Nanofluid CPU Cooling: Novel Block Design

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According to Moore’s law, the number of CPU transistors doubles every 18 months. Increased transistor density causes increased heat production. The need for CPU cooling is therefore increasing exponentially. The challenge is that further increments in CPU speed will require improved cooling. Instead of using metal heat sinks with fins cooled by air, computer systems are now beginning the use of metal blocks that are cooled by water flowing through channels. This project investigated novel channel designs for fluid flow and also tested for synergy between nanofluid and specific channel designs. Nanofluids are suspensions of nanoparticles in a base fluid, which provide for increased thermal conductivity. Twenty-one CPU cooling blocks were designed and simulated using computer-aided design software with computational fluid dynamics to test for fluid flow and cooling efficiency. Four novel blocks, in addition to a control block, were selected for manufacturing and real world testing on a computer with a processor overclocked from 3.5 GHz to 4.0 GHz for all trials. Compared to a conventional straight geometry block with water, the spiral geometry block with TiO_2 nanofluid kept the CPU 3.6°C cooler with a flow rate of 2.2 L/min ($p<0.001$) and 3.7°C cooler at 4.1 L/min ($p<0.001$). Linear regression analysis showed a statistically significant synergy between the spiral block designs and the TiO_2 Nanofluid ($p<0.001$). Applications for this improved cooling could be implemented into large-scale servers in an effort to increase efficiency and reliability, or on commercial CPUs to permit higher clock speeds at lower temperatures.

Awards Won:

First Award of $5,000