RESULTS

The simulation period is 24h with the initial room temperature of 15°C. The simulation result is shown in Figure 3. The model parameters are that the penalty parameter *C*=100, and the forgetting factor $\lambda = 0.56$. From Figure 3, it can be seen that all set points are correctly decided corresponding to the hot and cold votes, i.e., hot votes triggered lower temperature settings, while cold votes triggered higher temperature settings. The zoomed in simulation result from 8:00 to 12:00 are shown in Figure 4. The temperature settings tend to be stable accompanying to the model learning, and finally get close to the middle of the comfortable range. This proves that the model has learned out the previously assumed comfortable temperature range.

The performance of the SVM predicted control are quantitively evaluated using three indexes, comfort range entering time t_{steady}, less vote time t_{less}, and satisfactory time ratio γ. The comfort range entering time t_{steady} is the hours that the room temperature takes to enter the comfortable temperature range. The less vote time t_{less} is the hours that it takes until the frequency of vote descends to 10% of that at the beginning. The satisfactory time ratio γ, as shown in Equation 6, reflects the ratio of the occupant's comfortable time to one control period, which is 24 hours here. The evaluation results are shown in Table 1. The SVM predicted control takes 0.872 hour to make room temperature enter comfortable range [20, 24]. It takes 2.936 hours to make the hot/cold vote frequency decrease to 1/10 of that at the beginning. For the 24 hours control period, the satisfactory ratio is 0.878. These parameters show that the proposed SVM predicted control can fast and reliably control room temperature to be in the comfortable range. Further the comfortable temperature range is learnt out according to individual hot/cold vote, so the proposed method can be easily achieve personalized comfort and prevent energy waste caused by improper temperature settings.

$$\gamma = \frac{24 - t_{less}}{24} \qquad (4)$$

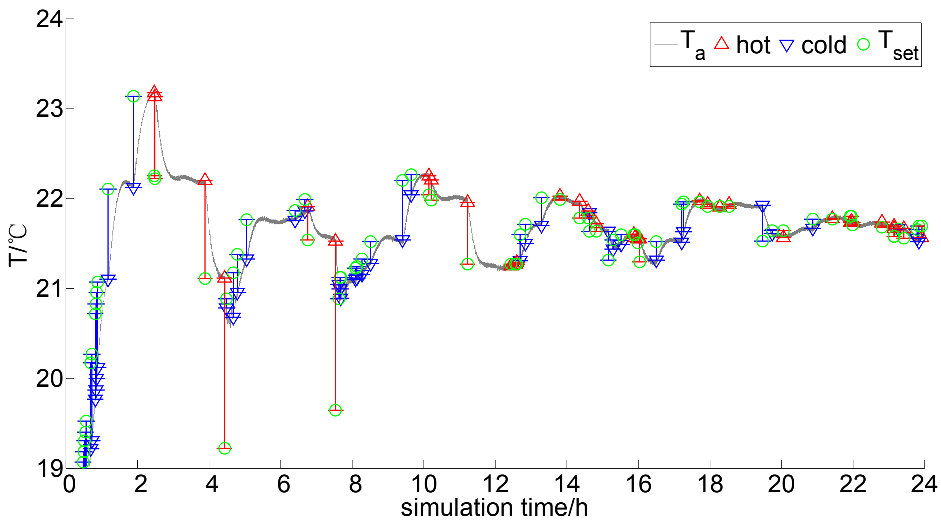

Figure 3. *Simulation result through SVM*

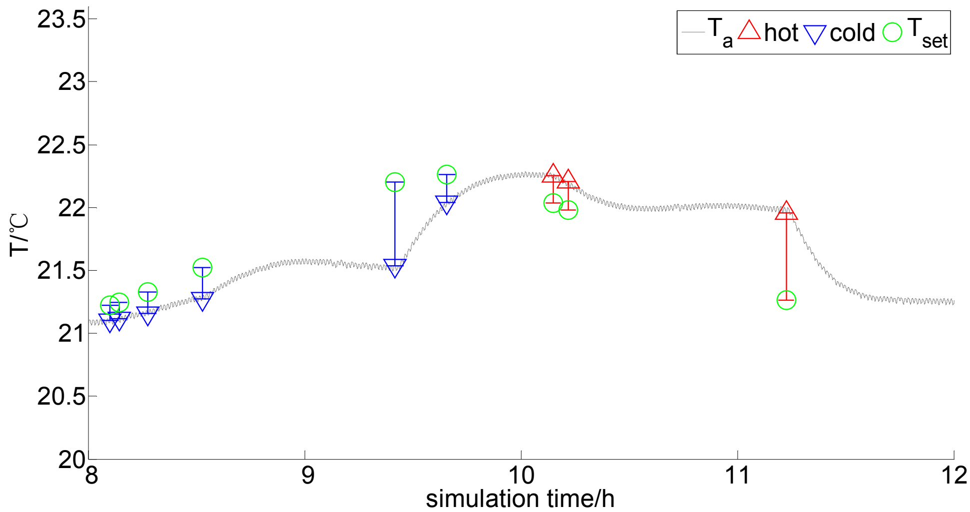

Figure 4. *Details of simulation result from 8:00 to 12:00*

Table 1. *Evaluations of SVM predicted control*

Model	t_{steady} **(h)**	t_{less} **(h)**	**Satisfactory rate** γ
SVM	0.872	2.936	0.878

CONCLUSIONS

In this article, a new method of thermal sensation based control for SFDH system is proposed. Through an HMI, an occupant can input the thermal sensation of hot or cold and the control system learns out the occupant comfortable temperature range and adjusts the room temperature to be in the comfortable range. The SVM model is used for the on-line learning of the comfort temperature range. Simulation is conducted to check the performance of SVM predicted control. The simulation results show that the temperature set point predicted by the SVM model can achieve satisfied thermal environment quickly and reliably. It takes less than 1 hour to find out the occupant comfortable temperature and less than 3 hours to let an occupant achieve thermal comfort.

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