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Team Control Number
54293

Problem Chosen
A

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2016
MCM/ICM
Summary Sheet

(Your team's summary should be included as the first page of your electronic submission.)

Type a summary of your results on this page. Do not include the name of your school, advisor, or team members on this page.

A mathematical model was developed to simulate the temperature dynamics of water in a bathtub. The bathtub and water were divided into discrete, identical cells, with varying temperatures based on their location. Five heat exchanges are present in the model: the exchange from water to water, from bathtub walls to bathtub walls, from water to the bathtub walls, and from both water and bathtub to the ambient air. These models predominantly utilized the heat equation, but also utilized convection equations and heat loss equations. Additionally, a model was approximated for the shape of a human in a bathtub. Due to metabolic processes, the human was estimated to be at constant temperature on the time scale of a bath.

Using this model, several solutions to the bathtub cooling problem were attempted, including variation of input temperature and volume, as well as human motion. However, none yielded a successful solution to the cooling problem, as the conduction of heat outside the bathtub via the bathtub walls significantly overrode the ability of the bathtub user to prevent cooling. While the temperature of the bathtub may be marginally improved under the input of additional water from a tap, the water expenditure is not recommended, as it will not have a significant impact on the temperature. This makes any heating solution with the chosen method inefficient, ineffective, and inadvisable. Through our results, we were able to make several suggestions for reducing cooling and variability in the bathtub.