Accepted Manuscript

Data-Driven Soft Sensor Modeling Based on Twin Support Vector Regression for Cane Sugar Crystallization

Yanmei Meng, Qiliang Lan, Johnny Qin, Haifeng Pang, Kangyuan Zheng

PII: S0260-8774(18)30330-3

DOI: 10.1016/j.jfoodeng.2018.07.035

Reference: JFOE 9349

To appear in: Journal of Food Engineering

Received Date: 22 June 2017

Accepted Date: 30 July 2018

Please cite this article as: Yanmei Meng, Qiliang Lan, Johnny Qin, Haifeng Pang, Kangyuan Zheng, Data-Driven Soft Sensor Modeling Based on Twin Support Vector Regression for Cane Sugar Crystallization, *Journal of Food Engineering* (2018), doi: 10.1016/j.jfoodeng.2018.07.035

This is a PDF file of an unedited manuscript that has been accepted for publication. As a service to our customers we are providing this early version of the manuscript. The manuscript will undergo copyediting, typesetting, and review of the resulting proof before it is published in its final form. Please note that during the production process errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.



Data-Driven Soft Sensor Modeling Based on Twin Support Vector Regression for Cane Sugar Crystallization

2 3 4

Yanmei Meng¹, Qiliang Lan¹, Johnny Qin^{2*}, Haifeng Pang¹, Kangyuan Zheng¹

⁵ ¹College of Mechanical Engineering, Guangxi University, Nanning, 530004, China

6 Email: <u>gxu_mengyun@163.com</u>

- 7 ²Energy, Commonwealth Scientific and Industrial Research Organisation, 1 Technology Court,
- 8 Pullenvale, QLD4069, Australia
- 9 *corresponding author, E-mail: Johnny.qin@csiro.au
- 10

11

12 ABSTRACT

13 Cane sugar crystallization is a complex physical and chemical process and is related with many 14 parameters. Due to the restriction of technical condition, some key parameters such as mother 15 liquor purity and supersaturation, cannot be measured directly by existing sensors. This hinders 16 the implementation of automatic control in cane sugar crystallization seriously. To handle this problem, a data-driven soft sensor modeling based on twin support vector regression is proposed 17 18 to estimate the mother liquor purity and supersaturation. Seven easy-to-measure variables are 19 chosen as input, including vacuum degree, temperature, massecuite level, steam pressure, steam 20 temperature, feeding rate and massecuite brix. Two difficult-to-measure variables are chosen as 21 output, including mother liquor supersaturation and mother liquor purity. The model parameters 22 are optimized by combining the particle swarm optimization and the ten-fold cross-validation 23 method. Experimental result indicates that this method performs well in aspects of prediction, 24 approximation, learning speed, and generalization ability compared with BP, RBF and ELM, and 25 is proved to have great effectiveness and reliability in cane sugar crystallization control.

26

Keywords: data-driven; twin support vector regression; soft sensor; particle swam optimization; model
parameters optimization; crystallization.

29 **1. Introduction**

30

Cane sugar crystallization is a complex chemical and physical process involving both heat 31 and mass transfer, and it is determined by many parameters such as the mother liquor 32 supersaturation, purity, temperature, pressure, purity, liquor level and vacuum degree. 33 34 However, the supersaturation and purity is unable to be measured by traditional physical sensors. This seriously hinders the growth of automatic control in cane sugar 35 crystallization. In order to take correct operation actions so that the ideal product quality be 36 achieved, it is desirable to estimate these immeasurable key parameters. Soft sensors have 37 been widely considered due to its ability to estimate immeasurable parameters based on 38 39 historical data and predictive model (Yu et al., 2012). Taking measurable parameters as

Download English Version:

https://daneshyari.com/en/article/11000699

Download Persian Version:

https://daneshyari.com/article/11000699

Daneshyari.com