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

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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
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, IWWALL, DENNX, VISWX
  1 1 50 1 1 1 1 1 1 0.000e+00 0 1.000e+00 1.000e+00
  1 1 50 25 25 1 1 1 1 0.000e+00 0 1.000e+00 1.000e+00
  2 1 1 1 51 1 1 1 1 0.000e+00 0 1.000e+00 1.000e+00
  2 1 75 1 1 1 1 1 1 0.000e+00 0 1.000e+00 1.000e+00
  2 1 75 75 75 1 1 1 1 0.000e+00 0 1.000e+00 1.000e+00

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10/22/01
# 3D 22-Grid Case

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<th>Type</th>
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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

- Checking grid dimensions
  - No errors in grid definitions
- Checking Patched Interface Definitions (23)
  - No errors in patched interface definitions
- Checking Flow Boundary Definitions (36)
  - No errors in flow boundary definitions
- Checking Wall Definitions (58)
  - No errors in wall definitions

Print to File
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
FlowShow: Super-Sonic Back Facing Step
Monitor: Super-Sonic Back Facing Step

[Image showing various plots and graphs related to fluid dynamics and flow characteristics.]

10/22/01
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