Example: Rotating Fluid and Heat Transfer

Elmer Basic Course

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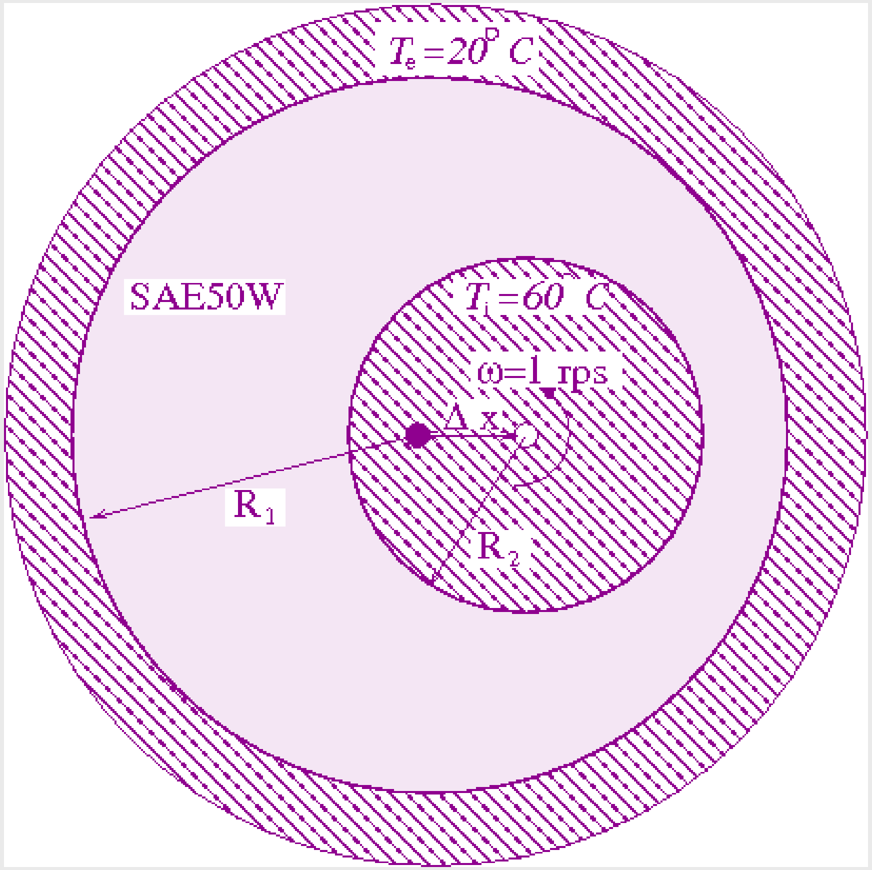
Problem Outline

- **Geometry**
  - R1 = 10 cm (0.1 m)
  - R2 = 5 cm (0.05 m)
  - Dx = 2.5 cm (0.025m)
- **Kinematics:**
  - ω = 1 rps = 2 π rad s^{-1}
- **Thermodynamics:**
  - *Te* = 20°C = 293.16 K
  - *Ti* = 60°C = 350.16 K
- **Material (SAE50W):**
  - $\mu = \mu_0 \exp[C \cdot (293.16/T[K] - 1)]$
  - $\mu_0 = 0.86$ kg m^{-1} s^{-1}, $C=20.2$
  - $C_p = 1.9$ kJ kg^{-1} K^{-1}
  - $K = 0.12$ W m^{-1} K^{-1}



CSC

Rotating Boundary

- **Tangential velocity:**

  $v_t = \omega\ R_2 = 0.05 \cdot 2 \cdot \pi = 0.31416\ \text{m s}^{-1}$

- **Boundary numbering:**
  1. **Inner wall**
  2. **Outer wall**
  3. **Sidewalls (top, bottom)**

- **Inner wall (how it not works):**

  `Normal-Tangential Velocity = True`

  `Velocity 2 = 0.31416`

  `Temperature = 60.0`

- **Outer wall:**

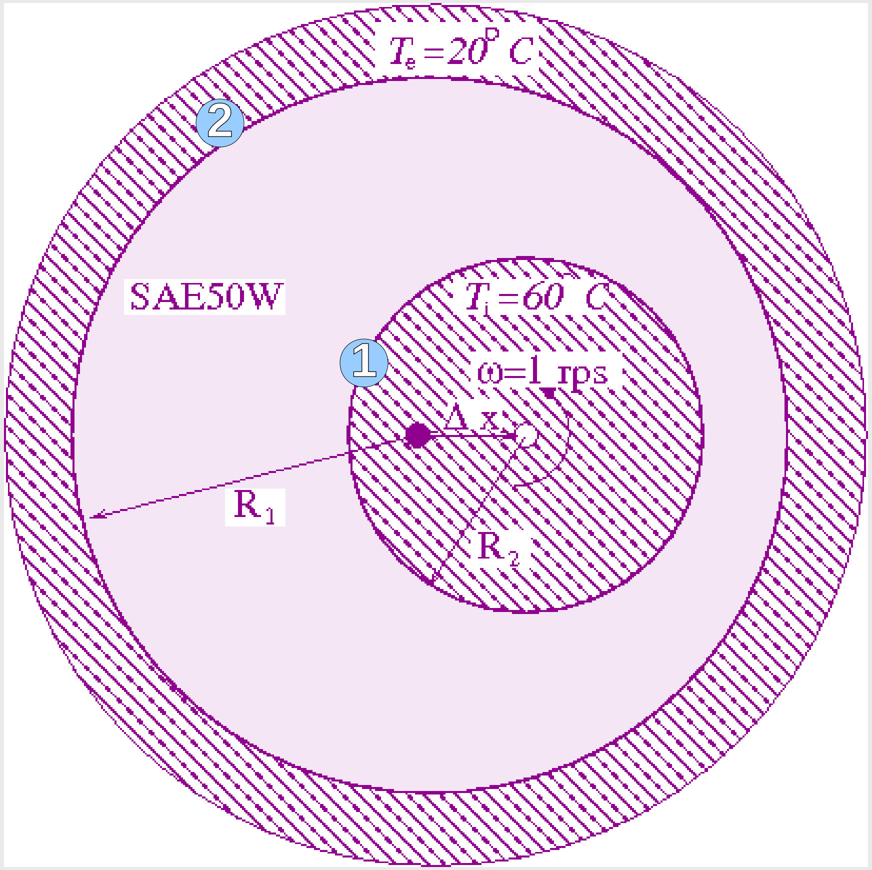
  `Velocity 1/2/3 = 0`

  `Temperature = 20.0`

- **Adiabatic sidewalls:**

  `Velocity 1/2/3 = 0`

  natural BC for HTEq. (i.e., nothing)



Exercises

- Check out the remedy to the rotating boundary problem in `annulus.sif`

  try to understand the different calls to the MATC functions
- Write a F90 function for the viscosity, compile it and insert it into the SIF