Master's Thesis Defense Announcement
Mechanical and Aerospace Engineering Department
University of Texas at Arlington

DESIGN AND CFD ANALYSIS OF DYNAMIC COLD PLATE FOR HIGH POWER DIRECT-TO-CHIP LIQUID COOLING

By

Apurv Pravin Deshmukh

Thesis Advisor: Dr. Dereje Agonafer

1:00pm- 2:00pm, Thursday, 5th Aug 2021

[Teams link]

Abstract

Rising demand for high-performance chips results in the need for advanced and efficient cooling technologies like direct to chip liquid cooling. Cold plates based utilizing direct liquid cooling is one of the most efficient and the most investigated cooling technology since the 1980s. Major data services and cloud providers like IBM, Microsoft, and Google had already started a shift towards liquid-cooled data centers for their high computational servers. At the chip level nowadays, the processors are divided into several cores and each of these cores continuously works at varying computational demands. This creates a non-uniform heat distribution across the processor, thus, developing a temperature gradient on and around the processor. This can lead to localized thermal transients and even thermo-mechanical failures in the worst cases to cyclic thermal stresses. This situation arises because the present-day cold plates provide the same flow rate irrespective of the IT load which is usually redundant and causes excessive water and energy usage. Therefore, to achieve uniform temperature distribution and achieve optimal cooling flow rates, new techniques are needed, and this can be done by the deployment of dynamic cold plates. In this paper a concept of self-regulatory flow control strategy using bimetal strips is introduced. The proposed novel cold plate design and the damper will dynamically change the coolant flow rate to each section according to temperature in that section temperature. This design will not only reduce the thermal gradient on the processor but will also be beneficial in terms of equipment reliability.