

2008 Ohio Student Research Forum

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RESEARCH ABSTRACT FORM

TITLE: Analysis of Extrema Values of a Scalable Parallel Algorithm for Simulating the Control of Steady State Heat Flow Through a Metal Sheet.

AUTHOR: Linda M. King

MENTOR(S): Robert L. Marcus

INSTITUTION: Central State University

The objective of this research project is to develop a scalable parallel algorithm that simulates the control of steady-state heat flow through a rectangular metal sheet and implements it using MPI and C++ code. The simulation sets initial conditions of heat of 100° applied to some edges and an ice bath of 0° applied to the other edges. The parallel algorithm uses a row-wise decomposition of the metal sheet with various grid sizes: 100×100 , 200×200 and higher. The rows are distributed to each node (or task) in the partition and the steady state condition is determined in parallel. Various numbers of compute nodes are used for each of the grid sizes so that the optimum speed-up and scalability of the algorithm can be determine.

The boundary conditions are changed in a variety of ways and for each change steady-state heat flow is determined and the topology is analyzed. The hot edges (100°) were lowered and raised repeatedly, and the cold edges (0°) were raised and lowered repeatedly. These changes caused dramatic changes in the heat topologies. Analysis shall be done to determine the locations, if any, of local maxima and minima heat points.

The project uses MATLAB surface plots to display the various heat topologies and MATLAB two-dimensional function plots to display the speed-up graphs.