# Systems Level CFD Simulations of Large Power Density Electronics Packages Using K-Core Heat Exchanger/Cold Plate Assembly

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Our CFD research focuses on electronics cooling of high power density packages (~1kW/m^2) where computer cooling fans provide forced air convection and a heat exchanger/cold plate assemblage, which has a pumped fluid loop integrated within it, employs internal fluid flow to serve as an effective heat sink for the power dissipation.

Our current research is aimed at modeling the heat exchanger/cold plate apparatus from k-core (k = 1100 W/m-K) material and hence showing the positive effects k-core has on enhanced heat transfer spreading. Also we are looking at fault simulations, i.e. thermal runaway of a component/chip/card when thermal contact resistance is a choke.

Fully coupled convection, conduction and radiation are being used with STAR-CCM+ v8.04. Correlations against theoretical hand-book predictions of the form h (W/m^2-K)=A*T^1/4. h (W/m^2-K)=B*V^1/2 and thermal resistance vs. thermal conductivity of the gasket material are shown for a typical range of simulation parameters.

STAR-CCM+ v8.04 with fully conjugate heat transfer/fluid flow analysis was used to perform the simulations. The systems level model included fan inlets having a polynomial curve fit for the fan law (pressure drop vs. flow rate) and the thermal interfaces between chip/components/boards/heat sinks, etc. was modeled using the solid/solid interface capabilities within STAR-CCM+.

This systems level CFD research performed at our non-linear FEA/CFD multi-physics lab at California State Polytechnic University at Pomona, Mechanical Engineering Department has showcased the abilities our CFD lab has in providing turn-key simulations run on a series of 64-bit dell quad-core and six-core power-workstations. Such bench top real-world CFD simulations are of practical interest to practicing thermal control systems engineers engaged in electronic packaging and systems level thermal management solutions.

This research has demonstrated our CFD lab?s ability to provide accurate, reliable, value-added engineering thermal design solutions in a timely fashion.

**Author Company:**
California State Polytechnic University at Pomona
**Author Name:**
Kevin R. Anderson

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