基于逆模型解耦的绿茶烘焙变论域模糊控制

Method of variable universe fuzzy control base on inverse-model decoupling for green tea baking

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中文摘要：

　　绿茶烘焙过程，伴随着复杂的物质交换和热交换，温、湿度变化耦合严重。针对这一问题该文提出了一种基于逆模型解耦的变论域模糊控制方法。采用支持向量机（support vector machine，SVM）方法辨识绿茶烘焙过程，建立精度相对较高逆模型，根据试验结果，电热丝电流平均误差为4.3%，而风机转速为8.5%。将该模型并与被控对象进行串联，建立伪线性系统，实现温、湿度解耦。同时采用模糊控制器对温、湿度分别进行独立控制，同时对模糊控制器的论域进行改进，增强系统的环境适应能力。性能试验结果表明，该控制系统能够将温度误差控制在小于1.4℃，相对湿度控制误差仅为2.8%；品质试验表明，绿茶橙花叔醇成分平均提升15.2%，α-法呢烯成分平均提升17.4%，芳樟醇成分平均提升14.2%。该文方法能够有效提升绿茶烘焙过程的控制效果，提供了一种控制绿茶烘焙过程的新途径。

英文摘要：

　　Abstract: Baking technology is the key technology of the Green Tea refining process, and it directly affects the preservation of tea time, aroma and taste. At present, there are two ways for Green Tea baking; charcoal baking and roasting. Machine baking of charcoal, the main process by manual operation, greatly rely on the experience of workers and a low degree of standardization, but the tea quality is not stable; machine baking with an electric oven for baking is widely used, but due to the lack of systematic research, the control algorithm is simple, the temperature error is higher than 5℃, and the humidity error is greater than eight percent. Therefore, studies of one kind of advanced green tea baking process control method should be of vital significance.The key of the baking process is precise control of temperature and humidity, however, the roasting process physics, complex chemical changes, system temperature, and humidity influence each other, forming a nonlinear coupling. At the same time, when baking process parameters are affected by environment changes, the traditional control algorithms often provide poor results. Through the analysis of the principles of machine roasted green tea baking, it is not hard see that control key processes, such as the high precision control of decoupling temperature and humidity, are important.To solve these problems, a variable universe fuzzy control model based on the inverse-mode decoupling method was proposed. The control system consists of the inverse system decoupling compensation based on SVM, base temperature, humidity, and variable universe fuzzy algorithm for independent control of two parts. The SVM decoupling compensator, utilizing self-learning characteristics of SVM, and the reverse identification of the original system, to approximate the inverse model Green Tea baking system, connected with the original system in parallel, a pseudo linear system. The motor temperature and humidity into the subsystem are independent of each other, and then the linear system control method is used to control the baking process.Variable universe fuzzy algorithm, according to the temperature, humidity setting value and the system detection feedback value, respectively, to achieve closed-loop on temperature, humidity independent fuzzy control; then the variable universe fuzzy algorithm, to solve system device parameters and the parameters of the sensor drift on the fixed rules of fuzzy algorithm, improve control accuracy and adaptability to environment.Adopting this control system, the test comparison of 3 kinds of Green Tea sample, temperature control error is less than 1.4℃, relative humidity error is only 2.8%, but with PID controller, the temperature error is 5.2 ℃, the relative humidity of the error of 7.6%. The average score of sensory evaluation in this paper is 95.7, better than PID control algorithm scored an average of 85.8, the average increase of 15.2% tertiary alcohol ingredient orange flower, alpha foreseen component increased an average of 17.4%, linalool increased an average of 14.2% components. The performance and quality of experiments prove the effectiveness of this method.

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