Thesis Notes:

Mukherjee Conjugate Heat Transfer Paper: HT2007-32434

Numerical study of conjugate heat transfer due to growth of a vapor bubble during flow boiling of water in a microchannel

Notes:

Grid independence study needs to be conducted.

A number of references for Conjugate Heat Transfer were presented in the paper and can be used in the thesis.

A microchannel, conjugate heat transfer numerical model was created to investigate the temperature distribution of in the side walls as well as the fluid. The model was extended from a previous three-dimensional numerical model to investigate lateral mergers of vapor bubbles during nucleate boiling (Mukherjee, Dhir / Mukherjee, Kandlikar). The grid size used was based on previous work from Mukherjee & Kandlikar to minimize the numerical error and optimize calculation time. A step time independence study was also performed to verify that the results were not dependent with the time step size.

The diffusion effects of the conduction heat transfer were modeled using the harmonic mean method.

The results show that the bubble growth rate and bottom wall temperature increased with an increased heat flux from the side walls.

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This paper can be used to develop the foundation for the thesis paper. A number of references were included for conjugate heat transfer that should additionally be reviewed (these will probably be included in the literature review presented in the thesis). The explanation of the model development is key to the thesis as the model is Mukherjee's. The paper is, however, dated in 2007 and many advances in theory have been made in the last 8 years.

May be useful to bring up as part of the weekly meeting with Mukherjee.

Mukherjee Meeting - 150319

Thesis:

Lit Review for Conjugate Heat Transfer

Next Thursday

Schedule Time to focus on reviewing papers

Mukherjee to debug code

Speak with Arman to determine what has already been finished

Start Writing Paper

Come up with abstract by next week

Preliminary, but will help define the goal of the project

Determine goals for the thesis

Come up with a timeline

Come up with goals

Send to Mukherjee prior to meeting on Thursday

Review timeline & identify risks to schedule

Review goals and determine "Yay or Nay"

ICNMM Paper

Revise paper Friday night / Saturday

Send to Mukherjee for review

Submit by Monday, March 23

Tasks for next week:

Lit Review (5 papers minimum)

Project Planning

Abstract

Paper Outline

Goals

Schedule / Timeline

Goal:

Create a numerical model that accurately (validated by experiments) represents conjugate heat transfer in a micro channel

Validate the model against experimental data (from Lit review)

Thesis Planning

Focus Area: Bubble dynamics in a flow boiling microchannel with conjugate heat transfer

Why: Experience investigating contact angle in microchannel boiling

What: Perform a parametric study of a conjugate heat transfer model.

Vary the following parameters: Contact Angle (3 sides), Re, Heat Transfer inputs

Base variations on experiemental works... possibly focus on difference applications

Studies:

Time Independance

Grid Independance

Parametric Study

Results to Look at:

Bubble Growth Rate

Bubble Stability

Nusselt Number

Velocity Field Comparison

Temperature Gradient Comparison

Thesis Proposal Template

Abstract

Perform a feasibility study of a microchannel heat exchanger integrated in a PCB for use in both consumer, industrial, and scientific computing.

Introduction

a. Background

b. Significance of Research

Existing Knowledge / Significant Prior Research

Thesis or Project Statement

Fesibility study of a microchannel heat exchanger for integration into a the printed circuit board.

Approach

a. Methods

b. Bibliography of Sources

c. Implications of Research

Potential Outcomes

Blueprint for integrating a microchannel heat exchanger onto a PCB.

Challenges (obstacles) associated with developing this system.

Estimated heat dissipation.

Estimated production pricing.

A specification for creating a microchannel heat sink.

Limitations

Research and feasibility only. No integration or development.

Contributions to Knowledge

Creating a blueprint to develop a microchannel heat exchanger for commercial use.

Proposed Thesis Chapters

Project Timeline

Thesis Tasklist

Due 1/19

- Find a workspace and compiler for C/C++ and for Fortran

- Start work through Fortran examples in the book to get a better understanding of the coding structure.

Raspberry Pi Cluster

https://www.sparkfun.com/products/13724

http://thenewstack.io/installing-mpi-python-raspberry-pi-cluster-runs-docker/

http://www.southampton.ac.uk/~sjc/raspberrypi/

Due 1/26

- Review of 32-bit vs. 64-bit processing and why the current code does not utilize all available memory.

- Implement a TDM solution algorithm.

o Understand how this algorithm would work in a CFD Code.

* Review MPI implementation of CFD code.

CSUN Thesis - Software Requirements

Microsoft Visual Studio (Code)

https://code.visualstudio.com

And the fortran extension

color the program, it helps

Fortran MPI Compiler

https://www.open-mpi.org/software/ompi/v2.0/

- Remote Access to lab computer

Can I have it?

Run/Stop/Review Data

- Using MPI to send data between computer nodes on the network lan

- Do you have any experience with it?

- Outline of what I'm trying to do

- What time works best for you?

- Weekdays after 4pm?

- Saturday morning?

Talk with IT - Tania / [data@csun.edu](mailto:data@csun.edu)

Email sent 8/25/16

Mukherjee Meeting – 8/2/2016

Outline:

* Discuss OpenMPI
  + Review Code
  + Review Results
  + Discuss Advantages / Disadvantages
* Discuss Thesis
  + Focus Area
  + Specific Topic
  + Timeline Goals
  + Risks to Timeline Goals
* Set Up Recurring Meeting (Call or In-Person)
* Set up tasks to complete for next week