Announcing the Final Examination of Fuad Ismayilov for the degree of Doctor of Philosophy

Time & Location: October 30, 2019 at 3:00 PM in HPA1 110
Title: Investigation of Novel Fin Structures Enhancing Micro Heat Sink Thermal Performance

Operating temperature in electronics applications is continuously increasing. Therefore, for the past few decades, high heat flux removing micro heat sinks are investigated in terms of heat transfer effectiveness. This study generally concentrates on improving the passive heat transfer technique, which includes pin fin configurations entrenched in the micro heat sinks. The flow and heat transfer behaviors were enlightened in terms of experimental and numerical results. Micro heat sinks used in experiments are fabricated using MEMS techniques. Resistance temperature detectors, RTDs, were used for temperature measurements. The experimental data was obtained for single and two phase flow regions; however, only single phase flow results were considered in 3D numerical simulations. Numerical models were validated using experimental data. Validated models were used to extract additional and corrected results in terms of local temperatures and heat transfer coefficients. Validations were performed on the micro heat sinks, including cylinder and hydrofoil shaped pin fins. A representative heat transfer domain was selected to optimize hydrofoil shapes, further improving the hydraulic and thermal performance. Design of experiments, DOE, study was conducted and showed that the chord length and leading edge size of the hydrofoil pin fin are significant contributors to the performance of the micro heat sink. The optimization objectives were to minimize pumping requirements while enhancing the local and global heat transfer effectiveness over the surface of the heater in single phase flow environment. A broad range of geometries were obtained with an acceptable tradeoff between thermal and hydraulic performance for low Reynolds number. Additionally, tandem geometries were investigated and showed that higher heat transfer effectiveness could be obtained with acceptable pumping power requirements. Novel and promising geometries are presented for further experimental investigations. Thermal performance improvement of 28% was obtained via implementing proposed geometries with only a 12% pressure drop increase. Local heat transfer optimization, aiming to decrease the local temperatures were also performed using doublet pin fin configurations. Results showed that tandem hydrofoils could control the flow with minimum pressure drops while reaching the desired low local temperatures.

Major: Mechanical Engineering

Educational Career:
Bachelor’s of Mechanical Engineering, BS, 2011, Middle East Technical University
Master’s of Mechanical Engineering, MS, 2013, University of Central Florida

Committee in Charge:
Yoav Peles, Chair, Mechanical and Aerospace Engineering
Alain Kassab, University of Central Florida
Shawn Putnam, Mechanical & Aerospace Engineering
Ali Akturk, Siemens

Approved for distribution by Yoav Peles, Committee Chair, on November 28, 2019.

The public is welcome to attend.