CFD++
METACOMP TECHNOLOGIES

Software Review
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MAE 598 – Experimental Computational Fluid Dynamics
Numerical Architecture

- Wide range of numerical features available:
  - Up to fourth order accuracy in time in implicit mode
  - Finite-volume framework
  - Fast convergence to steady state
  - Fast computation of unsteady flows
  - Dual time stepping
  - Multi-dimensional TVD (Total Variation Diminishing) polynomial reconstruction

- Unified-grid framework (grid-transparent) unifies the treatment of different cell shapes and grid Topologies

- Unified physics treatment allows to solve different sets of governing equations and provides the modularity to handle incompressible flows as well as low and high-speed compressible flows, with or without reactions

- CFD++ provides total portability between different computing platforms

- Covers the following equations
  - Navier Stokes for either compressible or incompressible fluid flows
  - Advection-Diffusion
  - Multi-Species
  - Turbulence Models
## Strengths & Weaknesses (as compared to Fluent)

<table>
<thead>
<tr>
<th>Strengths</th>
<th>Weaknesses</th>
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<tr>
<td>§ Moving mesh provides flexibility for multiple grids as well as rigid body dynamics</td>
<td>§ Limited variations in number of parallel processes used</td>
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<td>§ Fast processing time using coupled, implicit solution with multi-grid acceleration</td>
<td>§ Data extraction issues with large datasets</td>
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<td>§ Separated &amp; reversed flow prediction capability</td>
<td>§ Expert knowledge required to correctly set up and run multiple processes (not useful for educational purposes)</td>
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<td>§ Second-order accurate, implicit time-integration with dual time-stepping for unsteady flow</td>
<td>§ Customization for specific applications is costly and complex</td>
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<td>§ New turbulence-chemistry interaction models</td>
<td>§ Only few sources available for purchase</td>
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Availability & Cost

- Available for purchase from few sources
- Pricing is based on the selected modules
- Limited basic version available for personal use starting at $250
- Professional licenses range from $8,000 to $12,000
- No free student version available
Recommendations

- CFD++ application contains a wide range of capabilities including:
  - Low and high speed reacting/non-reacting flows
  - Incompressible flows
  - Conjugate heat transfer
  - Multiphase flows
  - Highly accurate 6-DOF module

- CFD++ software is more sophisticated CFD solver than ANSYS Fluent

- Limited access to the various modules makes it a poor choice for educational purposes

- CFD++ software is an appropriate solver choice for complex CFD analysis within the aerospace and automotive fields
References