Variable Cooling System Design

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Senior Design Clinic I-II (ENGR 480-1) 2005-6 Project Mission Statement: To design and prototype a variable cooling system that is capable of fluid control in order to increase efficiency and decrease coolant consumption in radar array applications.

Major Design Requirements:

1. Liquid coolant (water or ethyl glycol water mixture)
2. Thermally driven
3. Pressure drop of less that 50% after device is added
4. Flow rate must be less than one gallon per minute
5. Maximum coolant temperature rise is 20°C
6. Reduce the temperature ratio between the two channels from 2.0 to 1.67
7. The height of the channel will be between an 1/8" and 1/2" with the with being four times that of the height
8. Made of aluminum
9. Must be either mechanically or electronically controlled
10. Use power required to achieve a temperature rise of 20^{o}C

Team Lockheed (L to R): Brian Shovelain, Heather Helgeson, Ian McLaughlin, Joe Kattar, and Joe Heiderscheidt

Senior Design Project Summary:
Coldplates are advanced fluid control systems that are used to provide cooling for high-power electronic components. Applications that require coldplates include computing and radar systems or other situations where air-cooling is insufficient. Coldplates usually have flow channels machined from aluminum. The cold channels are arranged to direct fluid past high-temperature locations. A limitation of traditional coldplates is that they are not able to alter flow as the pattern of heating changes. Overcoming this limitation was the focus of the present design project. Team Lockheed Martin was tasked with designing an active fluid control system that is capable of modifying the flow patterns to account for changes in the overall heating pattern. In this manner, as the power level to the heat-generating components increases or decreases, the flow rate to that component changes accordingly. Our preliminary results show that the temperature uniformity on a coldplates can be markedly improved. In addition, our design drastically reduces the amount of required coolant. This dual-advantage suggests that the performance of coldplates can be improved with implementation of our design. The variable flow devices are able to be retrofitted to existing coldplates or integrated in to future designs.

Figure 1. Retrofit valve for existing coldplate applications

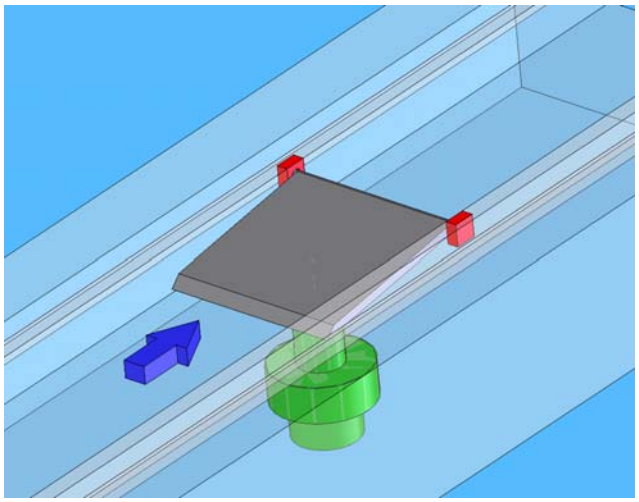

Figure 2. Integrated design for future coldplate