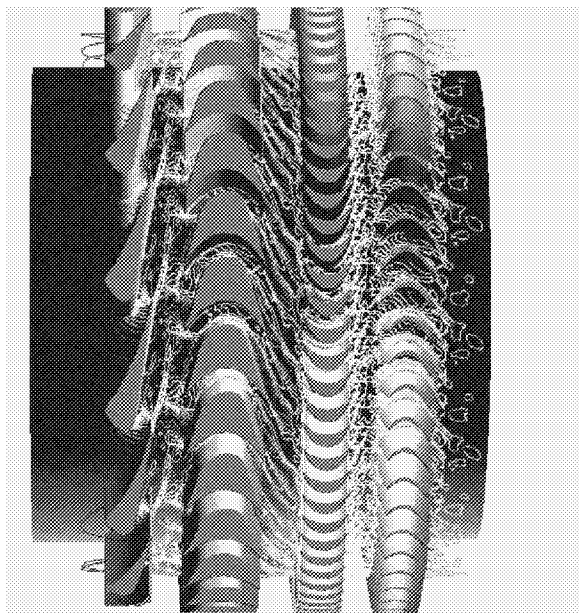


Pre- and Post-Processing Tools to Streamline the CFD Process



Suzanne Miller Dorney, PhD
Applied Fluid Dynamics Analysis Group
NASA Marshall Space Flight Center
MSFC, AL 35812

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Support of CFD



- **Pre-processing**
- **Interim-processing**
- **Post-processing**

CFD Codes



- **FDNS**
 - general purpose CFD code
 - combustion, pump, and external flow simulations
- **CORSAIR**
 - code for unsteady turbomachinery simulations
 - turbines, compressors, and internal flow simulations

Pre-Processing Support for FDNS



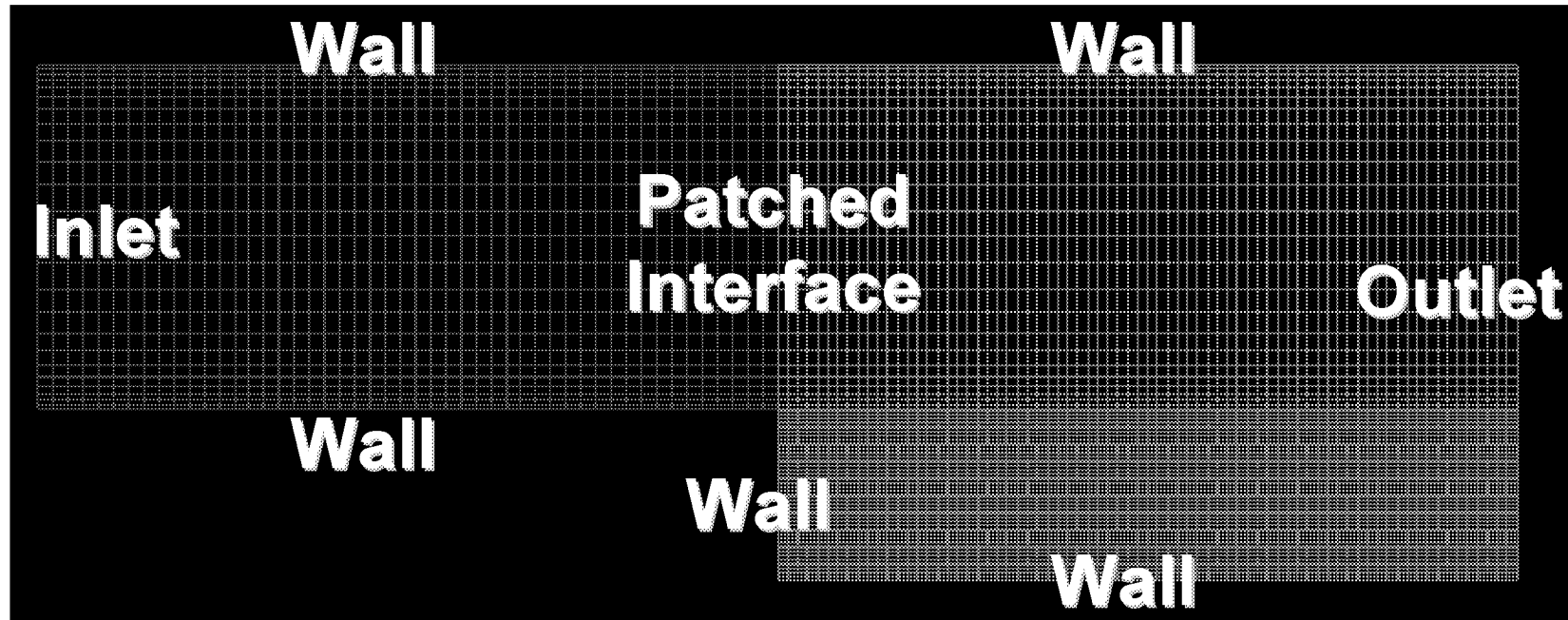
– Geometry specification

- generated by GridGen
- obtained by another source
- standard plot3d format

– Boundary condition specification

- generated by GridGen
- generated by hand

FDNS Boundary Conditions



Specification of Boundary Conditions



```

#IDIM
2
#IZON, IZFACE, IBND, ID, ISNGL, INPNT
2 2 2 5 0 0
# IZT, JZT, KZT, LPROC, CBG1, CBV2
50 25 1 1 0.000e+00 0.000e+00
75 75 1 1 0.000e+00 0.000e+00
#THCYCX, IZB1, IZF1, IJZ11, IJZ12, JKZ11, JKZ12, INONUF, IPROC1
# IZB2, IZF2, IJZ21, IJZ22, JKZ21, JKZ22, IDFACE, IPROC2
0.00 1 2 1 25 1 1 21 1
2 1 51 75 1 1 0 1
#IBCZON, IDBC, ITYBC, IJBB, IJBS, IJBT, JKBS, JKBT, IVFINT, PRAT, IPZ, IPI, IPJ, IPK
1 1 0 1 1 25 1 1 0 -1.000e+00 1 1 1 1
2 2 2 75 1 75 1 1 0 -1.000e+00 1 1 1 1
#IWBZON, L1, L2, M1, M2, N1, N2, IWTM, HQDOX, IWALL, DENNX, VISWX
1 1 1 50 1 1 1 1 0.000e+00 0 1.000e+00 1.000e+00
1 1 1 50 25 25 1 1 0.000e+00 0 1.000e+00 1.000e+00
2 1 1 1 1 51 1 1 0.000e+00 0 1.000e+00 1.000e+00
2 1 1 75 1 1 1 1 0.000e+00 0 1.000e+00 1.000e+00
2 1 1 75 75 75 1 1 0.000e+00 0 1.000e+00 1.000e+00
:
:
:

```

3D 22-Grid Case



Type	# Values Needed	Occurances	Total Values
Grid Dimensions	3	22	66
Patched Interfaces	17	37	629
Flow Boundaries	14	51	714
Walls	12	56	672
Total Values			2081

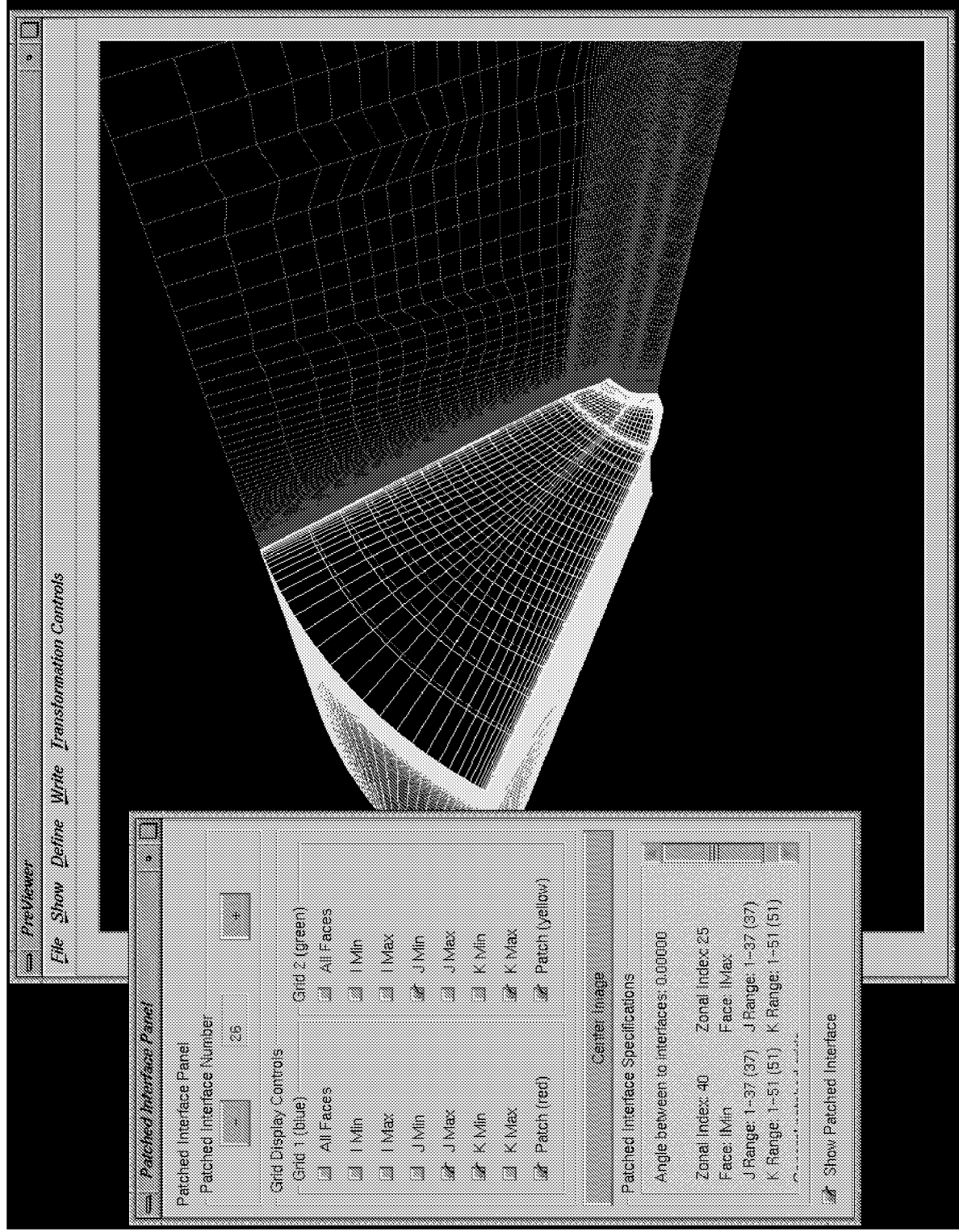
PreViewer



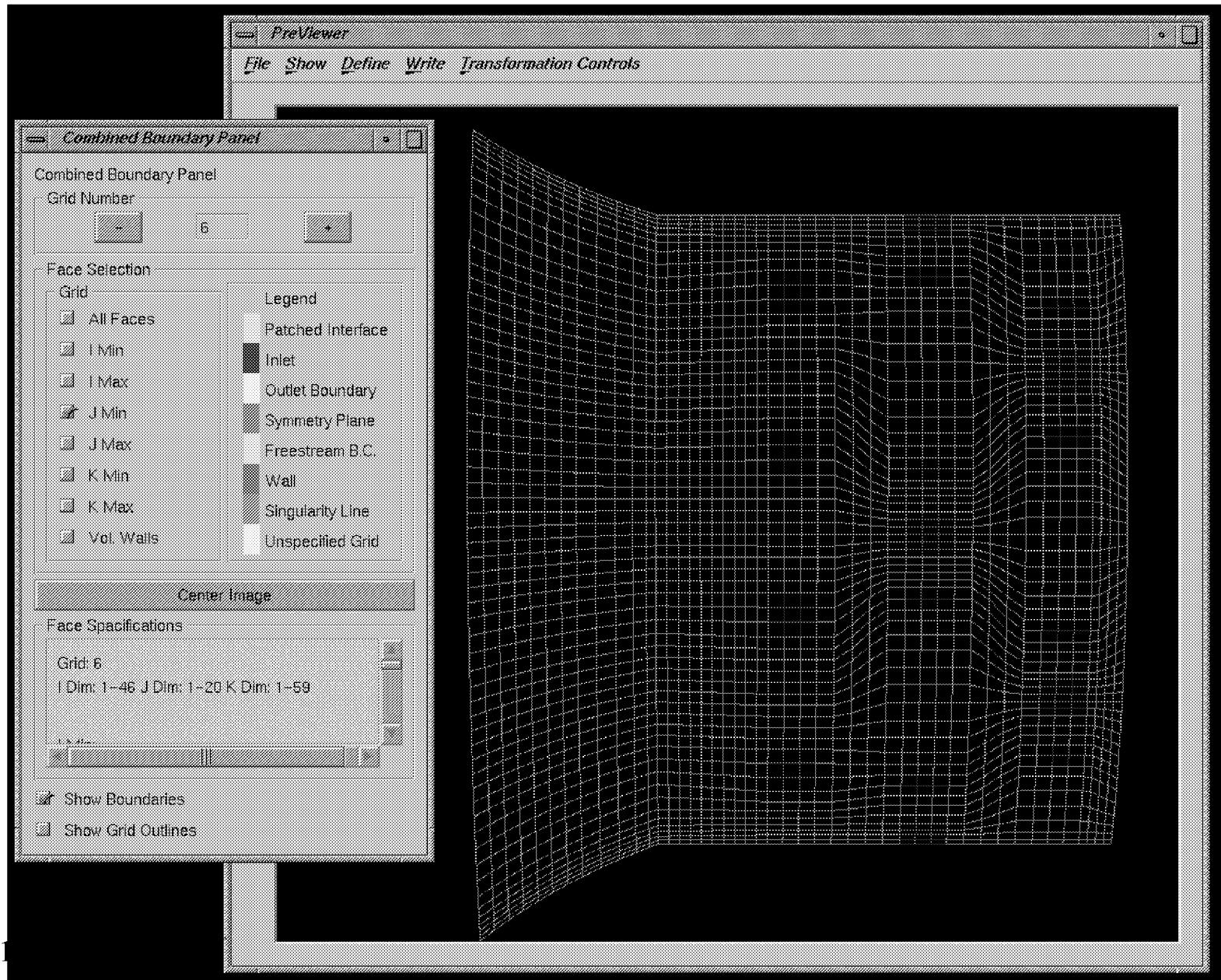
- **Visualization tool designed specifically for FDNS**
- **Interactive tool to visually inspect input files**
- **Automated error checking of input files**



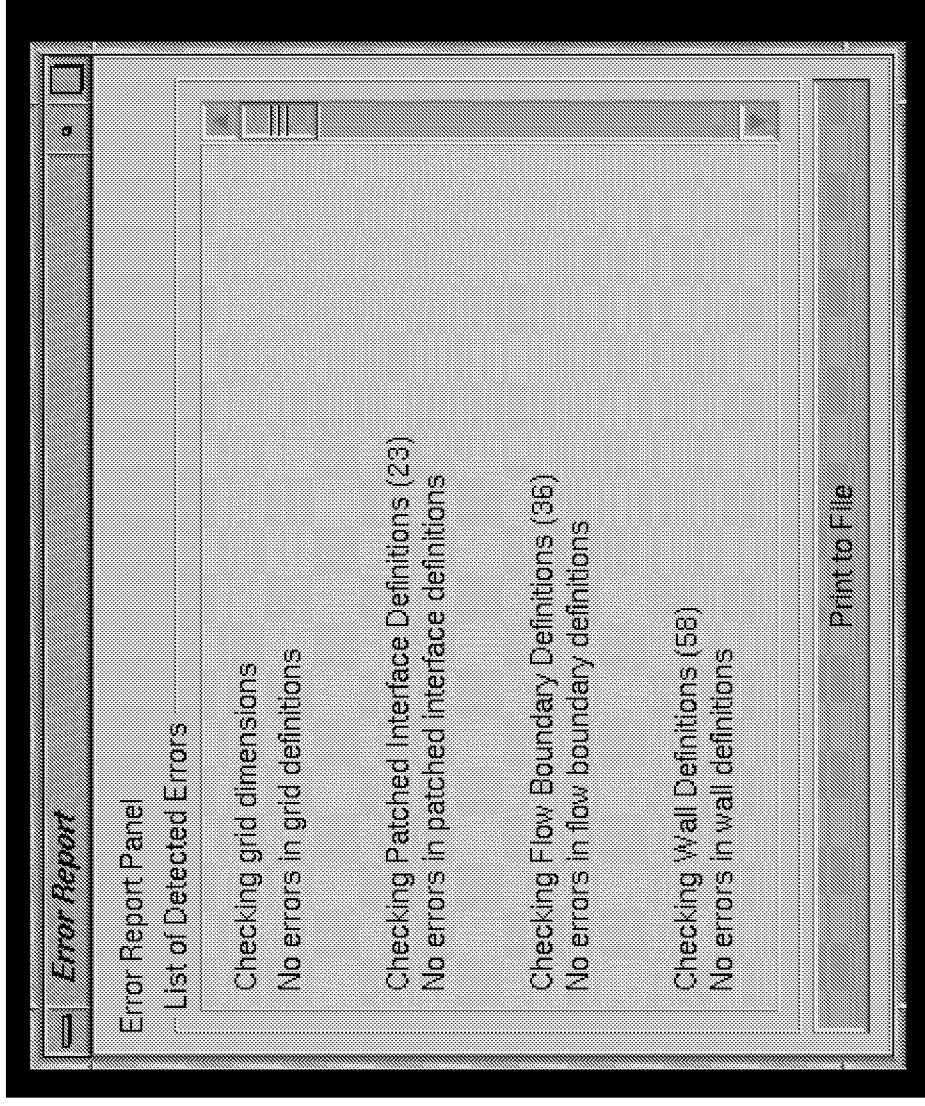
Patched Interface Panel



Combined Panel



Error Report Panel



Future Plans for PreViewer



- **Expand Error Checking**
- **Expand ability to define boundary conditions**
- **Set up specification files for interim- and post-processing tools**

Interim-Processing



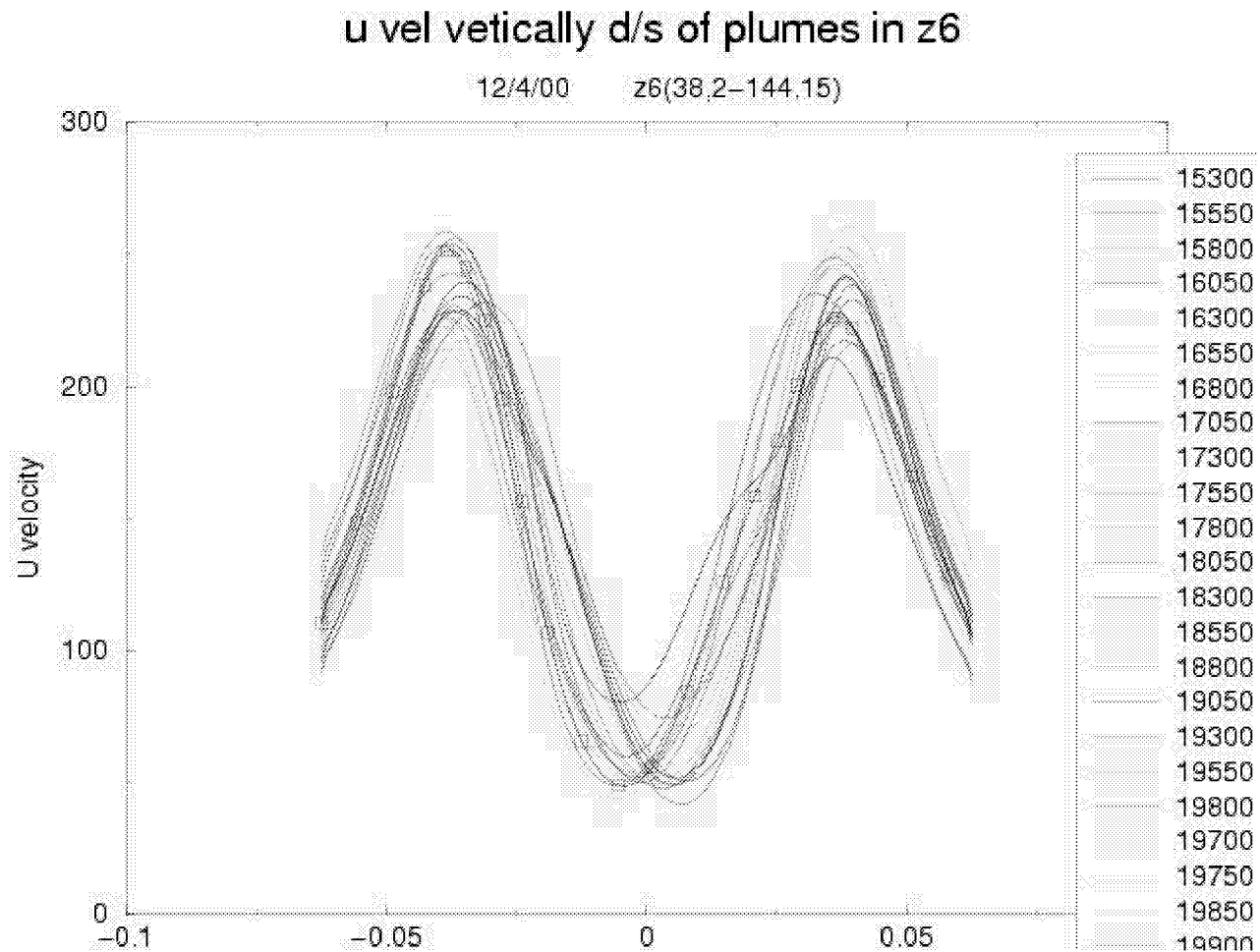
- **Process**
 - generates line plots of results while the solution is forming
- **FlowShow**
 - generates an animation of contour or vector plots of solution while it is forming
- **Monitor**
 - updates screen images of mass conservation, delta, contours, vectors, and line plots of a solution while it is forming

General Method for Interim-Processing



- Track a file that is being written by the flow solver during execution
- Processing is triggered each time file is updated/written
- Specified data is extracted from the file
- Line plots or images are updated, or new frames are generated

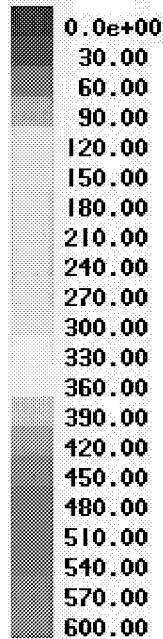
Process: Check for Convergence



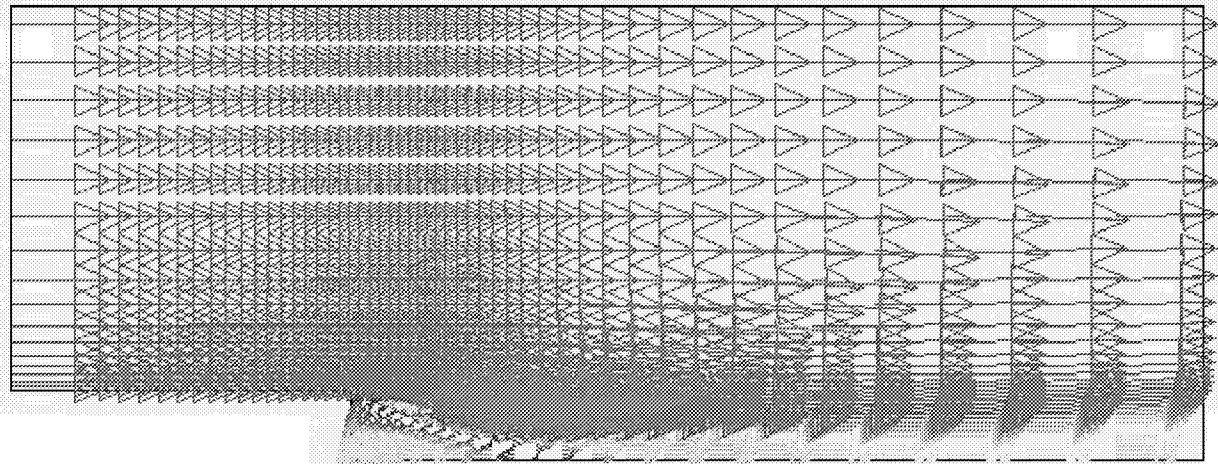
FlowShow: Super-Sonic Back Facing Step



Vel. Mag.

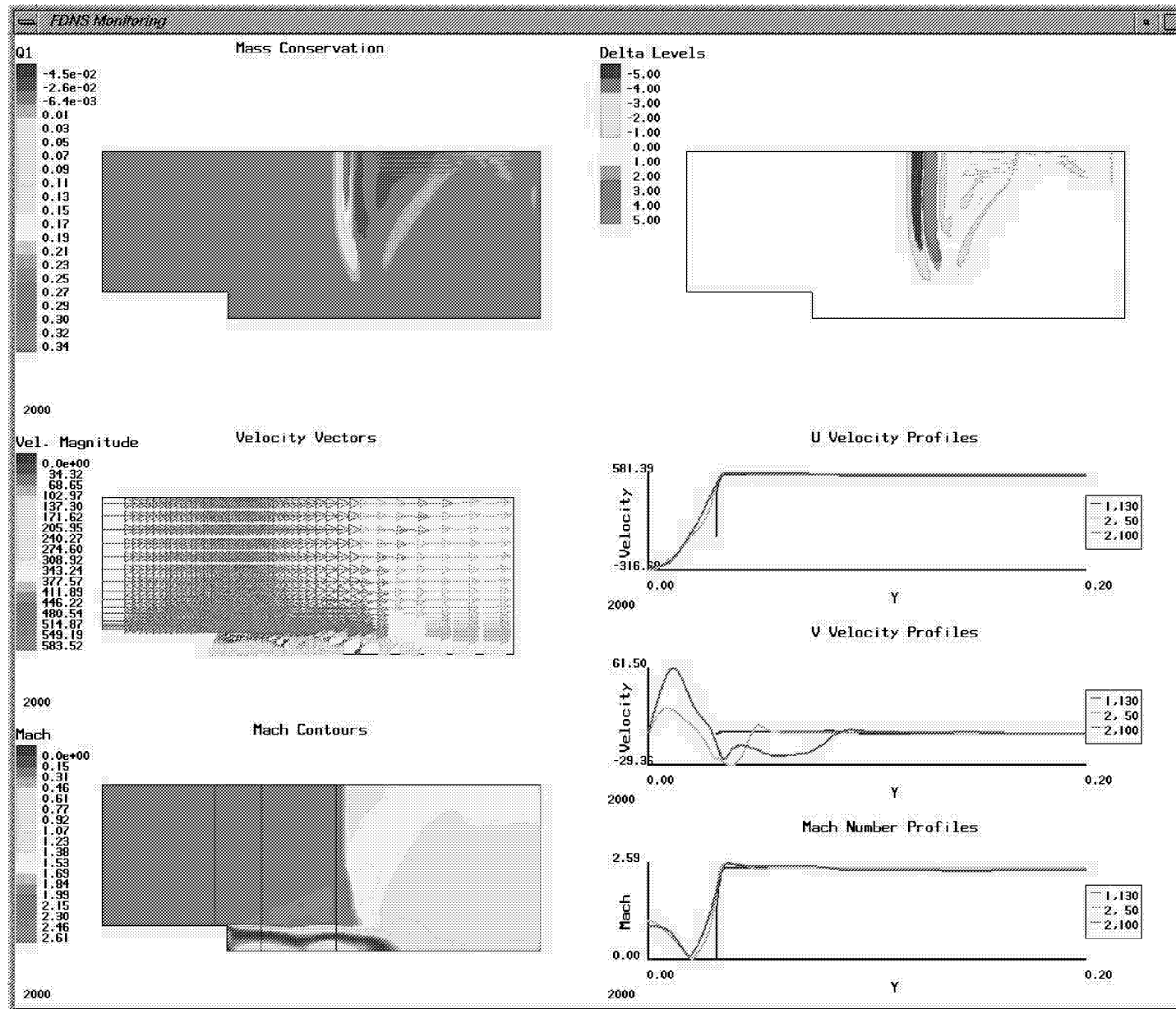


Development of Velocity Vectors



4000

Monitor: Super-Sonic Back Facing Step



Future Plans for Interim-Processors



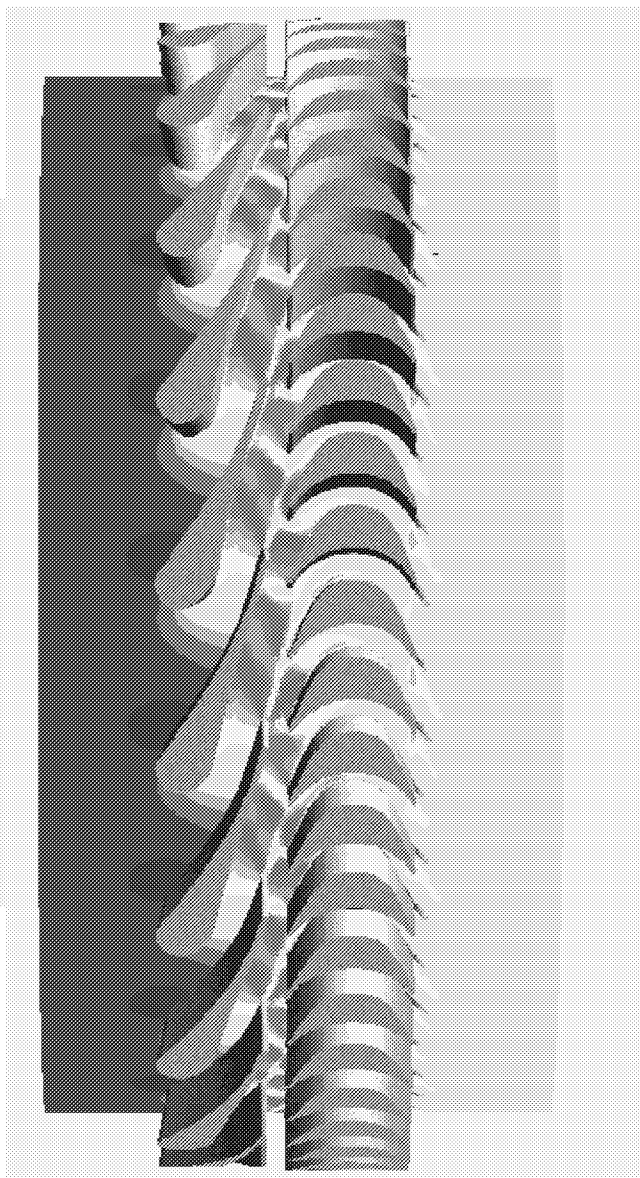
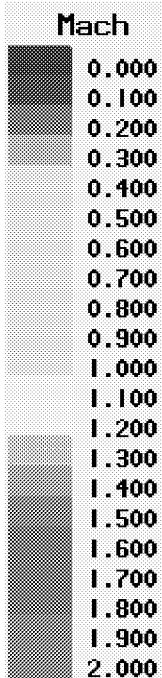
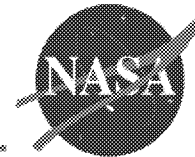
- Generate GUI's for specification of input files
- Combine functionality between tools
- Add display of experimental data

Post-Processing

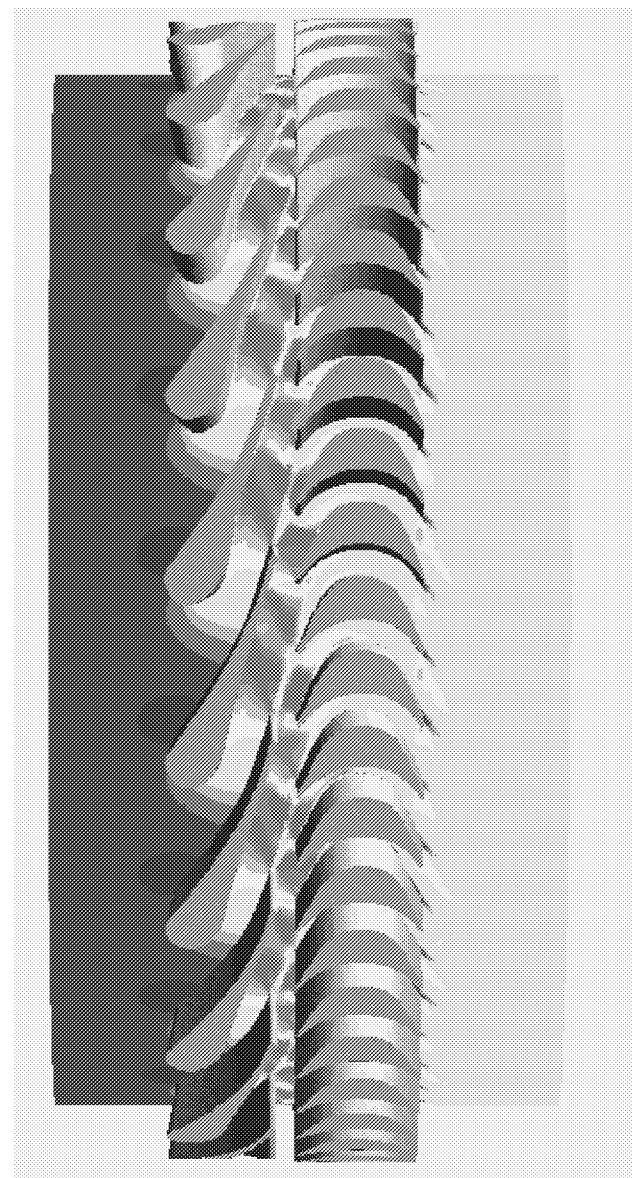


- Animations
 - simple format specifications
 - runs in batch mode
 - engineer friendly

Instantaneous Mach Contours



Timestep 0



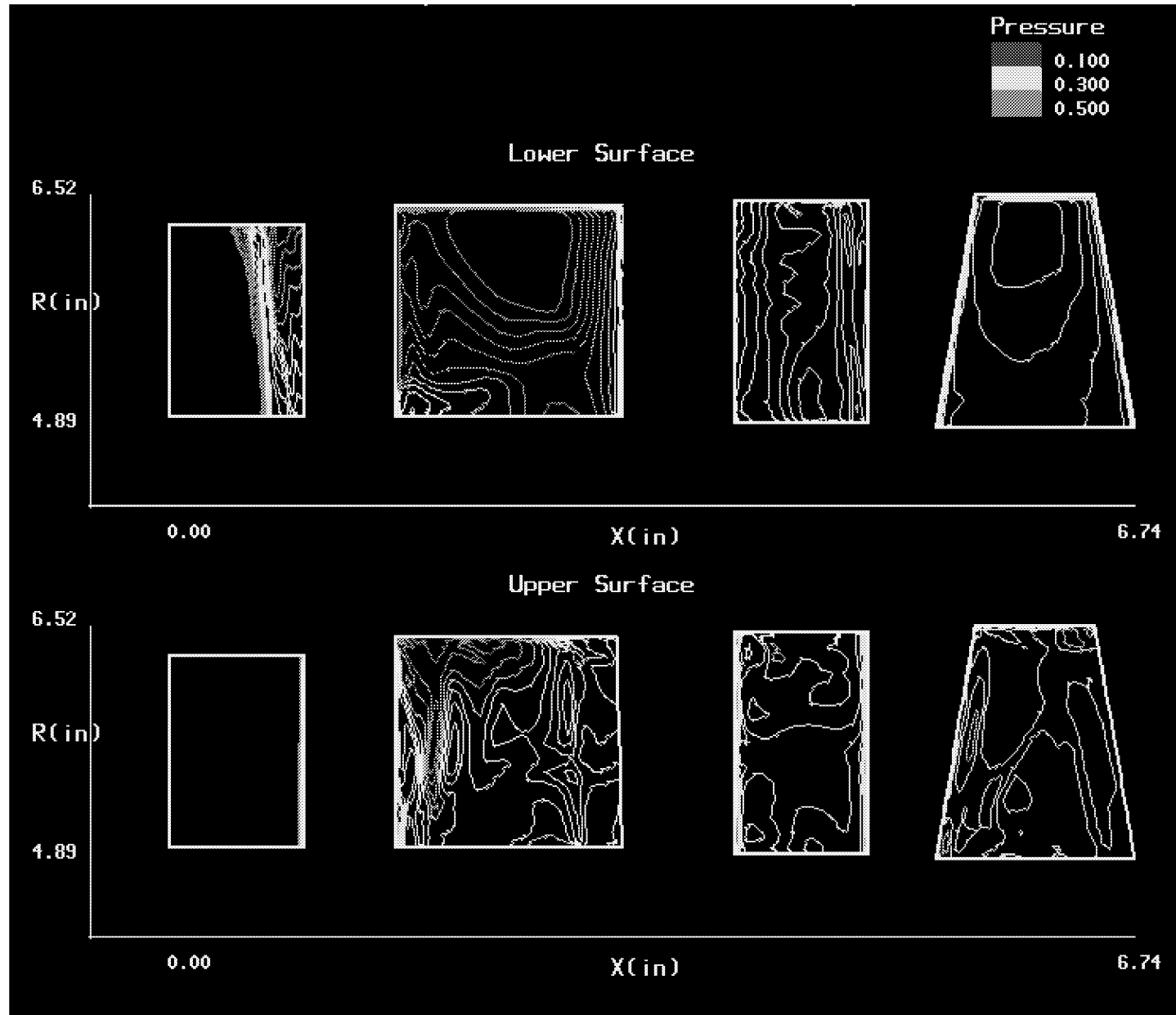
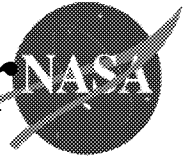
Timestep 16

Animator



- **Generates MPEG animation files in batch mode**
- **Allows input files to be compressed**
- **Input Data Files**
 - CORSAIR - customized output files
 - General Codes
 - standard Plot3D files
 - xy point files
- **Types of Animations**
 - envelopes
 - line plots
 - contours
 - vectors
- **Customization of animations**

2-Stage Turbine Pressure Contour



Future Plans for Animator



- Add the calculation of streamlines/streaklines
- Include a GUI to specify the view in 3D
- Include automated feature extraction

Conclusions



- **Pre-Processing**
 - significantly reduced time needed for error checking
 - eliminate ambiguities in input files
- **Interim-Processing**
 - improved ability to detect convergence
 - improved understanding of underlying flow mechanisms
- **Post-Processing**
 - improved understanding of underlying flow mechanisms
 - improved technology transfer
- **Improved Designs**