JETIR.ORG ISSN: 2349-5162 | ESTD Year : 2014 | Monthly Issue
JOURNAL OF EMERGING TECHNOLOGIES AND INNOVATIVE RESEARCH (JETIR)
An International Scholarly Open Access, Peer-reviewed, Refereed Journal

APPLICATION OF COMPUTATIONAL FLUID DYNAMICS IN JET IMPINGEMENT WITH NANO FLUID

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Abstract: The use of Nano Fluid in case of jet impingement is an important parameter for the study. The properties of the Nano fluid make it very important in increasing the rate of heat transfer. Now a days increasing temperature of electronic components is a very serious concern for the research. Nano fluids can lead to some solution to this type of problems. Due to this reason in the present analysis Nano fluid has been chosen. The three dimensional model of heat sink with airfoil pillars with jet impingent has been utilized for the study based on the pure water and water –Nano fluid. The execution has been carried out in terms of different characteristics parameters like maximum temperature rise, overall pressure drop, heat transfer coefficient, Nusselt number, thermal resistance and pumping power. The study has been carried out using Computational fluid dynamics as the tool. Model is validated with the available geometry. The CFD results and available literature results shows a good agreement between them.

Index Terms **- CFD, Fluid, Flow, Nano Fluid, Temperature, Pressure Drop**

I. INTRODUCTION

Now a day's temperature of electronic components is increasing day by day. So there is a need for the dissipation of heat to decrease the temperature. So effective cooling arrangement is needed.

Hempijid, T., & Kittichaikarn, C [1] use CFD to study the concept of sink using various parameters. Different shapes of sinks were studies and one of the best was predicted. Concept of vortices was also studied.

Mahdavi, M. et al [2] analyzed the use of Nano fluid in different types of flow. The properties were studied with different parameter. The effect of increase in the viscosity of the Nano fluid was predicted in terms of heat transfer. Heat flux value is taken as constant.

Duan, Z. et al [3] confronted the numerical simulation and experimental results. Results were found to be matched with each other. Sink of the plate fin shaped was taken for analysis. The results were compared for the two different cases. One with bottom as elliptical and other without elliptical.

Ramesh, K.N. et al [4] studied the heat transfer using different techniques i.e the concept of impingement, Nanofluid etc. Different optimization techniques were used to analyze the parameters.

Datta, A. et al [5] used Nano fluid to study the functions like stream function and velocity potential function in a heat sink. The observations were found in terms of heat transfer coefficient. The effect of Reynolds number was also analyzed. Relationship was found for different dimensionless numbers.

Chen, W., & Cheng, J. [6] compared the effect of water and water based Nano Fluid on the heat transfer process. The two different surfaces were used. One was concave surface and other was convex surface. The effect of surface was studied on Nusselt number.

M.S, A., & Venkata subbaiah, K. [7] used Fortan solver to emphasis on the concept of impingement. Several Nano fluids were used. Formation of governing equations was done with FDM. Percentage improvement in the heating process was analyzed.

Pratap, A. et al. [8] formed the dimensionless variable to study the effect of Nano fluid. Nusselt number was varied and the effect was analyzed on the dimensionless variable. Positive relationship was found between the two variables. The shape of the jet was assumed to be circular.

Ghanbari, S., & Javaherdeh, K. [19] enhanced the value of heat transfer coefficient. The same was performed using Nano Fluid of the Non-Newtonian nature. The system was analyzed for different concentrations. Percentage improvement was predicted. Numerical values have been compared with the experimental values.

Freegah, B. et al [20] used a new shape of heat sink and analyzed the heat transfer coefficient.

Husain et al. [21] introduced the novel concept of jet impingement heat sink with microchannel and pillars arrangement.

II. RESULTS AND DISCUSSION

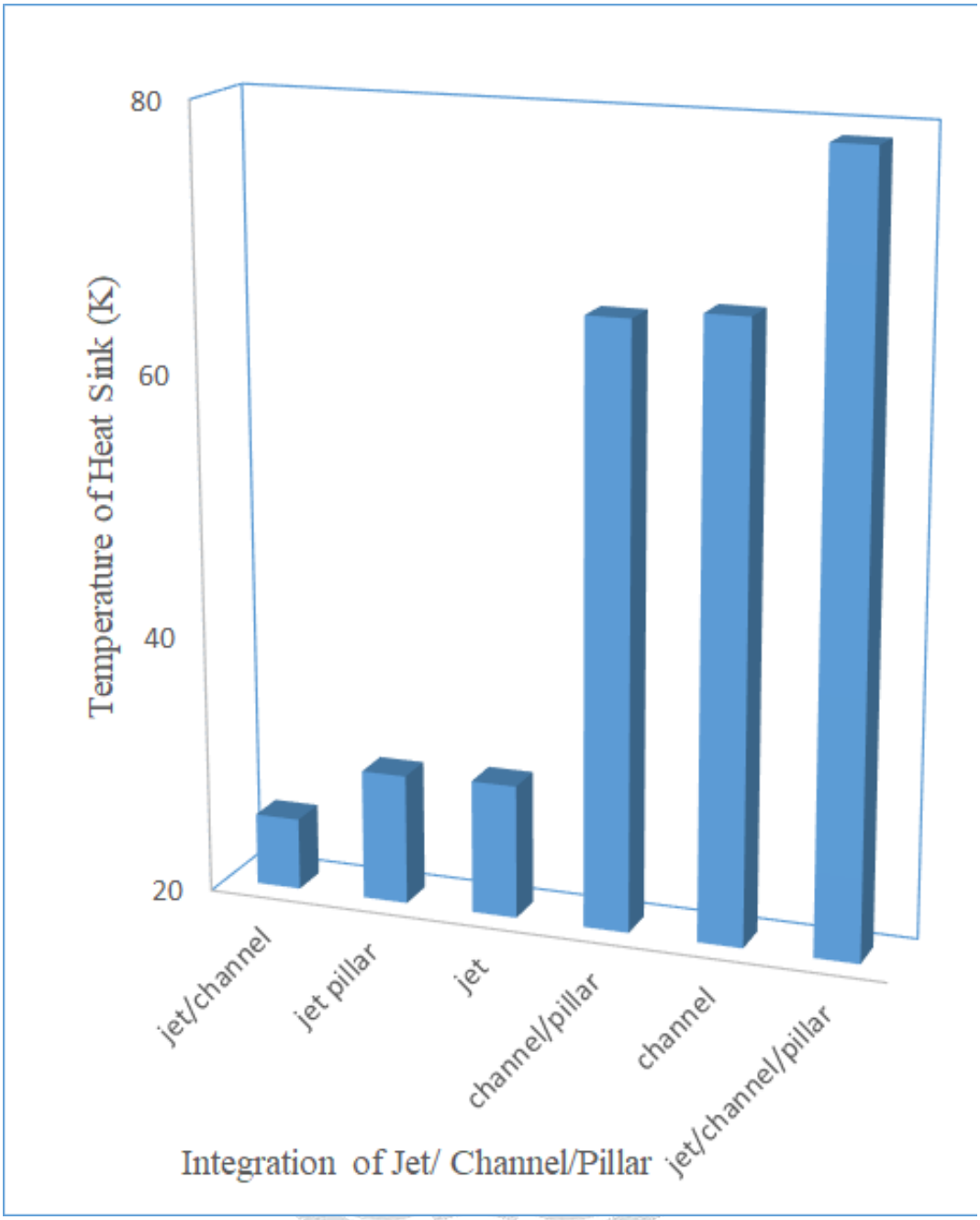

Figure 1: Temperature of heat sink Vs Integration

Figure 1 shows the relationship between temperature of heat sink and combination of different techniques. In case of jet-channel, temperature has been detected lowest and highest is detected in case of jet channel pillar.

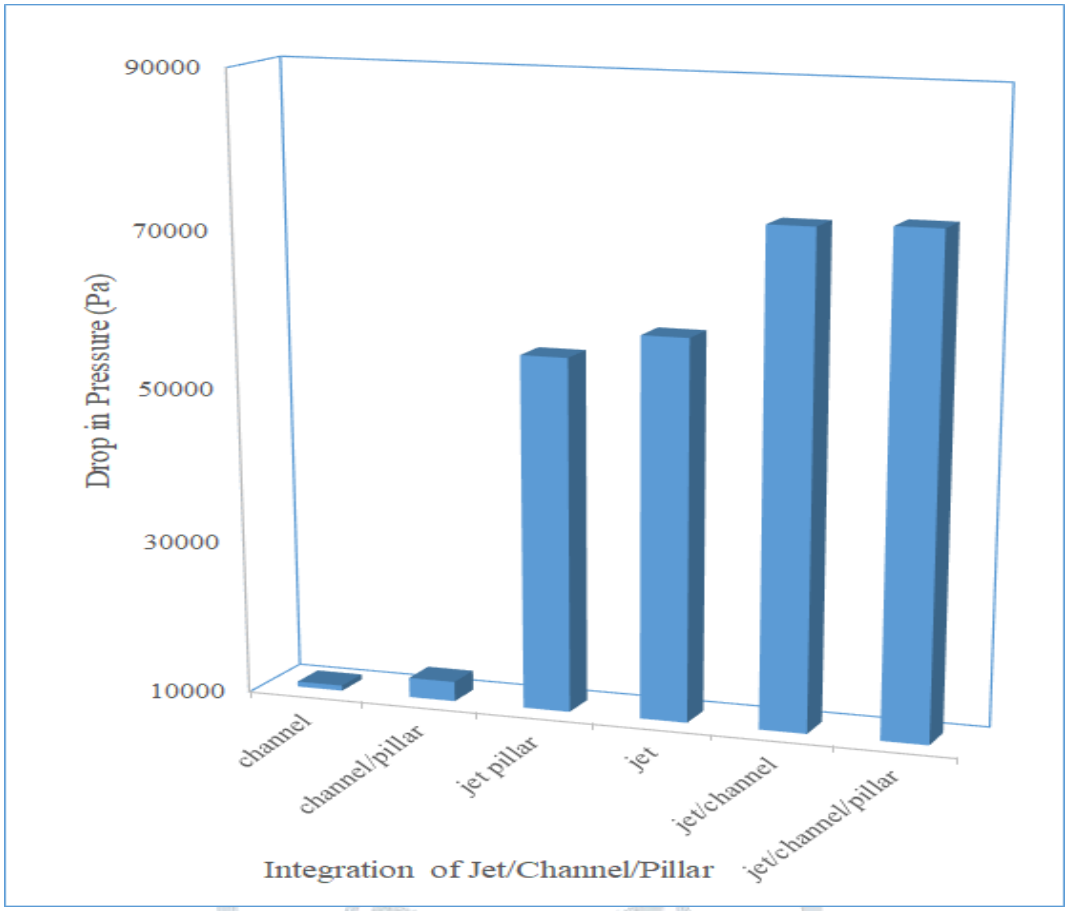

Figure 2: Drop in Pressure Vs Integration

Figure 2 shows the relationship between drop in pressure and combination of different techniques. In case of channel flow, drop in pressure has been detected lowest and highest is detected in case of jet channel pillar.

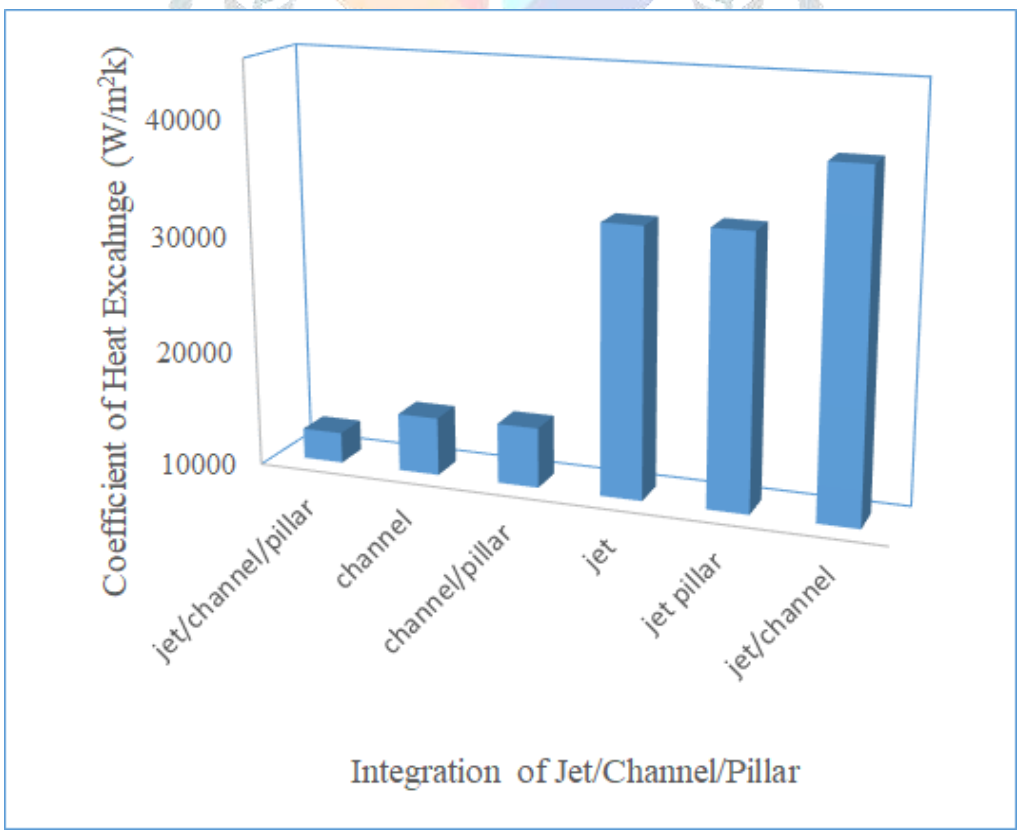

Figure 3: Coefficient of Heat Exchange Vs Integration

Figure 3 shows the relationship between coefficient of heat exchange and combination of different techniques. In case of jet-channel-pillar, coefficient of heat exchange has been detected lowest and highest is detected in case of jet -channel.

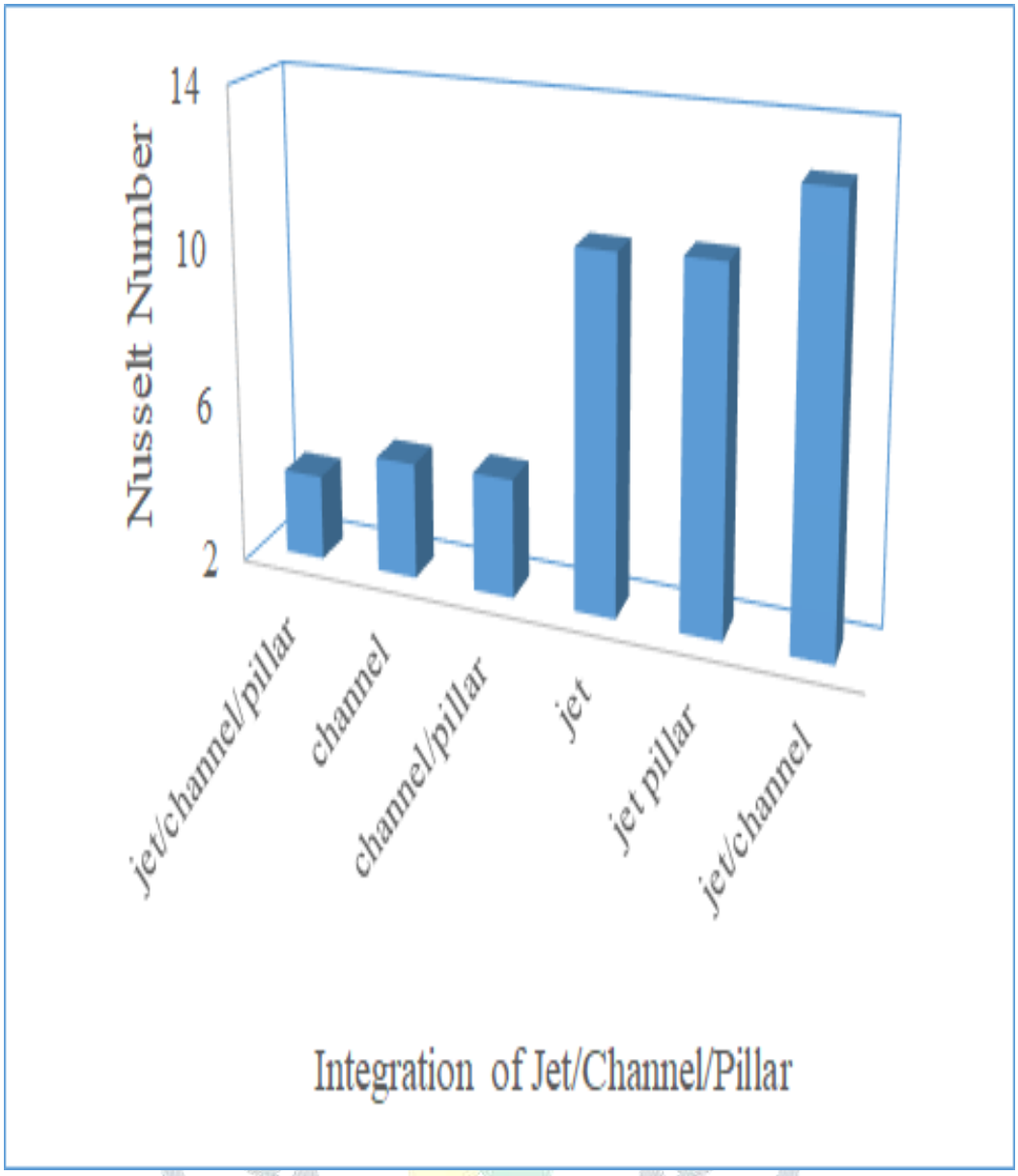

Figure 4: Nusselt Number Vs Integration

Figure 4 shows the relationship between Nusselt Number and combination of different techniques. In case of jet- channel- Pillar, Nusselt Number has been detected lowest and highest is detected in case of jet channel.

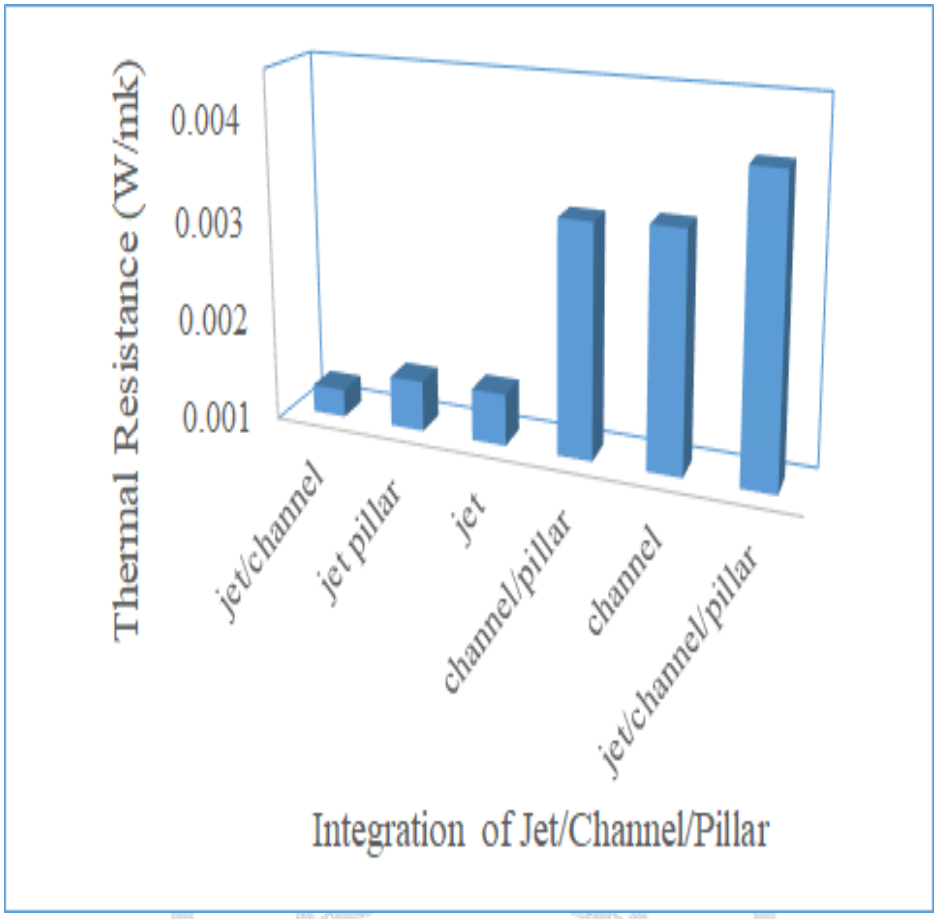

Figure 5: Thermal Resistance Vs Integration

Figure 5 shows the relationship between thermal resistance and combination of different techniques. In case of jet- channel, thermal resistance has been detected lowest and highest is detected in case of jet channel pillar.

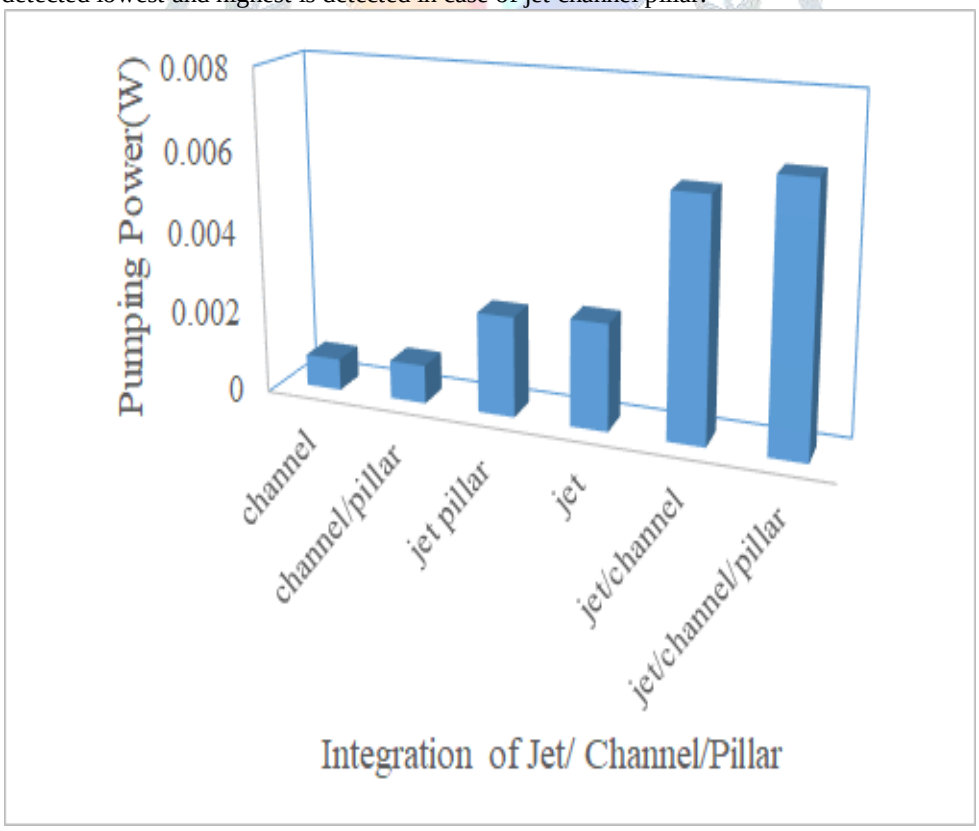

Figure 6: Pumping Power Vs Integration

Figure 6 shows the relationship between pumping power and combination of different techniques. In case of channel, pumping power has been detected lowest and highest is detected in case of jet channel pillar.

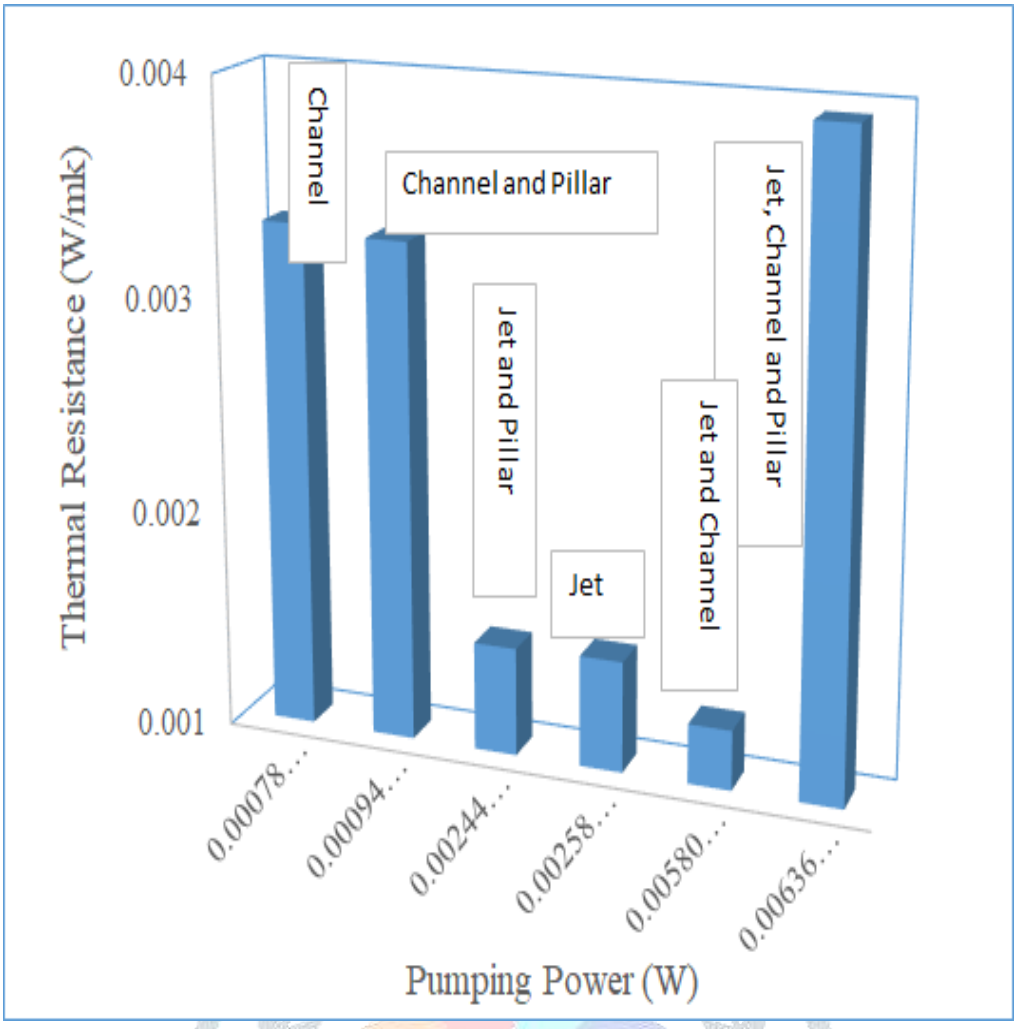

Figure 7: Thermal Resistance Vs Pumping Power

Figure 7 shows the relationship between thermal resistance and pumping power.

III. Conclusion

Jet impingement study has been carried out with the help of Computational Fluid Dynamics. The concept of Nano Fluid has been used to increase the heat transfer coefficient. The relationship between thermal resistance and pumping power has been predicted. Pumping power values has been found for different combinations of jet – channel and pillar. Also the temperature of heat sink, pressure drop is detected for different combinations. Heat transfer coefficient and Nusselt number has been analyzed for different combinations.

IV. Acknowledgment

I thank our colleagues from Amity University who provided insight and expertise that greatly assisted the research, although they may not agree with all of the interpretations/conclusions of this paper.

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