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Team Control Number
53768

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2016
MCM/ICM
Summary Sheet

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

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It is a common method for one to take a hot bath to take a break during the busy daily work. But it is quite annoying if the bathtub is not equipped with a secondary heating system since the temperature of the water decreases quickly. A simple way to keep the water warm is to add hot water into the bathtub while taking the bath. We established a model to find a best strategy to reheat the water considering the factors like the speed and temperature of heating water, the shape and volume of the bathtub, the move of the bather, and the influence of the bubble bath additive.

Based on the laws in thermodynamic, we first obtained a partial differential equation system which describes the temperature of the water in the bathtub. The system is a general form which holds for all situations. According to the different conditions, specific boundary conditions and initial values should be added to the system. Then the solution of the partial differential equation system can help us to illustrate the temperature distribution in the condition we depicted with the boundary conditions and initial values.

We assumed that the water is surrounded by the bathtub with a person sitting in it. And the top of the water is directly in touch with the air. The shapes of the bather and the bathtub are simplified to regular geometries. And the movement of the water is not considered. With the reasonable assumptions and simplifications made, the boundary conditions can be classified into Dirichlet boundary conditions and Neumann boundary conditions. Using finite element method, we were able to acquire an approximation of the time space function of the temperature of the water. We adopted variable-controlling approach to exam the relation between the reheating method and temperature function and deduced the best strategy.

In order to determine the extent to which our strategy depends upon the environment factors, we changed parameters in our models and regenerated the best strategy. We changed shape and the volume of the bathtub, the shape, volume and temperature of the bather. In addition, we also test the influence of movement of the bather and bubble bath additive. It is observed that the strategies our model gives do change when the environment parameters change. Finally, we make a detailed comparison of these strategies.