PROJECT PORTFOLIO

Vishwas Mehta

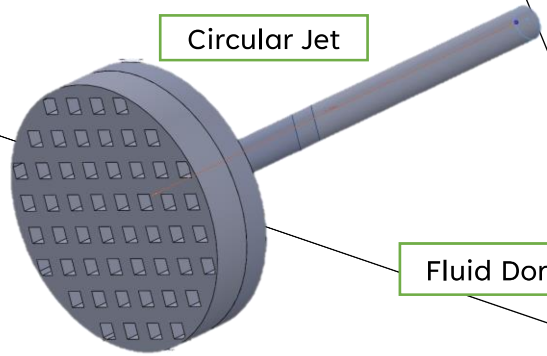
(919)-771-9844 vmehta5@ncsu.edu Vishwas Mehta

ABOUT ME

I am a Graduate student pursuing a Master’s degree from North Carolina State University.

While studying Mechanical Engineering, I found my interest lies in Heat Transfer, CAD, FEA, Simulations, Additive Manufacturing, and Optimization.

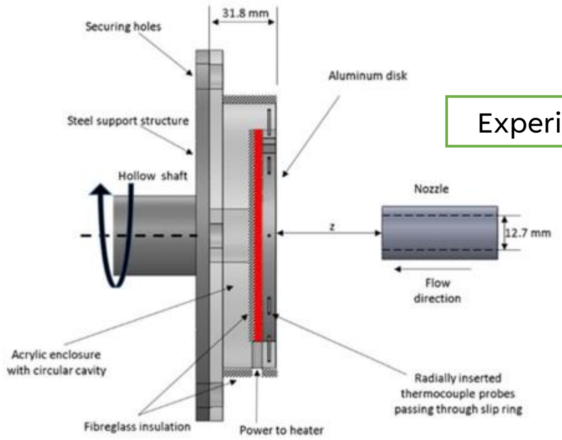
I will be graduating in May 2023 and am open to work post my graduation.



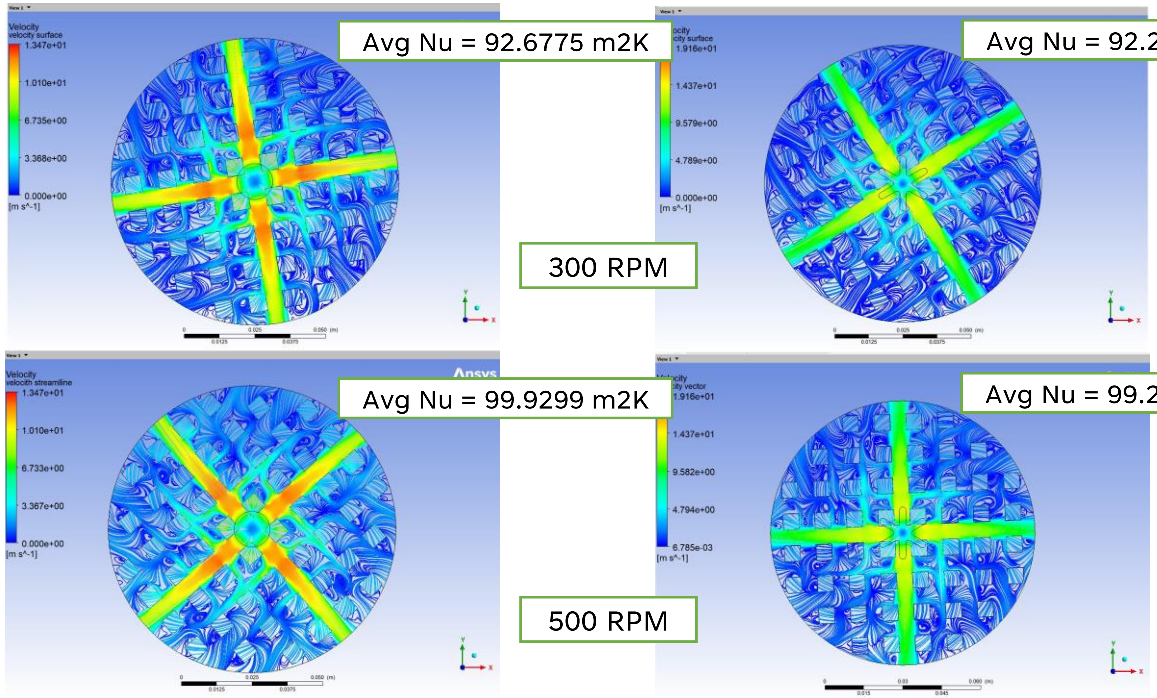
Circular Jet

6- Lobe Jet

Fluid Domain



Experimental Setup



Avg Nu = 92.6775 m2K

Avg Nu = 92.2971 m2K

300 RPM

Avg Nu = 99.9299 m2K

Avg Nu = 99.2252 m2K

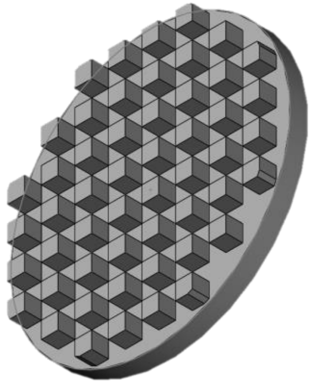
500 RPM

Surface velocity streamlines using CFX

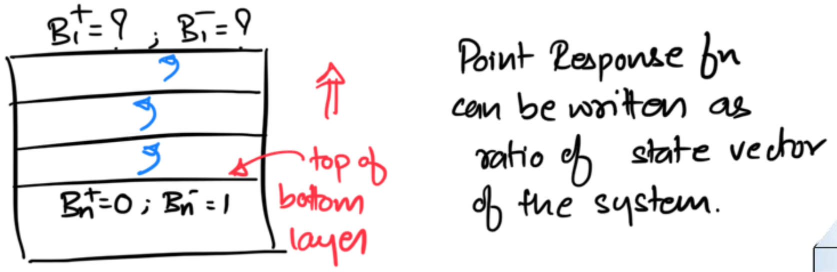
HEAT TRANSFER OVER ROTATING DISK

The objective of this project was to see the change in the average Nusselt number over the rotating disk with pin fin by varying the shape of the jet. The results were compared to the ones performed in the experimental setting

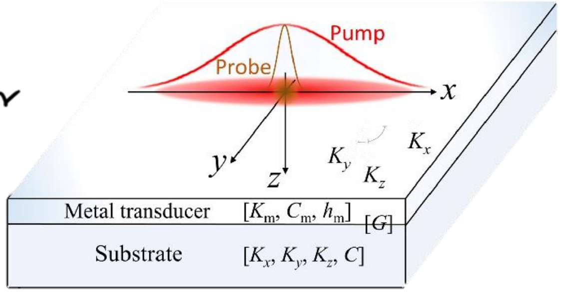
The jet Reynolds number was kept at 10000 and the rotational Reynolds number was 300 and 500 respectively.



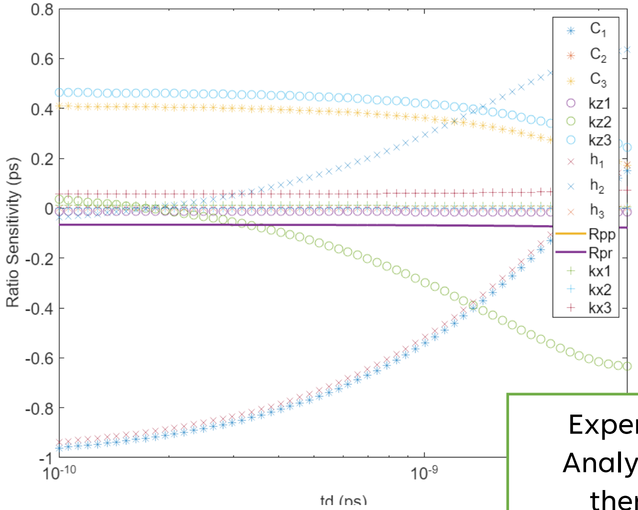
Rotating Disk for pin fins



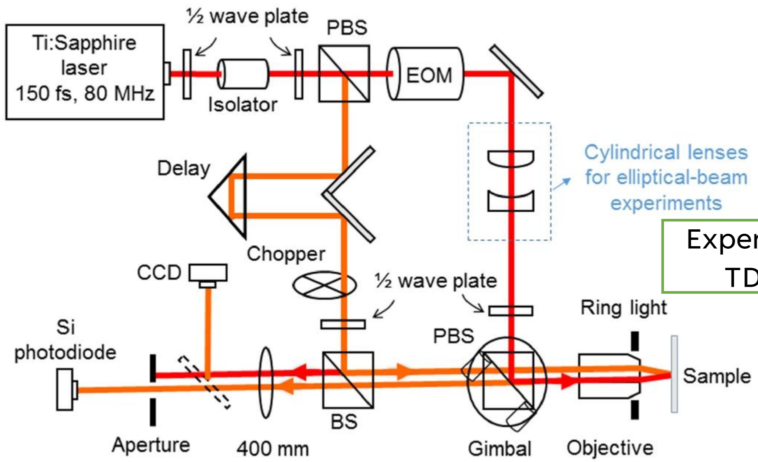
Calculation of the temperature



Interaction of the transducer and substrate



Experimental and Analytical data on thermal fitting

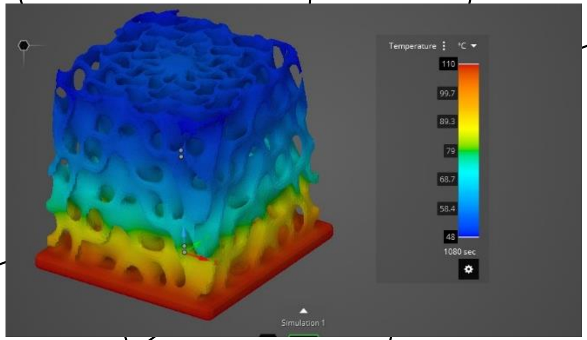


Experimental Setup for TDTR Experiment

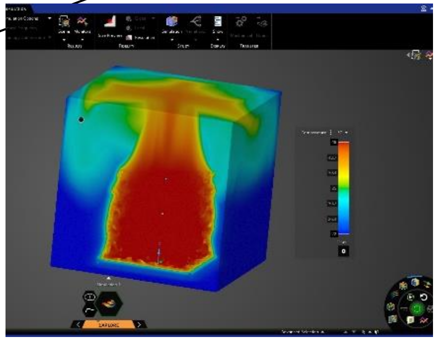
THERMAL PROPERTIES OF THIN FILMS

The objective of this project was to develop an algorithm that helps determine the thermal properties of a thin film using thermal fitting over a Pump-Probe spectroscopy method. The method we used was called Time Domain Thermo-reflectancy (TDTR).

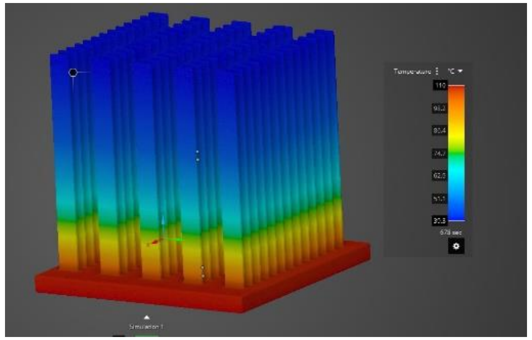
The source laser is split into two beams, the pump term and the discrete chopped signal (probe). The pump heats up the surface and the probe beam hits the heated surface at a certain angle, the change in reflectance of the beam is perceived by the receiver which passes on the data to the lock-in amplifier. This data is plotted and the material properties is determined by thermal fitting.



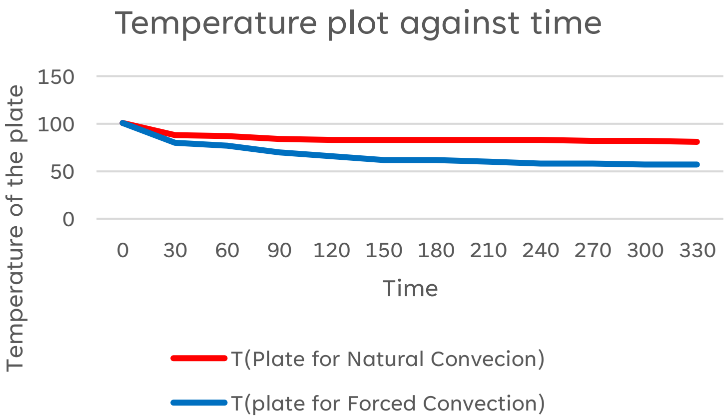
Conduction in a heat sink



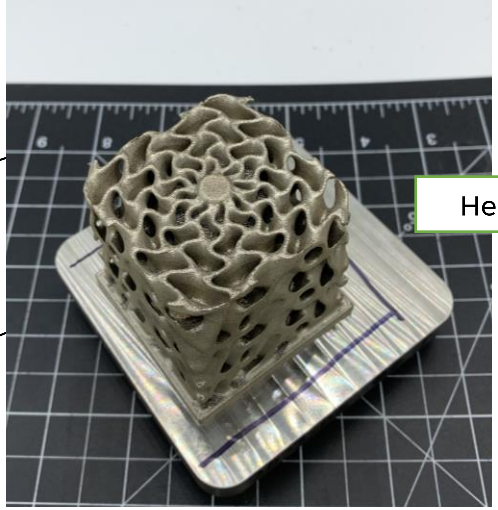
Convection in Fluid Domain



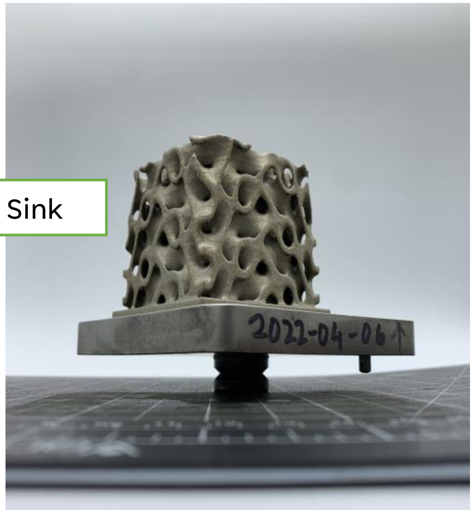
Conduction in Pin Fin in over same volume



Experimental Results



Heat Sink



$$\frac{A_s(Our\ Design)}{A_s(Pin\ fin)} = \frac{68160}{45353} = 1.4968 \cong 1.5$$

Area comparison between two heat sink

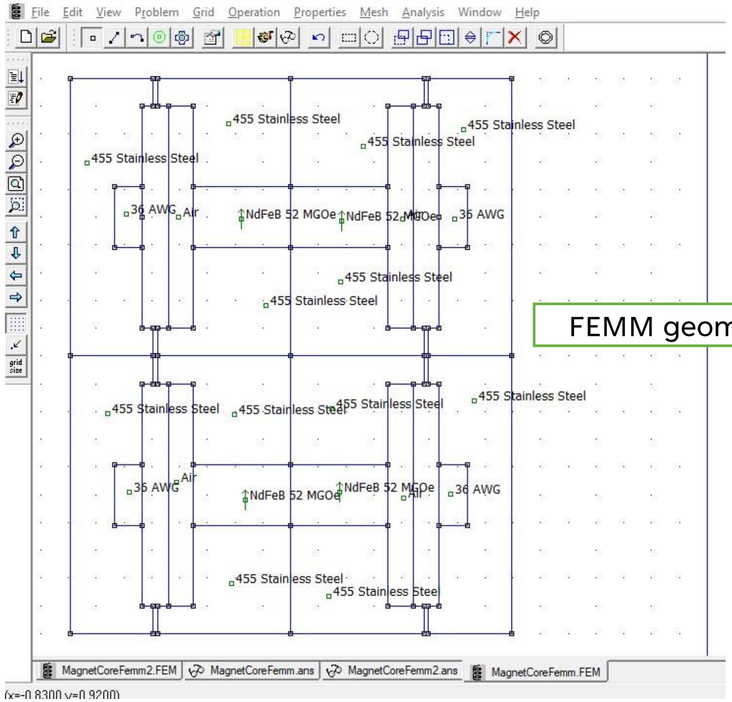
THERMO-MECHANICAL OPTIMIZATION OF A HEAT SINK

The objective of this project was to thermally optimize a heat sink.

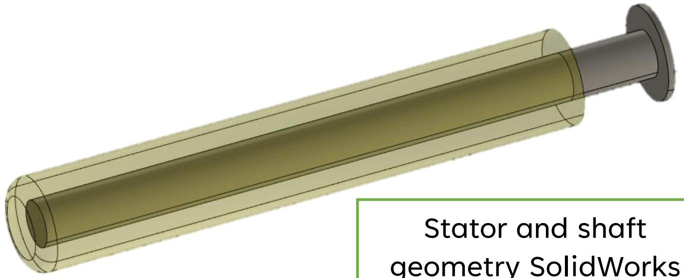
In this project, I confined myself to a given volume area and tried increasing the surface area for that given volume.

Post running the simulation we additively Manufactured it and ran tests on it.

There was a total of 1.49 times increase in the surface area of the heat sink and was able to lower the temperature of the heated plate from 101 to 57 degrees C with forced convection.



FEMM geometry



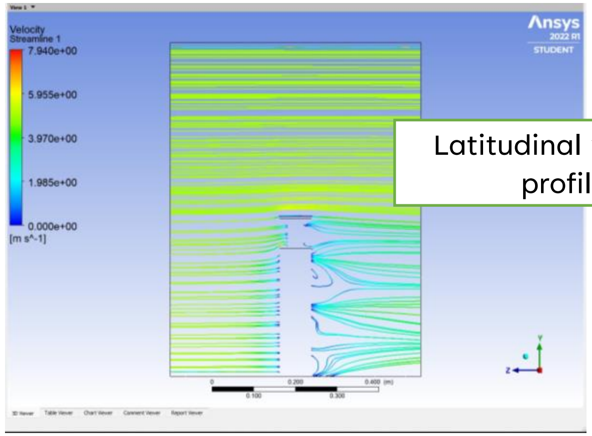
Stator and shaft geometry SolidWorks

SELF-SUSTAINING BUOY DESIGN

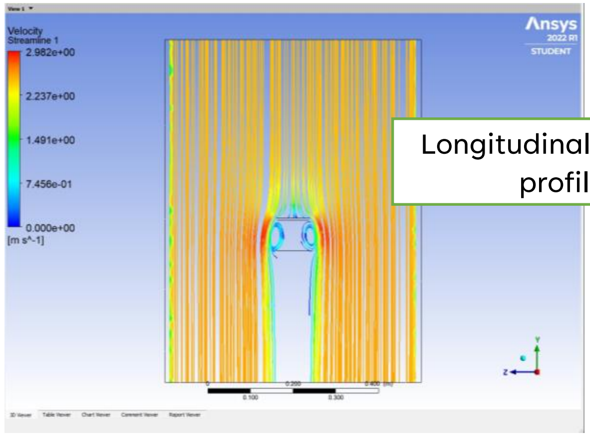
The objective of this project was to design a self-sustaining buoy that can harvest energy from the wave.

The buoy had to be free floating on the ocean surface and within the given dimension of 3 inches diameter and less than 20 inches long. It should have an antenna at the upper portion of the buoy. It should also have an energy storage resource with a capacity of 60J.

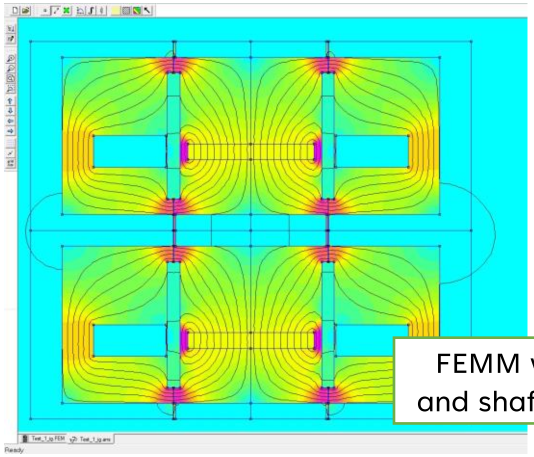
We used Solidworks to design the geometry, FEMM to determine the total magnetic flux and response during the varying situation, and ANSYS Fluent to calculate the forces on the buoy suspended free on the ocean surface.



Latitudinal velocity profile

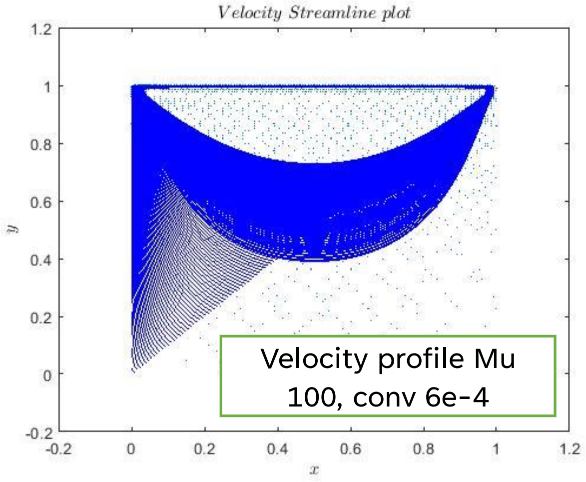


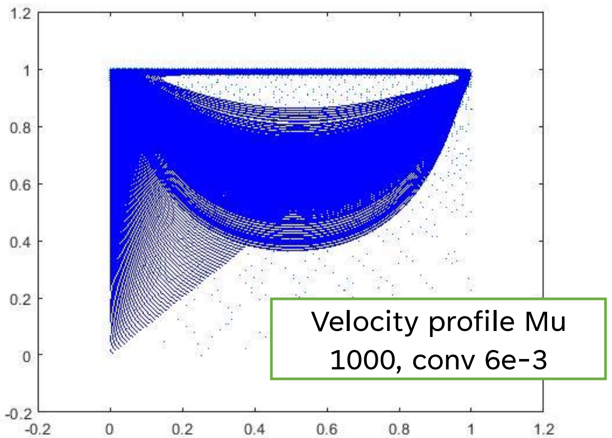
Longitudinal velocity profile

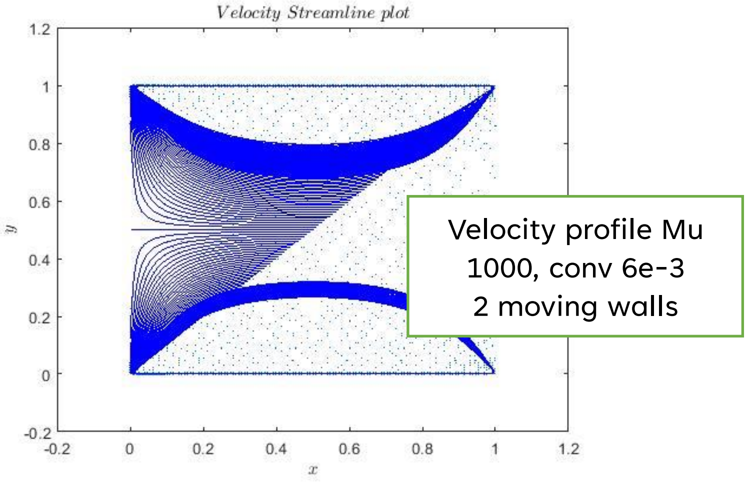


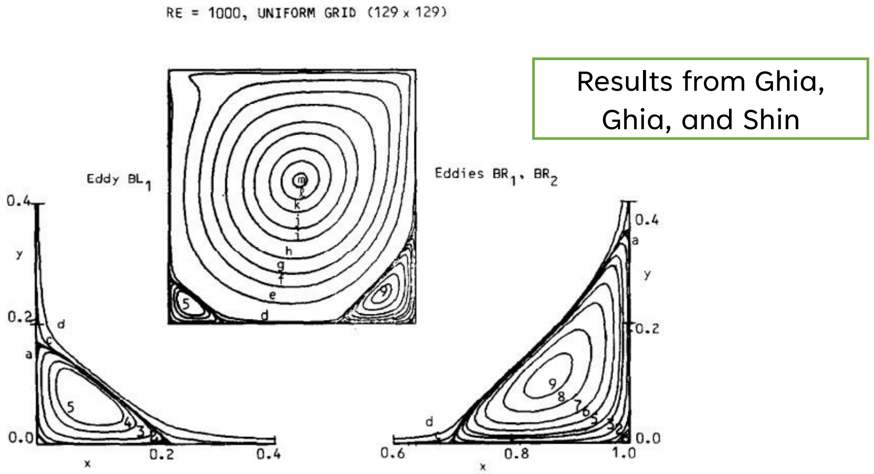
FEMM when stator and shaft are aligned

NAVIER STOKES LID DRIVEN CAVITY FLOW SOLVER





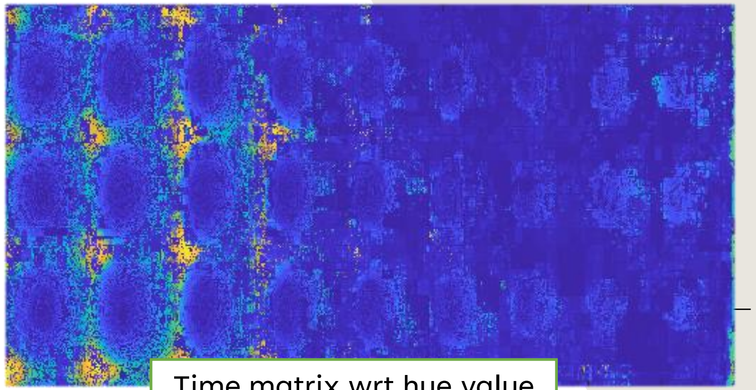




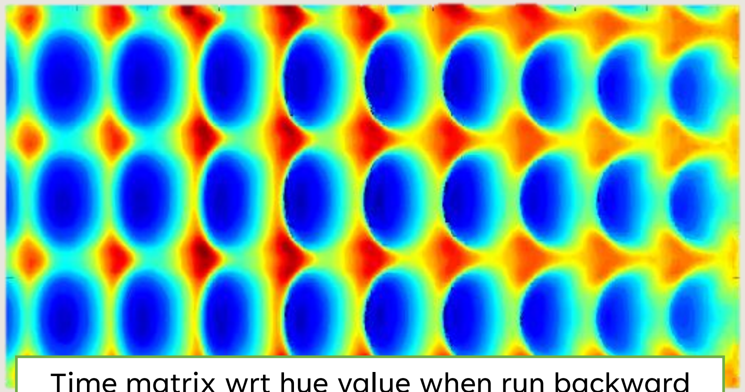
The objective of this project was to develop an algorithm that solves the incompressible Navier-Stokes equation and helps visualize what the velocity profile looks like when subjected to a case of one moving wall and a stationary wall.

The results were compared to the state-of-the-art paper by Ghia, Ghia, and Shin.

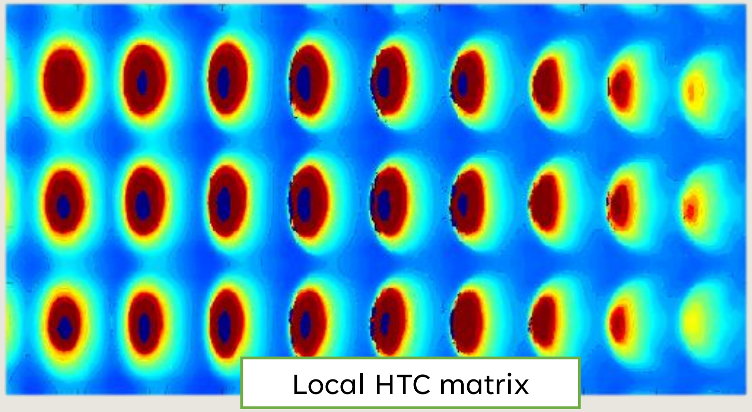
The runs were performed and different Reynolds numbers and the convergence criteria was fluctuated to measure the impact of the solver. 2nd order AB2 scheme for the Advection term and CN for the viscous term were implemented in the MATLAB code.



Time matrix wrt hue value



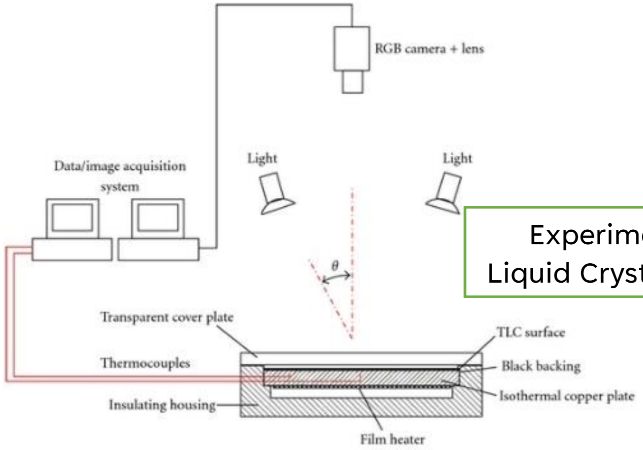
Time matrix wrt hue value when run backward



Local HTC matrix

$$T_w = T_i + \sum_i \left[T_{m,i} - T_{m,i-1}\right]\left[1 - \exp\left(\frac{h^2(t-t_i)}{pck}\right) erfc\left(\frac{h(t-t_i)^{0.5}}{(pck)^{0.5}}\right)\right]$$

Duhamel’s Superposition principle



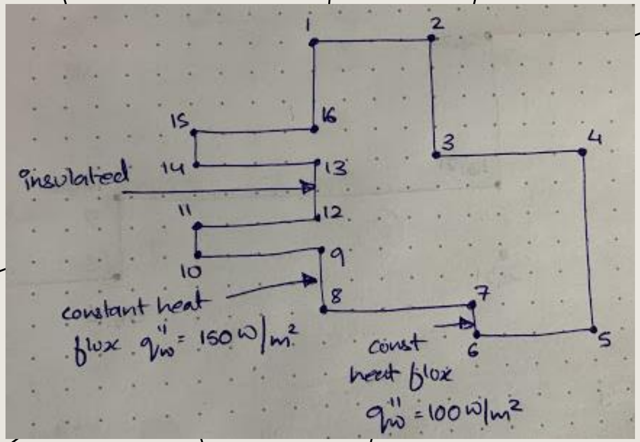
Experimental setup for Liquid Crystal Thermography

HEAT TRANSFER COEFFICIENT USING IMAGE PROCESSING

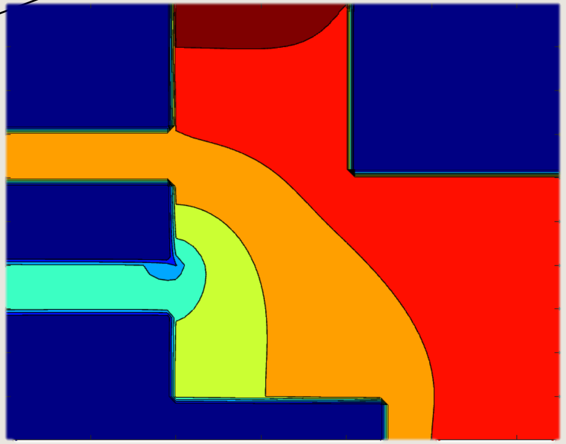
The objective of this project was to determine the Local Heat Transfer coefficient of the surface coated by LC being impinged by an array of jets.

We developed an algorithm that takes in a video file and breaks it up into frames. Resizing of the frames is done to determine the region of interest.

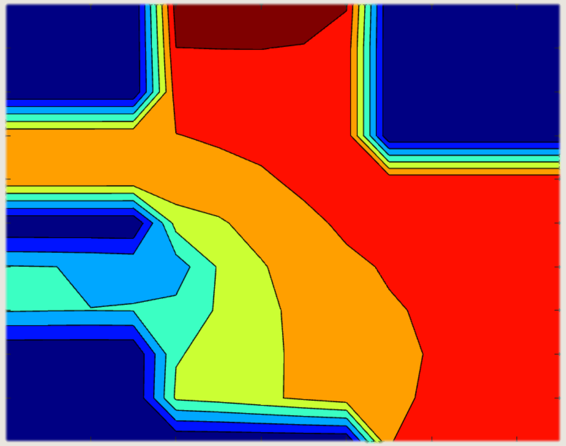
The time matrix returned from the file was stored and used to calculate the HTC for every pixel and was stored in another matrix which can be seen in the image above.



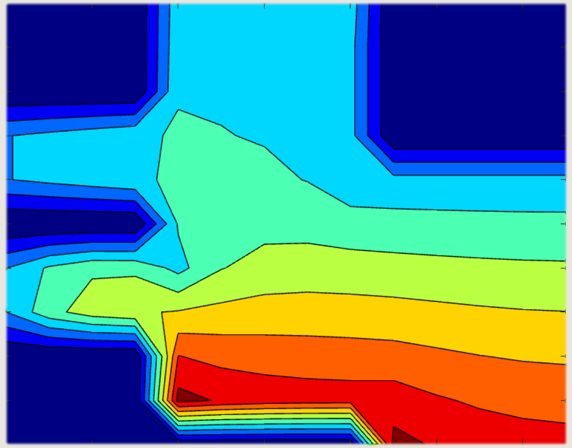
Experiment Geometry with BC



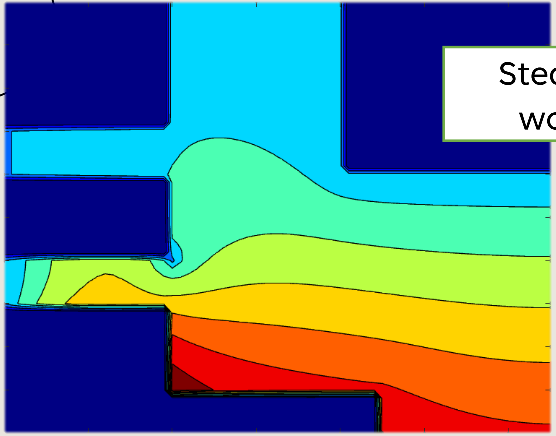
Steady-state result for aluminium mesh size 1x1



Steady-state result for aluminium mesh size 5x5



Steady-state result for wood mesh size 5x5



Steady-state result for wood mesh size 1x1

FEA ALGORITHM FOR 2D STEADY STATE HEAT TRANSFER

The objective of this project was to develop an algorithm on MATLAB to visualize the steady-state heat transfer and compare the results to the ANSYS package for Steady-state heat transfer.

The given geometry was hard coded into the package and a standard central finite difference scheme was implemented along with the 16 BCs based on the problem statement. BCs were either adiabatic, constant heat flux, or constant temperature.

The results obtained were compared for wood and aluminum with two different mesh sizes (1x1 and 5x5).

THANK YOU

For going through the slide deck. Please feel free to reach out via my contact details given below.

Ph. No.: +1 9197719844

Mail id: vmehta5@ncsu.edu