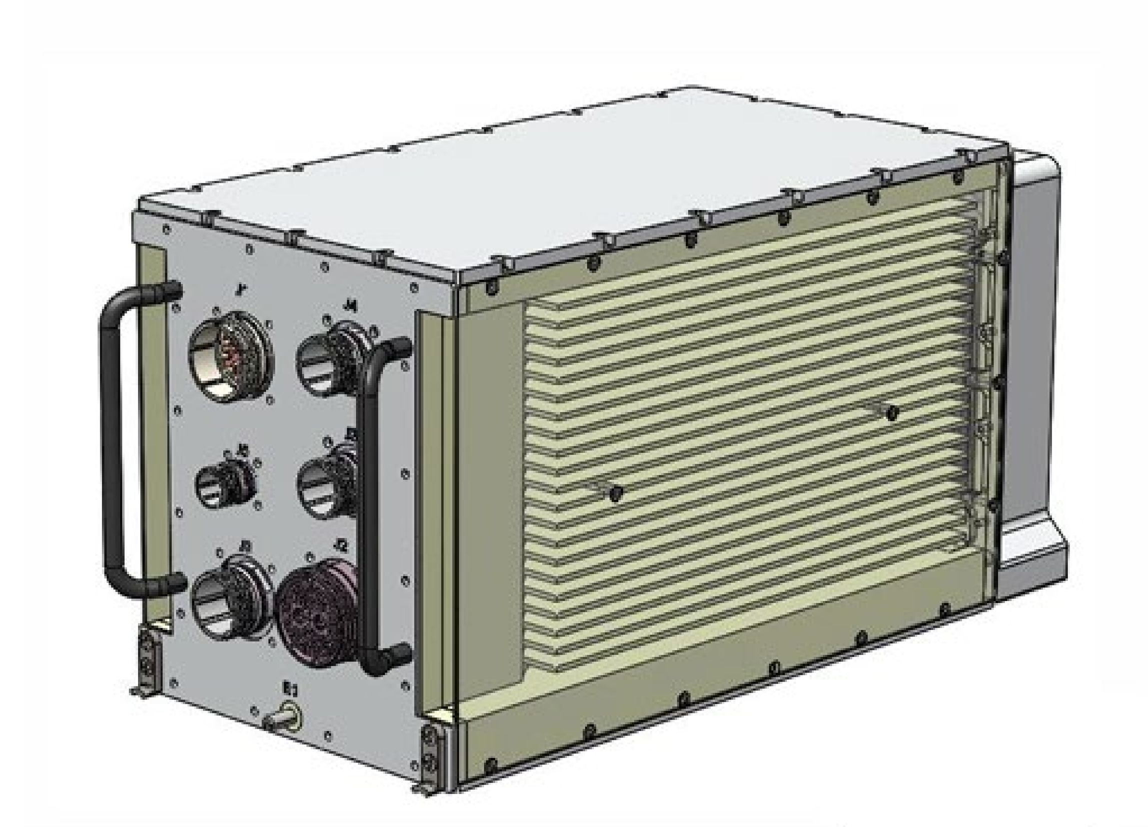
TTM Technologies

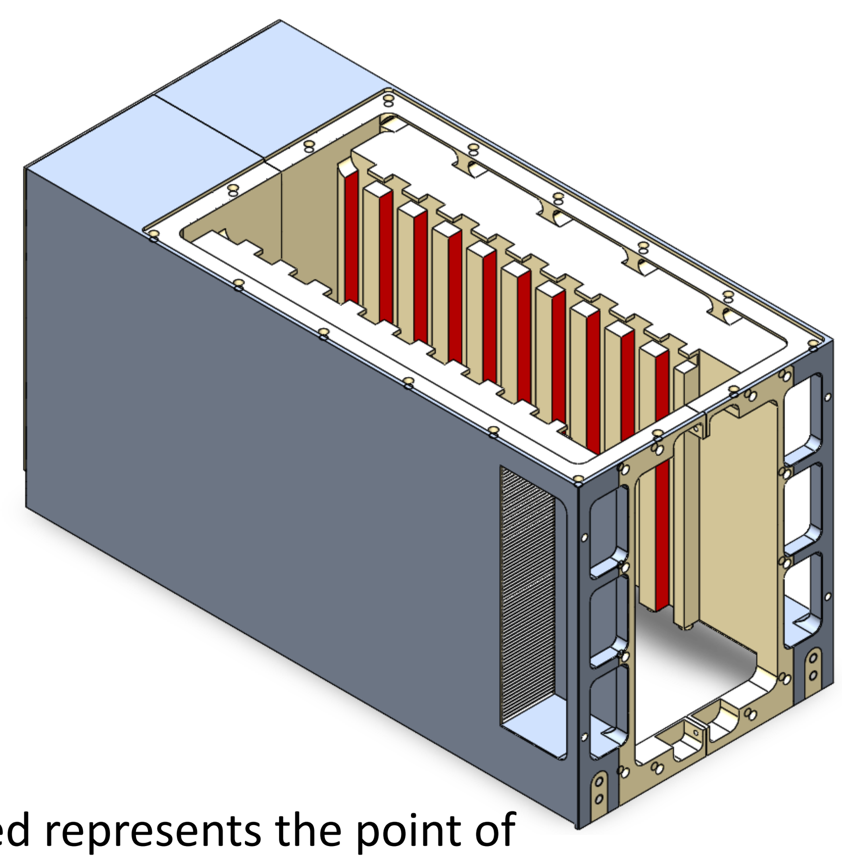
Syracuse University
College of Engineering
& Computer Science

Innovative SWaP Solutions for Rugged Embedded Computing Applications

Project Description:
Designing an innovative SWaP solution for a rugged embedded computer for TTM Technologies for the Defense and Aero Sector. The term SWaP is an acronym that refers to a systems' size, weight, and power. The primary focus of the project is to optimize the thermal performance of the embedded computing system while reducing its overall weight. With less weight in this application, an aircraft can hold more fuel. We utilize MIL-STD-810 standards while using design and structural software such as SolidWorks and Ansys thermal flow simulation during the design process to develop the most efficient heat exchanger.

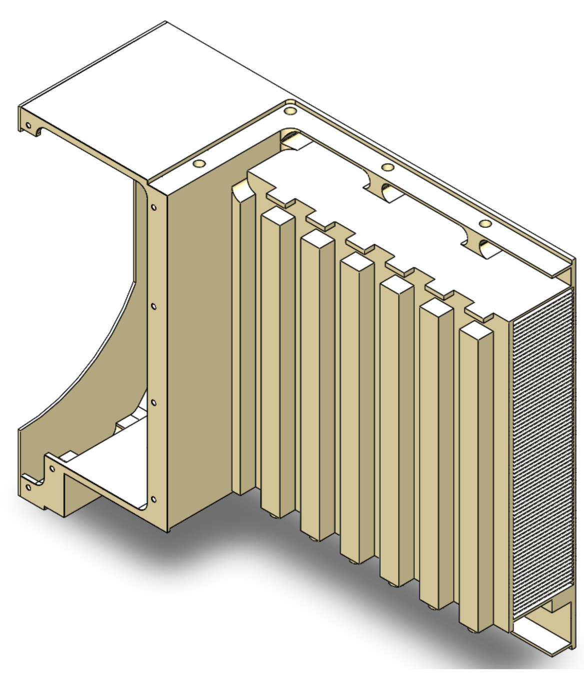


Original Chassis Design



The red represents the point of contact between the heat source and heat exchanger

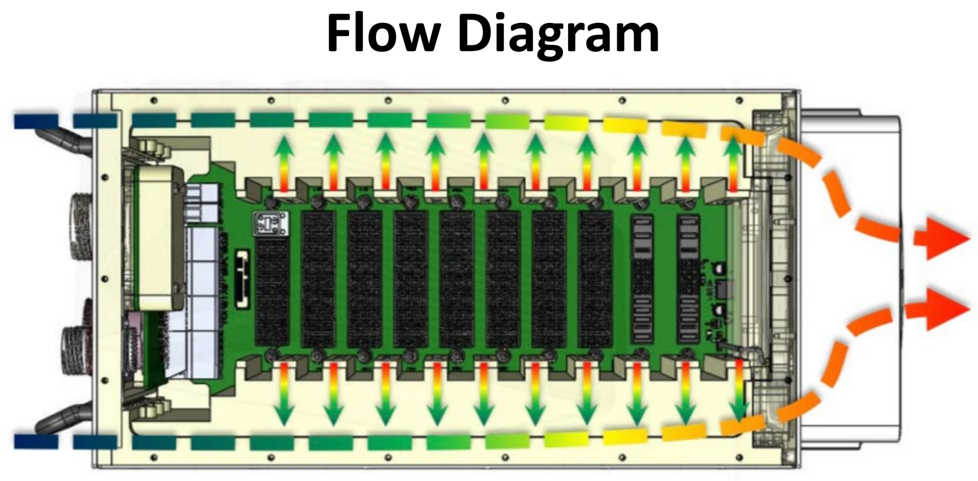
Quarter View



The quarter view shows the cross section of the fins and the cutout section for the fan.

Early Design Concept(s):
The current fins on the rugged embedded computer have a thickness of 0.02 inches and are the same thickness throughout the length if the fin. Changing the fin geometry will change the efficiency of the heat exchanger and the air flow from the fan.
Early design concepts:
- Increasing the spacing between the fins and increase it the thickness of the fins
- Tapering the fin thickness
- Swapping out the continuous fin for an array of cylinders

Flow Diagram



The fan at the end of the rugged embedded computer (right) controls the flow of air over the fins

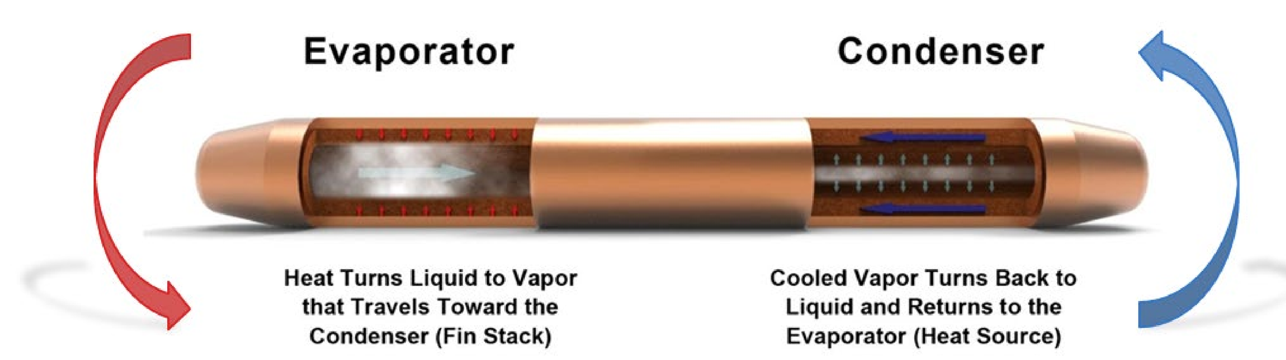
Semester Deliverables:
1. Material Research
2. Multiple CAD Designs
3. CFD Simulations and Testing
4. Fan Curve Research and Design
5. Adhere to MIL-STD-810H (Withstand effects of difficult environmental conditions)

Design Options/Possible Solutions:

Materials: Substituting the current 6061 Aluminum for a different material can improve the heat transfer efficiency, lower the weight and increase the strength of the structure. Current research has yielded the Celsia Liquid 2-Phase Heat Sink spreader plate. The spreader plate is 5-50x more heat conductive than aluminum or copper, while weighing less.

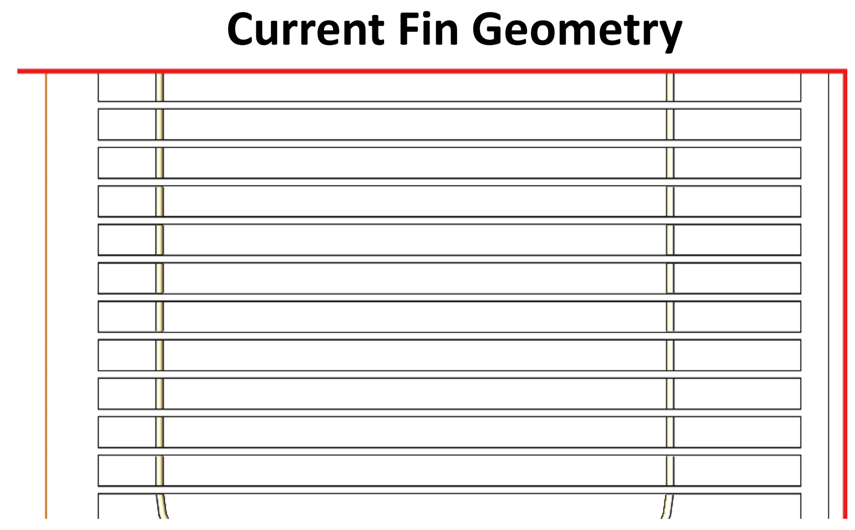
Fin Geometry: Changing the geometry of the fins can improve the rate of heat transfer from the exchanger to the surrounding air and increase the flow of heat to the exterior of the chassis.

Vapor Chamber Spreader Plate Process:

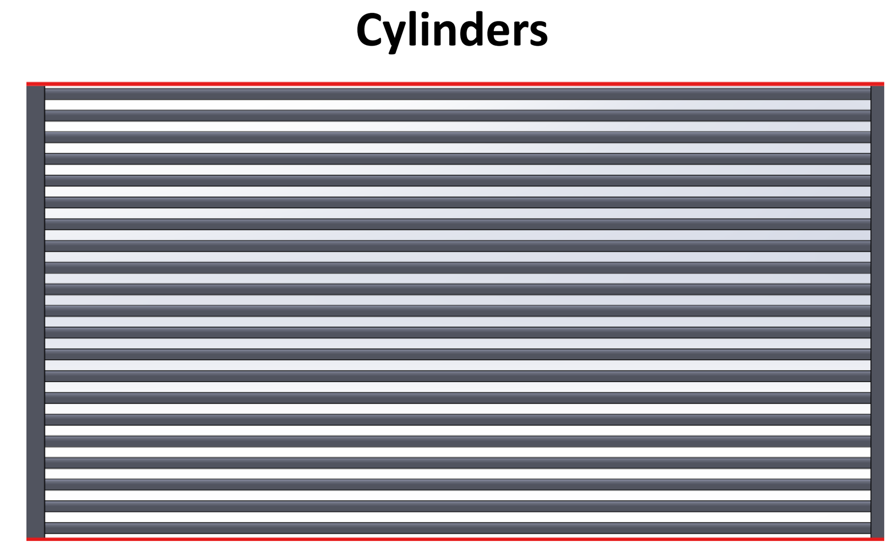


Fin Geometry Designs:

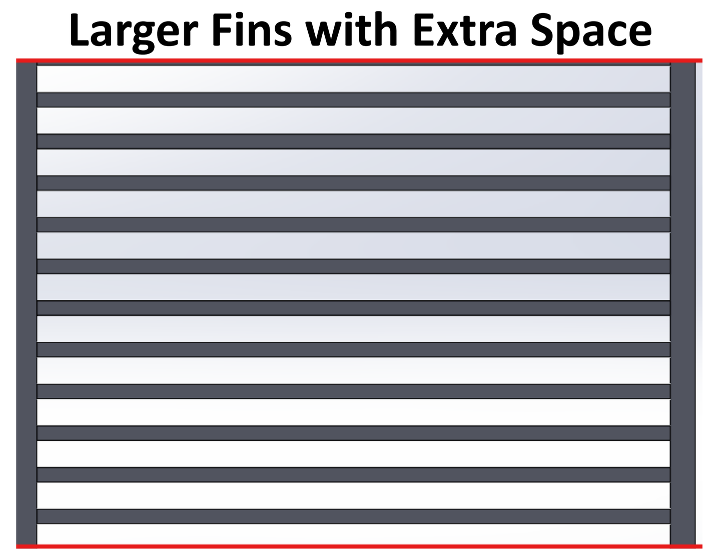
Current Fin Geometry



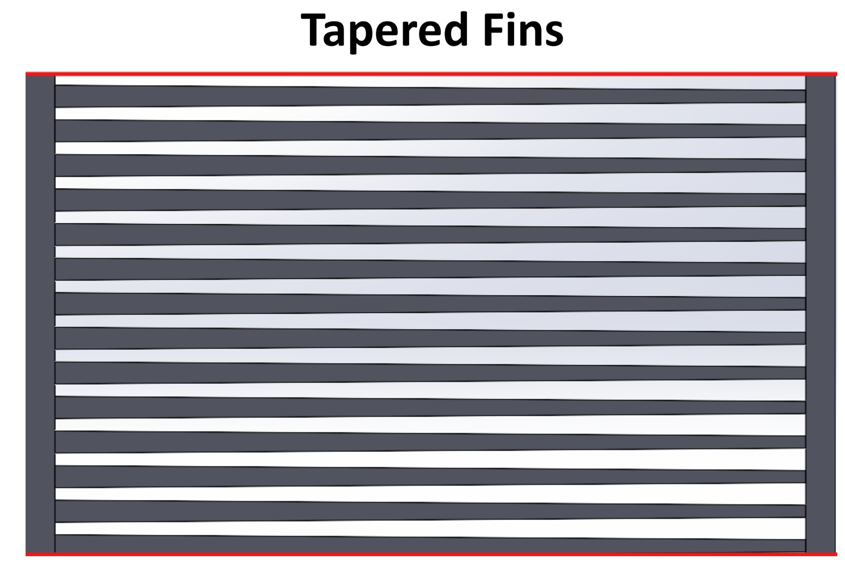
Cylinders

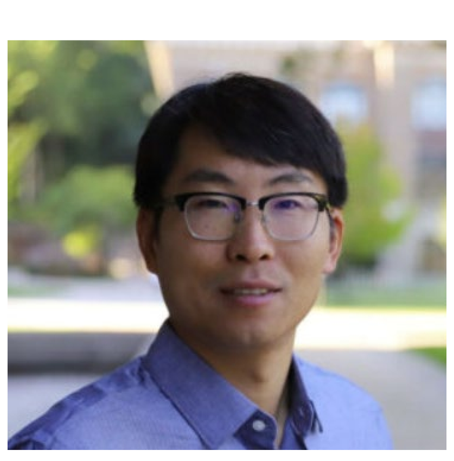


Larger Fins with Extra Space

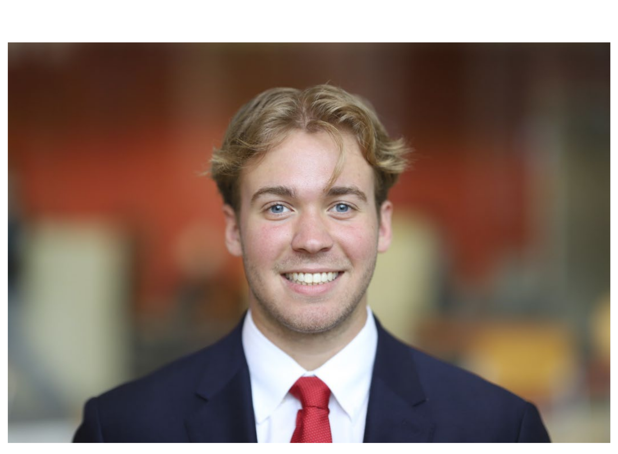


Tapered Fins

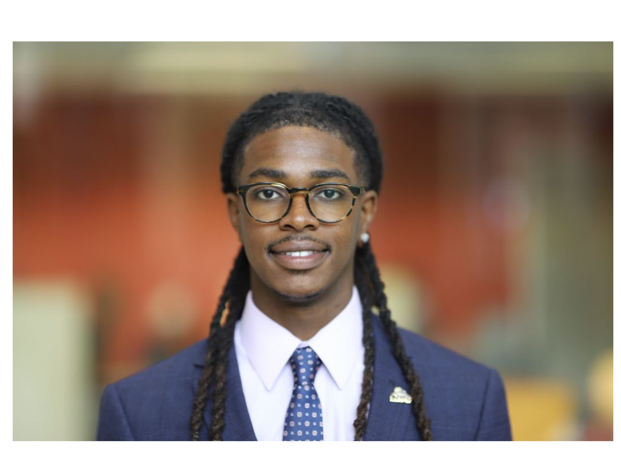




Faculty Mentor: Dr. Wanliang Shan



Jeffrey Bernstein



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