Presentation Poster: HYDRA-TH Conjugate Heat Transfer (CHT)

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Conjugate Heat Transfer Verification

- Shows heat conduction through outer walls into moving fluid.
- Hydra CHT capability proven when compared with Barletta et al. results.

Figure 1: Longitudinal section of channel with boundary conditions

Figure 2: Solid fluid interface

Native Conjugate Heat Transfer Comparison

- Preliminary Hydra CHT results with comparison to analytic solution
  - Conjugate forced convection heat transfer in a plane channel: Longitudinal periodic regime (A. Barletta et al. 2008).

- Conjugate heat transfer through wall into fluid. Results at fluid/solid interface as shown below.

Figure 3: Solid fluid interface

User Defined IC’s/BC’s Control File Setup

- Functions available to User
  1. Implementation of interface heat flux designation capability.
  2. Future Work
    1. Implementation of interface heat flux designation capability.

Implementation of block initial conditions as opposed to the current globally defined initial conditions allows for different initial conditions to be applied to different regions of the problem. I.E. Different initial conditions at the top and bottom of the core.

Initial condition application order in Hydra-TH
1. Apply Global Initial Conditions
   I. Apply Simple Initial Conditions
   II. Apply User-Defined Initial Conditions
   III. Apply Rigid Constraint (based on material)
2. Apply Block Initial Conditions
   I. Apply Simple Initial Conditions
   II. Apply User-Defined Initial Conditions

Future Work
1. Implementation of interface heat flux designation capability.

References

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Native Conjugate Heat Transfer Comparison

3 Function classes available using A, B, C, and D
1. \( A\alpha + B\beta + C\gamma + D \)
2. \( A\alpha^2 + B\beta^2 + C\gamma^2 + D \)
3. \( A\alpha^2 + B\beta + C\gamma + D \)

Also available is the ability to input several user defined functions using case structure and simply add on another case for each new user defined function.

Figure 4: Quadratic velocity profile block initial condition
Figure 5: Sinusoidal temperature block initial condition
Figure 6: Quadratic velocity profile global initial condition with rigid constraint.
Figure 7: Sinusoidal temperature profile global initial condition

Figure 8: Quadratic velocity profile global initial condition
Figure 9: Sinusoidal temperature profile global initial condition
Figure 10: Block velocities applied Block 1: 3.0 Block 2: 5.0 Block 3: 1.5

Figure 11: Block temperatures applied Block 1: 3.0 Block 2: 5.0 Block 3: 1.5

Figure 12: Quadratic velocity profile block initial condition with rigid constraint.
Figure 13: Block temperature initialized with user function.

Block Initial Conditions

Implementation of block initial conditions as opposed to the current globally defined initial conditions allows for different initial conditions to be applied to different regions of the problem. I.E. Different initial conditions at the top and bottom of the core.

Figure 14: Hydro Simulation (Dimensionless Temperature)