Summary

In order to determine the best strategy to keep the temperature of water in the bathtub even throughout the bathtub and maintain the water temperature as close to initial temperature as possible, the paper proposes two model. Model one is established to determine the hot water speed and hot water temperature, while model two is used to determine the best shape and size of the bathtub.

In model one, the authors firstly need to analyze the heat loss and heat absorption of water in the bathtub. Then based on the assumption of dynamic balance, the authors establish the dynamic balance model, that is, through the equality of heat loss and heat absorption, combined with the goal of not wasting too much water and the water temperature that human can tolerant , calculate the hot water speed and determine the best temperature of hot water. The result is to keep the water close to the initial temperature with 50℃ hot water and in order to save water, hot water speed is decided to be 0.00431(L/s).

In model two, the authors design 7 shapes of bathtub at first. Then, Genetic Algorithm is applied to find the most-water saving sizes for the seven shapes and the corresponding hot water speed. Finally, we compare the 7 optimums(hot water speed) of different shapes gained by GA, choose the shape and size corresponding to the minimum hot water speed as the best bathtub. The best shape of bathtub is the combination of cone and frustum of a prism (sitting shape), and the detailed shape and size can be seen in figure ......

What’s more, the sensitivity analysis is performed. During sensitivity analysis, the significant parameters are found, including the size of the bathtub, the value of heat transfer coefficient. And through the sensitivity analysis on heat convection coefficient we can find that bubble affect the model’s result little.

Finally, the strengths and weaknesses are discussed. And the paper proposes two model promotions. The first one is to design the hot water control system，the other is to determine the best strategy to fill the empty bathtub.

Genetic Algorithm Dynamic Balance Control variates Newton's law of cooling Fourier's Law