Homework #1

Due: 19 April 2007

Microchannel Cooling Design

Given:

Use the *COMSOL V3.3* model *Model Library / Chemical_Engineering_Module / Energy_Transport / sinusoidal_heat_exchanger*, for the basic configuration of the microchannel. Use the specifications of this model as default conditions for your problem. Determine the heat exchange performance for an average velocity of *Uav* = 0.02 m/s.

Approach:

1. Follow the instructions in the *COMSOL* documentation to create the heat exchanger geometry.
2. Save the *Model M- file (*.m)*. (M-files can be viewed and run as a script from Matlab)
3. Starting from scratch, recreate the geometry with a slightly thicker channel.
4. Save the new *Model M- file* and compare the differences. Use this information to determine how to modify the geometry from inside the *M- file*.
5. Solve the original model for *Uav* = 0.02 m/s.
6. Plot the steady-state pressure, velocity and temperature distributions for the original geometry. Also, calculate the total heat rejected and the performance (ratio of heat rejected to viscous power loss).
7. Save the *Model M- file*.
10. Now construct an *M- file* which conducts simulations at various separations ranging from (0.25mm< *d* <1.0mm) to determine the best heat rejection at various separation distances.
11. Heat rejection can be estimated by conducting a boundary integration

$$q_{rej} = q_{out} - q_{in} = \int_S \rho c_p T \left(\mathbf{u} \cdot \mathbf{n} \right) dA$$

Write Up:

This problem is expected to be written up in a professional manner with detailed explanations of the work. Show all necessary work, calculations and plots.