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The Effect of CPU Location in Total Immersion of Microelectronics

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Abstract : Meeting the growth in demand for digital services such as social media, telecommunications, and business and cloud services requires large scale data centres, which has led to an increase in their end use energy demand. Generally, over 30% of data centre power is consumed by the necessary cooling overhead. Thus energy can be reduced by improving the cooling efficiency. Air and liquid can both be used as cooling media for the data centre. Traditional data centre cooling systems use air, however liquid is recognised as a promising method that can handle the more densely packed data centres. Liquid cooling can be classified into three methods; rack heat exchanger, on-chip heat exchanger and full immersion of the microelectronics. This study quantifies the improvements of heat transfer specifically for the case of immersed microelectronics by varying the CPU and heat sink location. Immersion of the server is achieved by filling the gap between the microelectronics and a water jacket with a dielectric liquid which convects the heat from the CPU to the water jacket on the opposite side. Heat transfer is governed by two physical mechanisms, which is natural convection for the fixed enclosure filled with dielectric liquid and forced convection for the water that is pumped through the water jacket. The model in this study is validated with published numerical and experimental work and shows good agreement with previous work. The results show that the heat transfer performance and Nusselt number (Nu) is improved by 89% by placing the CPU and heat sink on the bottom of the microelectronics enclosure.

Keywords : CPU location, data centre cooling, heat sink in enclosures, immersed microelectronics, turbulent natural convection in enclosures
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