

Melanie Gonzalez ▪ Tianna Lentino ▪ Leslie Dunn ▪ James Hutchinson ▪ Colleen Kidder

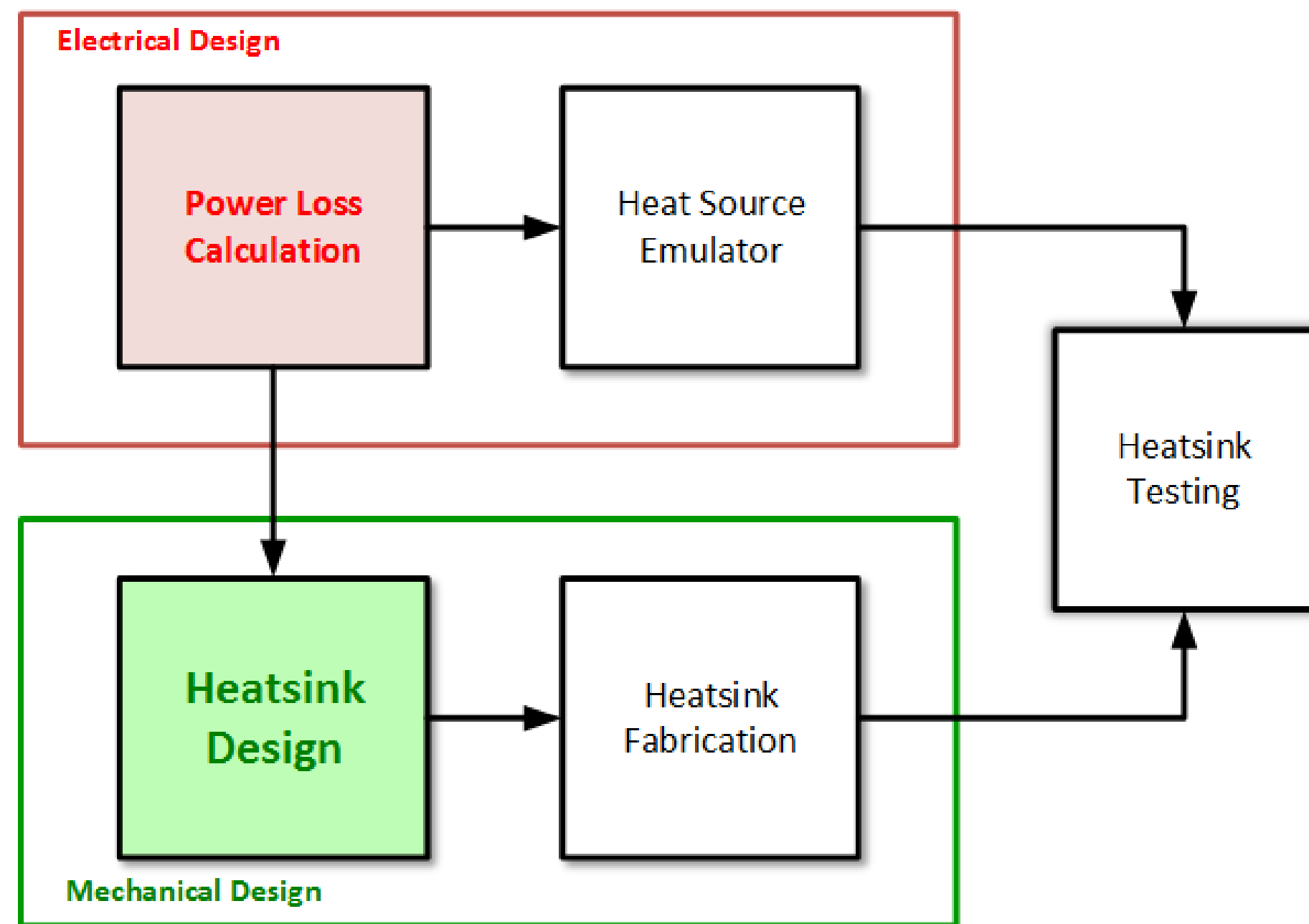
Sponsors: Dr. Hui Li, CAPS, AME and Power America Advisor: Dr. Juan Ordonez Instructors: Dr. Chiang Shih and Dr. Jerris Hooker

Project Scope

Design, build, and test thermal system for power converters to increase power density.

Solution Approach

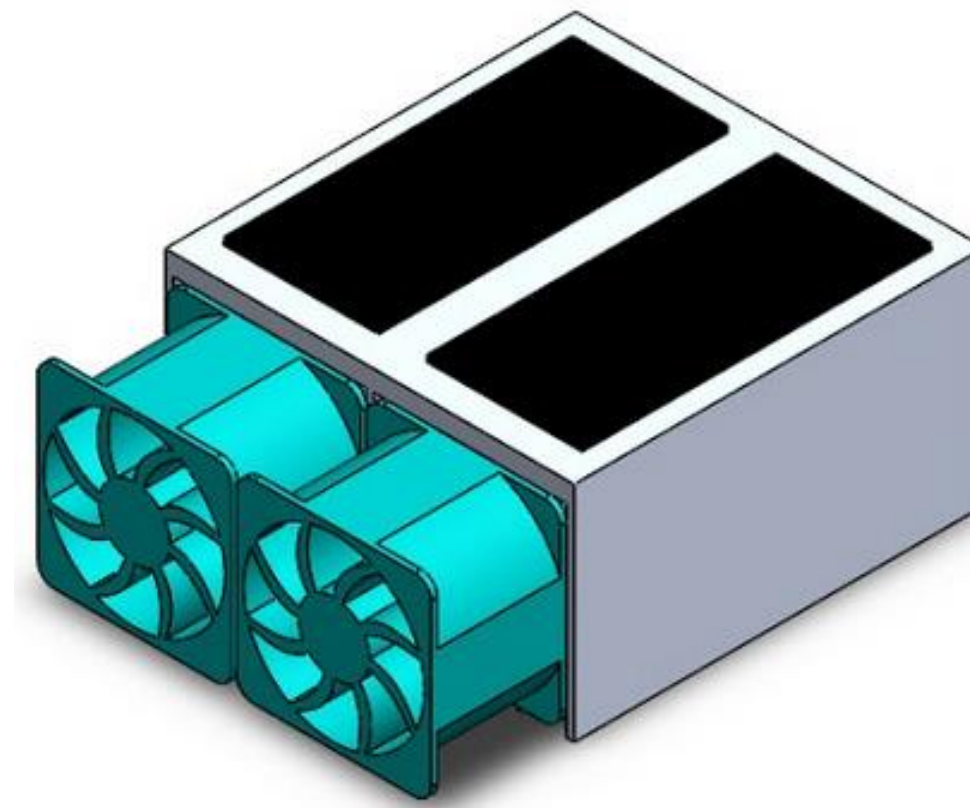
Implement bi-modular design of heatsink to reduce size and weight and test with heat source emulator.



Background Information

- Heatsink uses fins to dissipate heat
- Fans typically added to increase heat transfer
- Thermal resistance parameter reduces heat transfer
- Heat is caused by resistive winding in power electronic device

Conceptual Design I

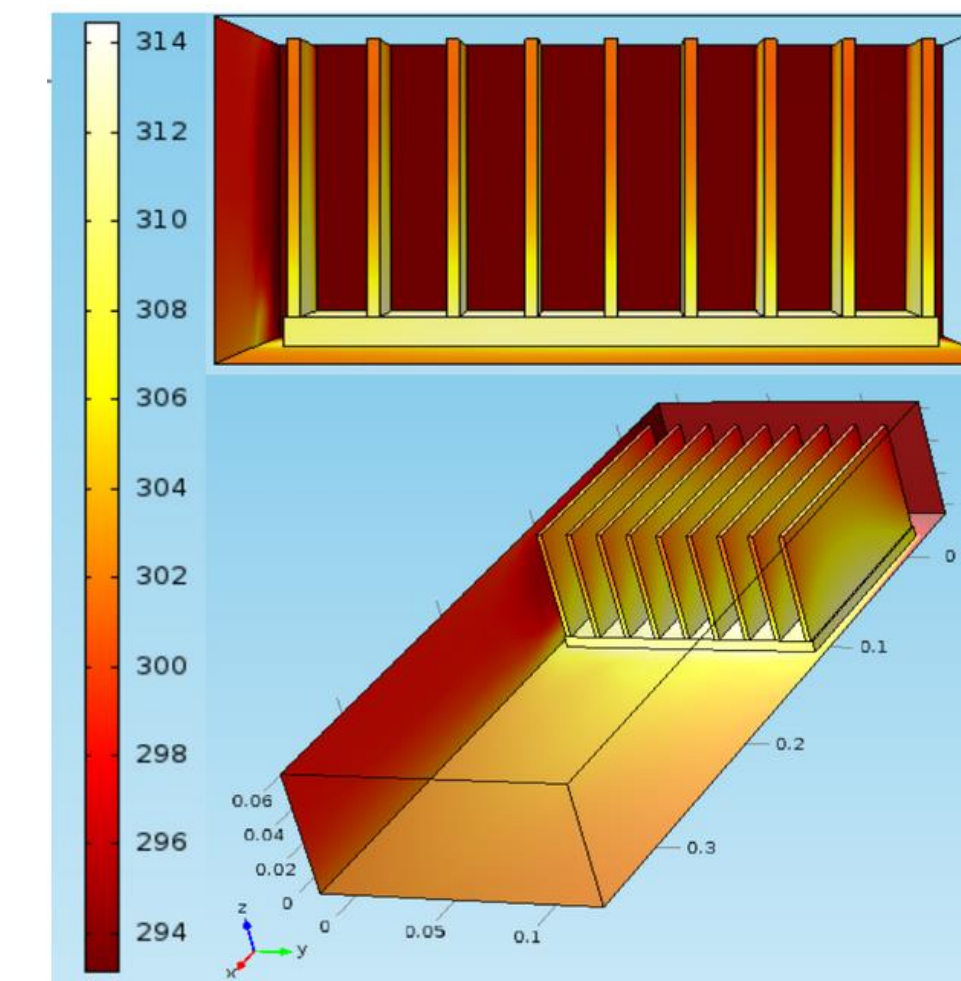


Analysis Results:

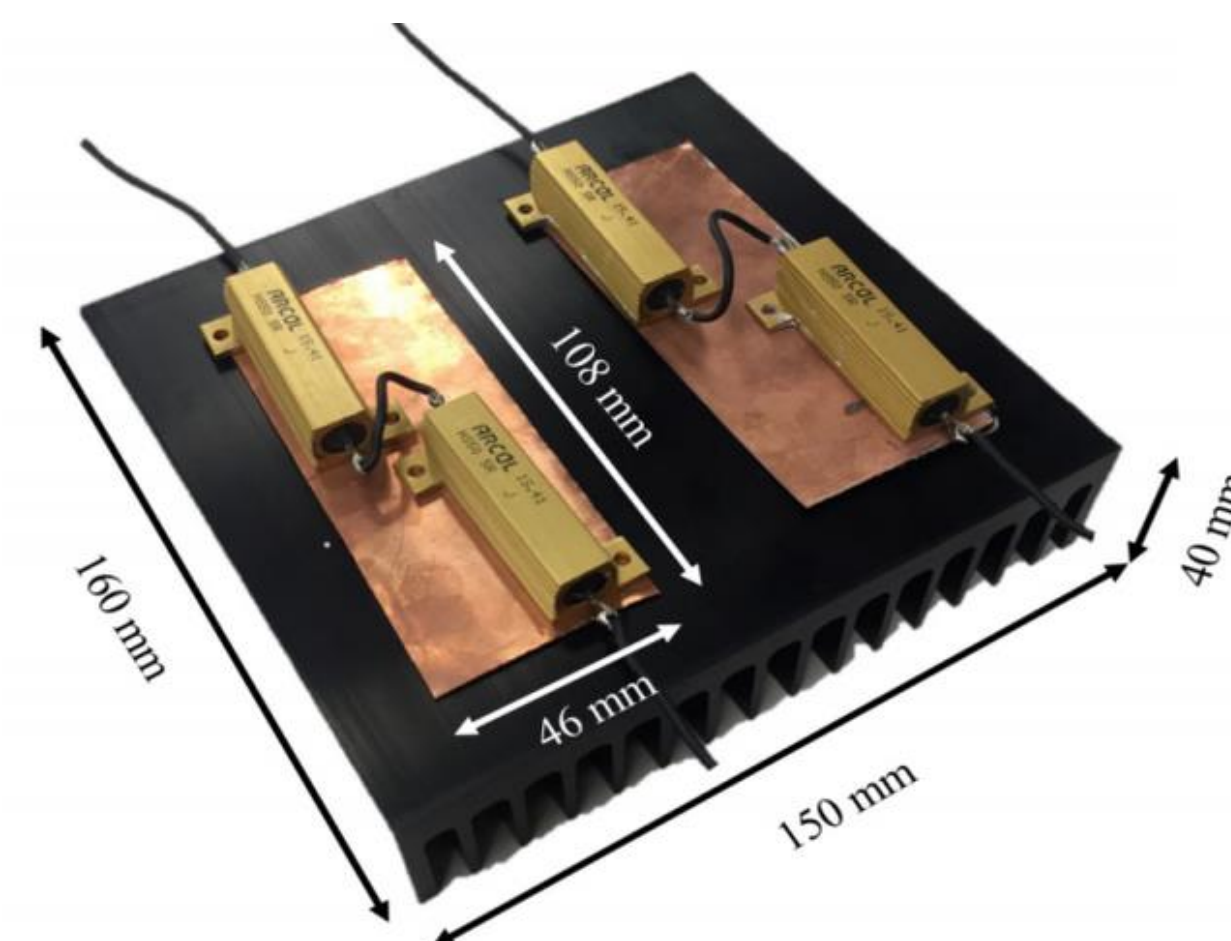
- Weight: 0.954 kg
- Pressure Drop: 7.406Pa
- Thermal Resistance: 0.335K/W

Finite Element Analysis

- Temperature in Kelvin
- Fan at max flow rate
- $T \approx 314K = 41^\circ C$



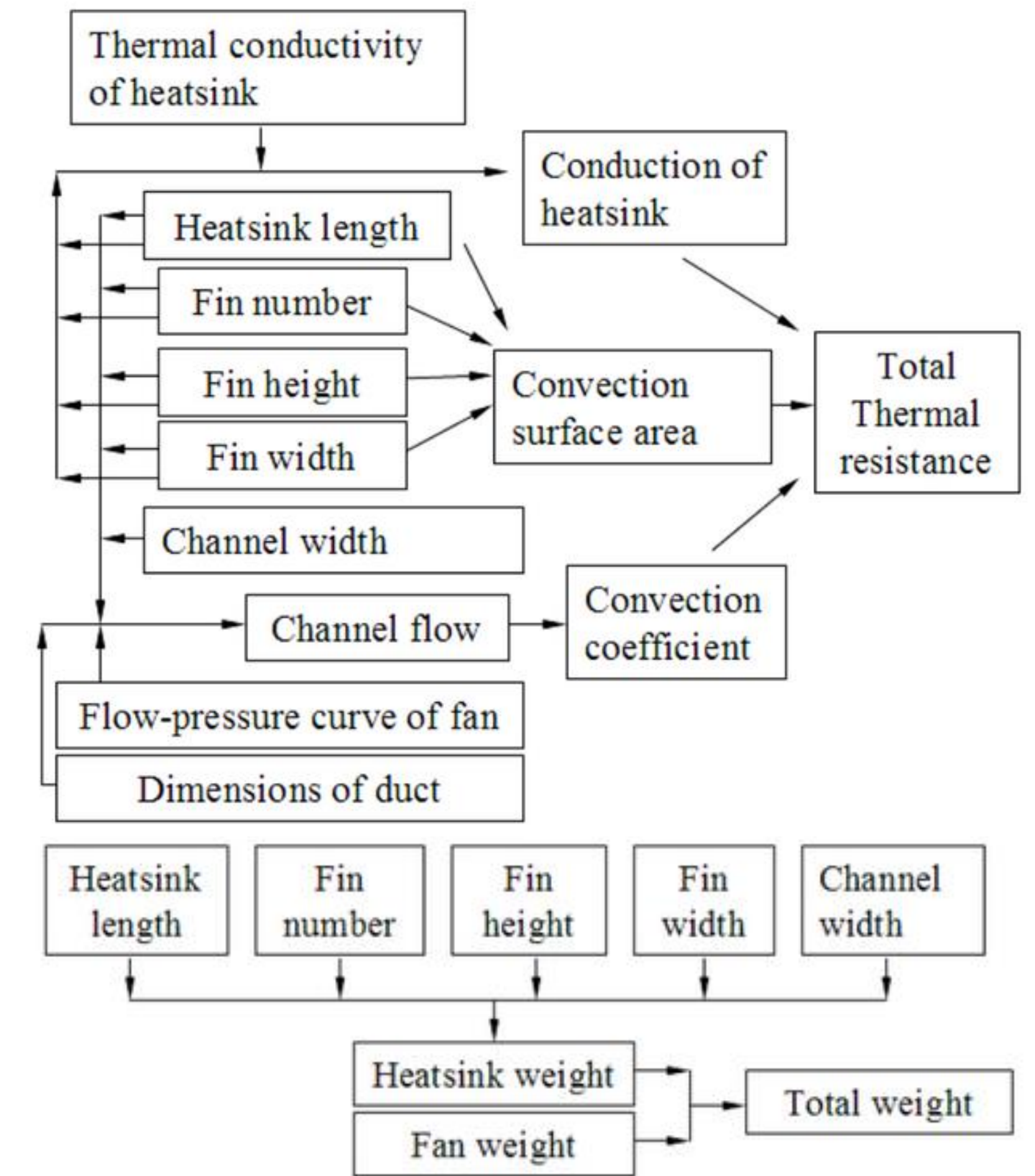
Physical Setup



$$\frac{T_j - T_a}{P_d} - R_{jc} - R_{ch} = R_{ha}$$

- R_{ha} – heatsink thermal resistance
- R_{jc} – thermal grease resistance
- R_{ch} – power module resistance
- T_j – junction temp
- T_a – ambient temp
- P_d – power dissipated

Optimization Parameters



Puqi Ning, Guangyin Lei, F. Wang and K. D. T. Ngo, "Selection of heatsink and fan for high-temperature power modules under weight constraint," *Applied Power Electronics Conference and Exposition, 2008. APEC 2008. Twenty-Third Annual IEEE*, Austin, TX, 2008, pp. 192-198.

Future Plans

- Determine heatsink thermal resistance
- Determine relationship between power loss and junction temperature
- Select heatsink design
 - Pin fin vs. plate fin
- Perform calculations to optimize heatsink
 - Fin height, width, length, etc.