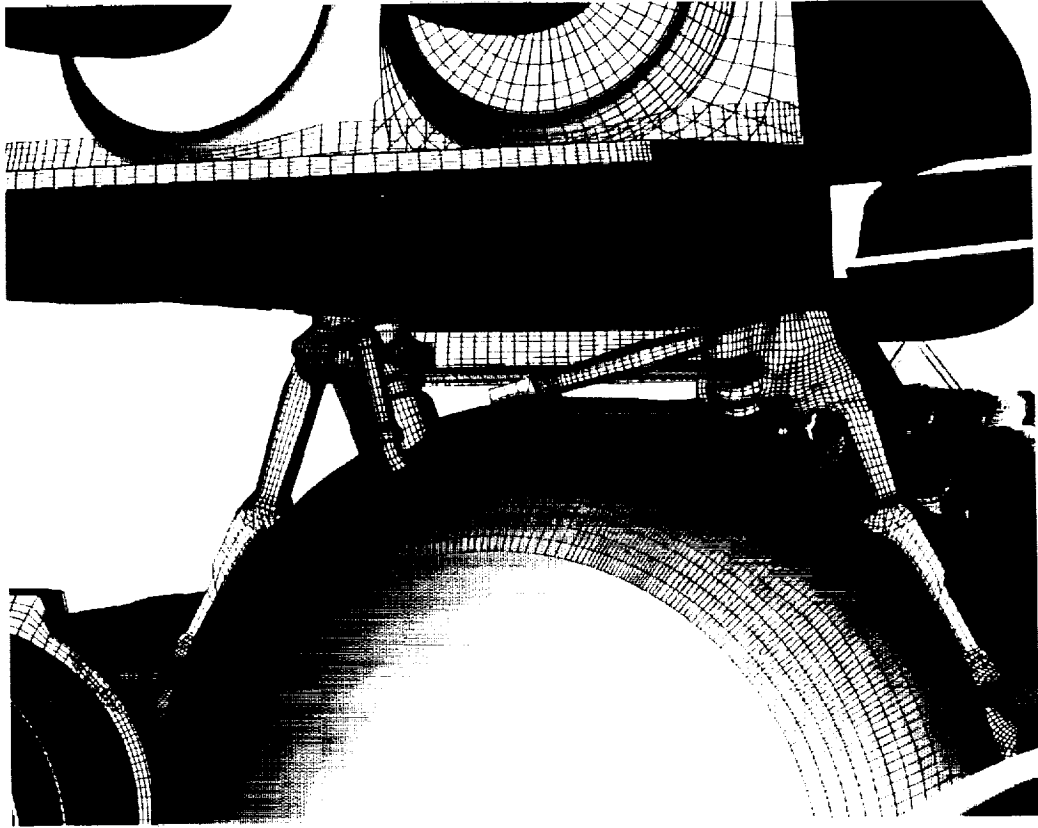
- **CHIMERA GRID to GRID COMMUNICATIONS with PEGSUS (ARC, AEDC) (6 months)**

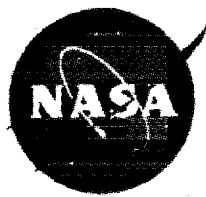
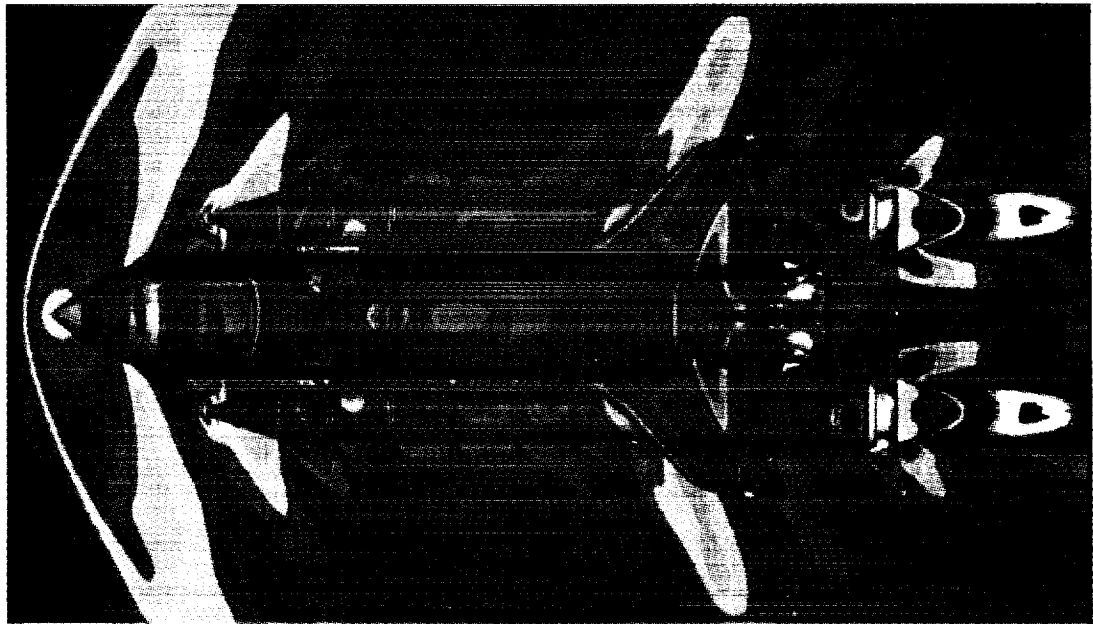
1st January, 1993

- Started Running The Flow Solver - OVERFLOW (ARC, Buning)
- Minor Corrections to the Grid System
- 16.5 Million Grid Points in 113 Grids, 64 bit Words - Flight Reynolds #

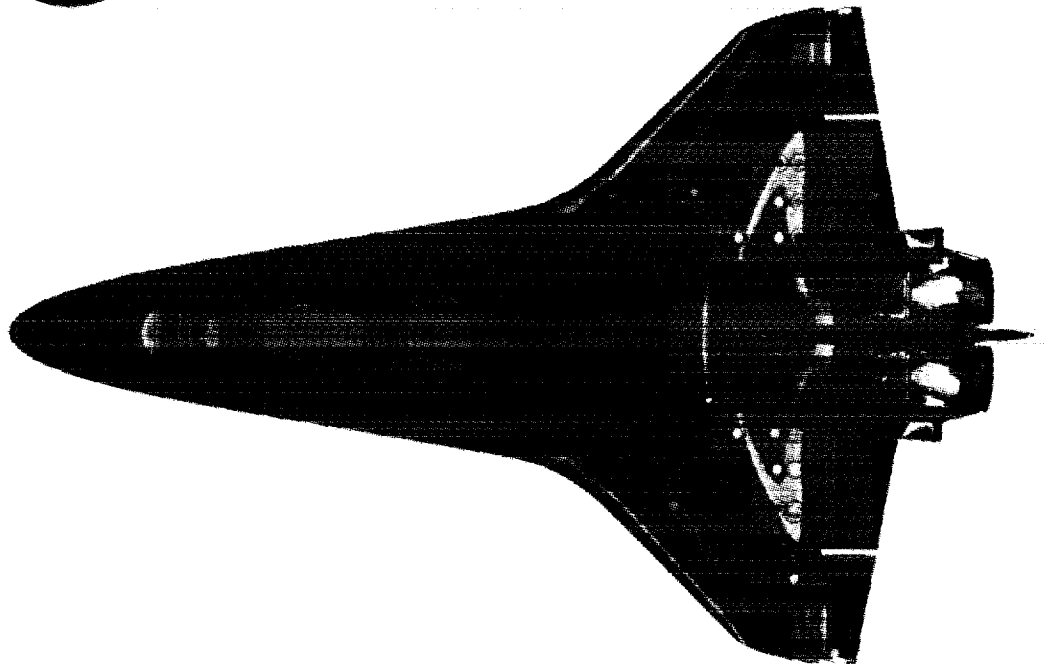
"ALL STEPS LOOP BACK TO ALL PREVIOUS STEPS"

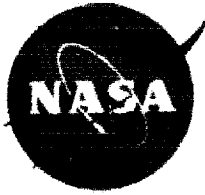




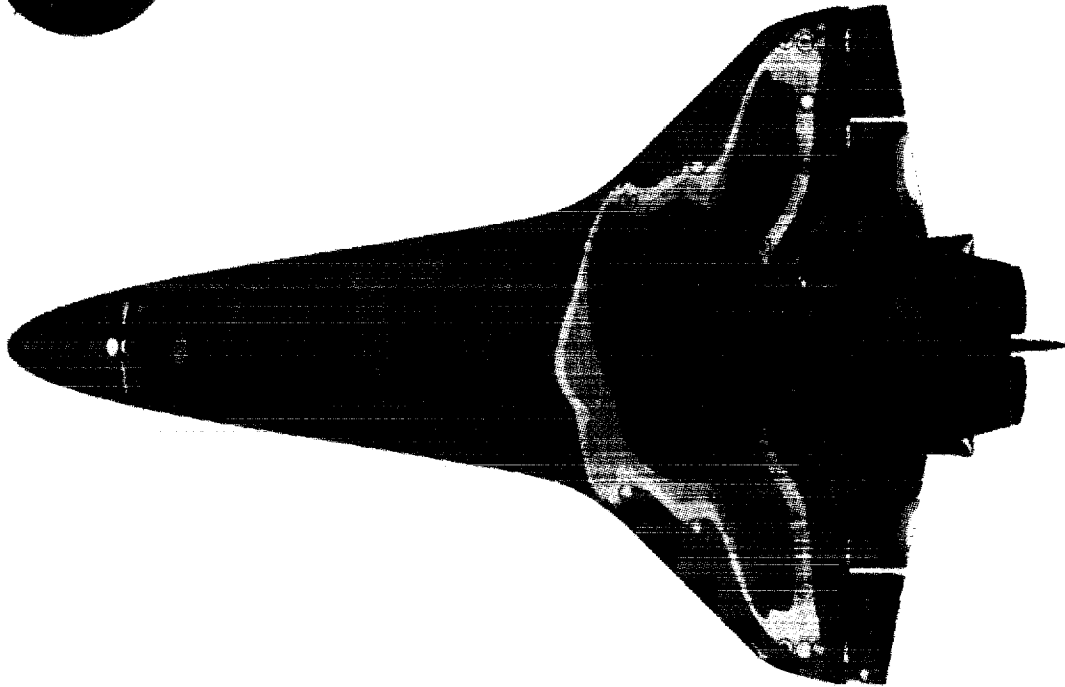


$Re = 3.4 \times 10^6 / ft$ $\alpha = -3.3^\circ$
 $M_\infty = 1.251$ $\beta = 0.0^\circ$





$$\begin{array}{l} Re = 3.4 \times 10^6 / ft \quad \alpha = -3.3 \\ M_\infty = 1.251 \quad \beta = 0.0 \end{array}$$



- Replace Orbiter with Space Station Core

6th April, 1993

- Dan Pearce is asked to Grid SLSS

16th April

- CAD model is Available From JSC Structures
 - MCAUTO, Surface Model, IGES transfers
- Rebuild Surfaces!

20th April

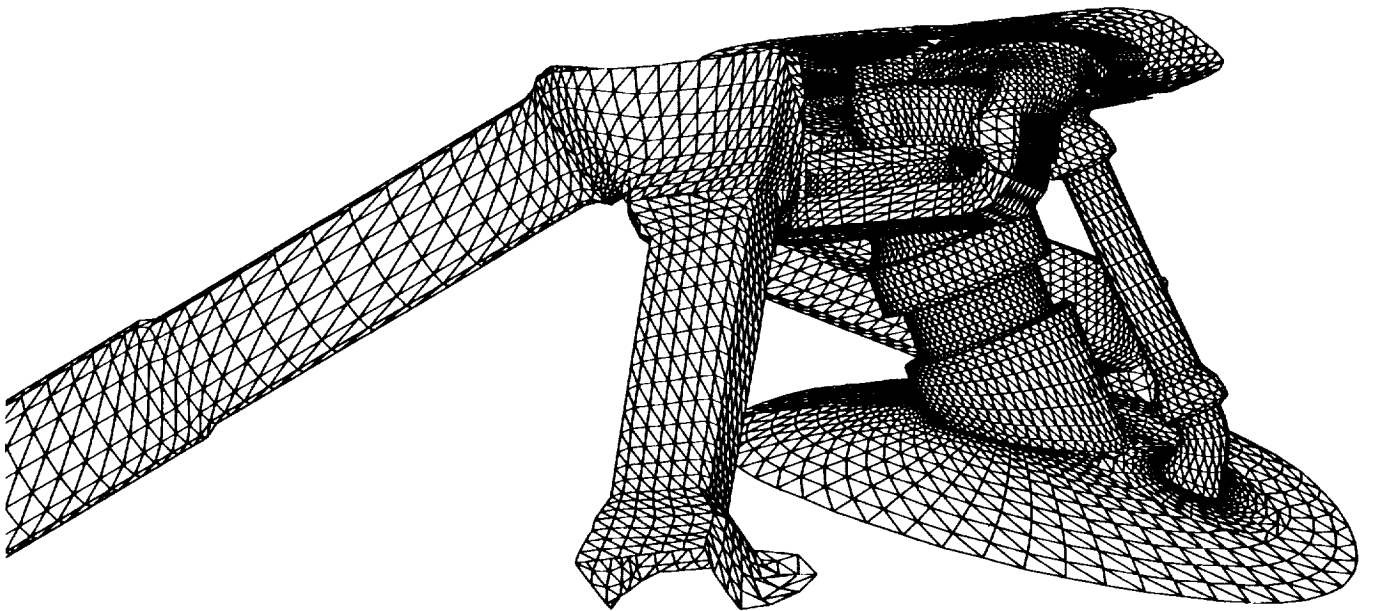
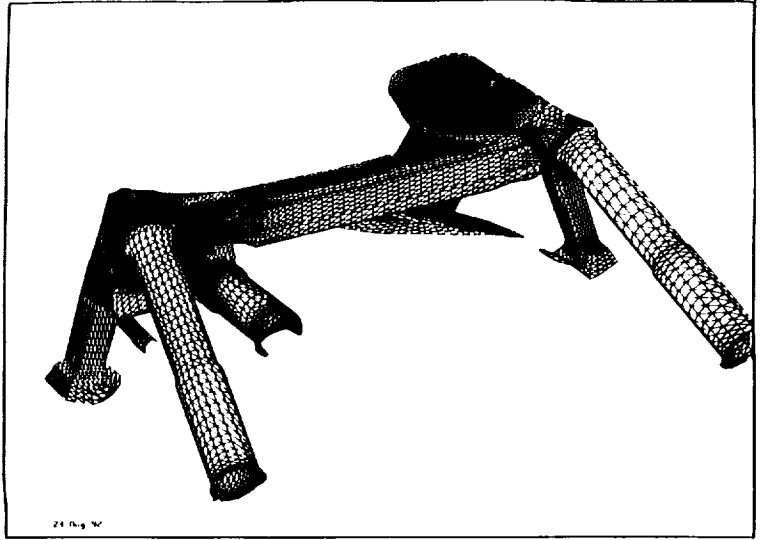
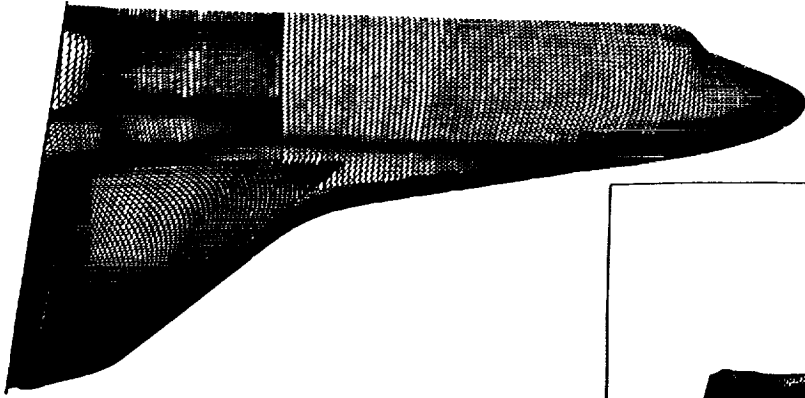
- Surface Gridding in ICEM-CFD

21st April

- Volume Gridding with HYPGIN

23rd April

- Ready to start developing the Grid to Grid Communications



- Complex Geometry - You Get The Picture

- Complex Physics
 - Must Be Viscous Solutions
 - Multiple Species Reacting Flows
 - Ascent Plumes - After Burning, Heating, Ingestion
 - Hypersonic Entry Flows
 - Reaction Control System Flow Field Interactions
 - Unsteady Flows
 - Booster Separation

- Computer Issues
 - Out of Core Grid Generation ? (1 large grid will probably not fit in memory)
 - Out of Core Flow Field Solver