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Abstract: Building energy consumption accounts for nearly 40% of global energy consumption, HVAC (Heating, Ventilating, and Air Conditioning) systems are the major building energy consumers, and as one type of HVAC systems, the heat pump air conditioning system, which is more energy-efficient compared to the traditional air conditioning system, is being more widely used to save energy. However, in northern China, extreme climatic conditions increase the cooling and heating load of the heat pump air conditioning system and accelerate the aging of the equipment, and the sensor may detect drifted parameters owing to climate change. This non-linear drifted parameter increases the false alarm rate of the fault detection and the need for unnecessary troubleshooting. In order to overcome the impact of the device aging and the drifted parameter, a Kalman filter and SPC (statistical process control) fault detection method are introduced in this paper. In this method, the model parameter and its standard variance can be estimated by Kalman filter based on the gray model and the real-time data of the air conditioning system. Further, by using SPC to construct the dynamic control limits, false alarm rate is reduced. And this paper mainly focus on the cold machine failure in the component failure and its soft fault detection. This approach has been tested on a simulation model of the "Sino-German Energy Conservation Demonstration Center" building heat pump air-conditioning system in Shenyang, China, and the results show that the Kalman filter and SPC fault detection method is simple and highly efficient with a low false alarm rate, and it can deal with the difficulties caused by the extreme environment and the non-linear influence of the parameters, and what's more, it provides a good foundation for dynamic fault diagnosis and fault prediction analysis.

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