Universidad Continental

FACULTAD DE INGENIERÍA

Escuela Académico Profesional de Ingeniería Mecatrónica

Tesis

Comparison Analysis of FIR, ARX, ARMAX by Least-Squares Estimation of the Temperature Variations of a Pasteurization Process

Sliver Ivan Del Carpio Ramirez
Jhon Rodrigo Ortiz Zacarias
Jalber Brayan Macuri Vazquez
Sario Angel Chamorro Quijano
Deyby Maycol Huamanchahua Canchanya

Para optar el Título Profesional de
Ingeniero Mecatrónico

Huancayo, 20xx

Universidad Continental

INFORME DE CONFORMIDAD DE ORIGINALIDAD DE TESIS: EN FORMATO ARTÍCULO CIENTÍFICO

A	:	Felipe Nestor Gutarra Meza Decano de la Facultad de Ingeniería
DE	:	Carlos Alberto Coaquira Rojo
ASUNTO	:	Remito resultado de evaluación de originalidad de tesis
FECHA	:	10 de octubre del 2023

Con sumo agrado me dirijo a vuestro despacho para saludarlo y en vista de haber sido designado asesor de la tesis titulada: "Comparison Analysis of FIR, ARX, ARMAX by Least-Squares Estimation of the Temperature Variations of a Pasteurization Process", perteneciente al/la/los/las estudiante(s) Sliver Ivan Del Carpio Ramirez y Jhon Rodrigo Ortiz Zacarias de la E.A.P. de Ingeniería Mecatrónica; se procedió con la carga del documento a la plataforma "Turnitin" y se realizó la verificación completa de las coincidencias resaltadas por el software dando por resultado 16 % de similitud (informe adjunto) sin encontrarse hallazgos relacionados a plagio. Se utilizaron los siguientes filtros:

- Filtro de exclusión de bibliografía SI [ ] NO [X]
- Filtro de exclusión de grupos de palabras menores (Nº de palabras excluidas:) SI [ ] NO [X]
- Exclusión de fuente por trabajo anterior del mismo estudiante SI [X] NO [ ]

En consecuencia, se determina que la tesis en formato artículo científico constituye un documento original al presentar similitud de otros autores (citas) por debajo del porcentaje establecido por la Universidad.

Recae toda responsabilidad del contenido la tesis en formato artículo científico sobre el autor y asesor, en concordancia a los principios de legalidad, presunción de veracidad y simplicidad, expresados en el Reglamento del Registro Nacional de Trabajos de Investigación para optar grados académicos y títulos profesionales – RENATI y en la Directiva 003-2016-R/UC.

Esperando la atención a la presente, me despido sin otro particular y sea propicia la ocasión para renovar las muestras de mi especial consideración.

Atentamente,

CCoaquiraR

_____

Asesor de tesis

Cc.
Facultad
Oficina de Grados y Títulos
Interesado(a)

DECLARACIÓN JURADA DE AUTORÍA

El presente documento tiene por finalidad declarar adecuada y explícitamente el aporte de cada estudiante en la elaboración del trabajo de investigación a ser utilizado para la sustentación de tesis: formato de artículo científico.

Yo: Sliver Ivan Del Carpio Ramirez, con Documento nacional de identidad (DNI) N° 71902502; teléfono 955427976; estudiante de la Escuela Académico Profesional de Ingeniería Mecatrónica.

Yo: Jhon Rodrigo Ortiz Zacarias, con Documento nacional de identidad (DNI) N° 71689110; teléfono 918224147; estudiante de la Escuela Académico Profesional de Ingeniería Mecatrónica.

Ante Usted, con el debido respeto me presento y expongo:

Declaramos que hemos participado en la ideación del problema, recolección de datos, elaboración y aprobación final del artículo científico.

Firma
DNI: 71902502

Firma
DNI: 71689110

Firma del asesor
Carlos Alberto Coaquira Rojo

Comparison Analysis of FIR, ARX, ARMAX by Least-Squares Estimation of the Temperature

INFORME DE ORIGINALIDAD

16%	8%	5%	6%
INDICE DE SIMILITUD	FUENTES DE INTERNET	PUBLICACIONES	TRABAJOS DEL ESTUDIANTE

FUENTES PRIMARIAS

1	Submitted to Abu Dhabi University Trabajo del estudiante	2%
2	telkomnika.uad.ac.id Fuente de Internet	1%
3	O. May Tzuc, A. Bassam, L. J. Ricalde, M. Flota-Banuelos. "Artificial neural network model to estimate investment viability of solar plants for the industry of Jalisco, Mexico", 2018 IEEE Latin American Conference on Computational Intelligence (LA-CCI), 2018 Publicación	1%
4	Nurul Nadia Mohammad, Ahmad Aftas Azman, Mohd Hezri Marzaki, Ramli Adnan et al. "Performance Comparison and Energy Consumption Index Between MPC and FuzzyPID in Small-scaled Agarwood Distillation Pot", 2018 9th IEEE Control and System Graduate Research Colloquium (ICSGRC), 2018	1%

	Publicación	
5	export.arxiv.org Fuente de Internet	1 %
6	aut.utcluj.ro Fuente de Internet	1 %
7	Submitted to University Of Tasmania Trabajo del estudiante	1 %
8	Submitted to University of Derby Trabajo del estudiante	1 %
9	cyberleninka.org Fuente de Internet	1 %
10	mdh.diva-portal.org Fuente de Internet	1 %
11	Submitted to Engineering Institute of Technology Trabajo del estudiante	1 %
12	www.sciencegate.app Fuente de Internet	1 %
13	explora.unex.es Fuente de Internet	1 %
14	Luca Cavanini, Francesco Ferracuti, Andrea Monteriù. "Optimal error governor for PID controllers", International Journal of Systems Science, 2021 Publicación	<1 %

15	Submitted to Stefan cel Mare University of Suceava Trabajo del estudiante	<1 %
16	e-journal.trisakti.ac.id Fuente de Internet	<1 %
17	Submitted to Lincoln University Trabajo del estudiante	<1 %
18	Lixiang Zhang, Yan Yan, Yaoguang Hu, Weibo Ren. "A dynamic scheduling method for self-organized AGVs in production logistics systems", Procedia CIRP, 2021 Publicación	<1 %
19	S. Durgadevi, K. Thirupura Sundari, D Raaghavi, R S Akshaya. "Comparative study of Controller Optimisation for CSTR using Particle Swarm Optimization Technique", 2019 Fifth International Conference on Electrical Energy Systems (ICEES), 2019 Publicación	<1 %
20	corpora.tika.apache.org Fuente de Internet	<1 %
21	ieeexplore.ieee.org Fuente de Internet	<1 %
22	www.apsipa.org Fuente de Internet	<1 %
	Submitted to AUT University	

23	Trabajo del estudiante	<1 %
24	pubs.ascee.org Fuente de Internet	<1 %
25	www.economics.eku.edu Fuente de Internet	<1 %
26	Amirreza Kebritchi, Pedram Hosseiniakram, Sara Havashinezhadian, Mostafa Rostami. "Design and Development of an Omnidirectional Mobile Manipulator for Indoor Environment", 2018 6th RSI International Conference on Robotics and Mechatronics (IcRoM), 2018 Publicación	<1 %
27	Submitted to Meerut Institute of Engineering & Technology Trabajo del estudiante	<1 %
28	www.ncbi.nlm.nih.gov Fuente de Internet	<1 %

Excluir citas	Apagado	Excluir coincidencias	Apagado
Excluir bibliografía	Apagado		

Comparison Analysis of FIR, ARX, ARMAX by Least-Squares Estimation of the Temperature Variations of a Pasteurization Process

Sliver Ivan Del carpio Ramirez
Department of Mechatronic Engineering
Universidad Continental Huancayo, Perú
71902502@continental.edu.pe

Jhon Rodrigo Ortiz Zacarias
Department of Mechatronic Engineering
Universidad Continental Huancayo, Perú
71689110@continental.edu.pe

Jalber Brayan Macuri Vazquez
Department of Mechatronic Engineering
Universidad Continental Huancayo, Perú
76611724@continental.edu.pe

Sario Angel Chamorro Quijano
Department of Mechatronics Engineering
Universidad Continental, Huancayo, Perú
72721011@continental.edu.pe

Deyby Huamanchahua
Department of Mechatronics Engineering
Universidad Continental, Huancayo, Perú
dhuamanchahua@continental.edu.pe

Abstract— This research shows the control of the pasteurization process in the dairy industry to obtain milk derivatives, which consists of applying heat at a certain temperature, obtaining the elimination of microorganisms, the preservation of nutrients, and product quality, however, when the temperature is exceeded, these benefits are lost. In addition, the PT-100 sensor was used to obtain a quick response and actuate a 2W-0.25-08 solenoid to avoid exceeding 62.8 C°. The development of the project shows the application of a microcontroller that obtained 3 types of samples of 430 data where the instability of the system was observed, so the FIR, ARX, and ARMAX methods were used to see the comparison of these and to be able to choose the most efficient for the process using the MatLab program. It was obtained that the ARMAX method is more effective for temperature control since it allows a fast signal from the sensor to the actuator. In conclusion, applying control with the ARMAX method will prevent the dairy company from exceeding the pasteurization temperature and thus obtain a quality product.

Keywords— Pasteurization, temperature control, Sensor, FIR, ARX, ARMAX.

I. INTRODUCTION

Dairy products are exposed to the pasteurization process where heat is applied in a temperature range to eliminate pathogenic microorganisms that may endanger the health of the consumer, as these are found internally in the dairy product. [2], it also helps prevent diseases such as brucellosis, diphtheria, tuberculosis, and scarlet fever; this process is the reason why milk has a shelf life of two to three weeks and if the milk goes through the ultra-pasteurization process, its shelf life would be extended from two to three months. [11]. These products go through a thermal process where temperature and time are necessary factors to guarantee the quality of the product since they must be exact [1]. At 62.8°C the ideal pasteurization for milk should be carried out to maintain its proteins, for a time of 30 minutes, if the temperature is exceeded then the nutritional content tends to be damaged, and this process ensures that the product can be consumed by humans. Each control created generates its character, to increase the rise time and minimize overrun [3].

The studies previously carried out for temperature control in the pasteurization process applied a control with the programming of the Mitsubishi PLC of the FX3U series for the Hatuey brewery in Santiago de Cuba, for which the MatLab program was used, implementing a mini-plant in real-time. The MPC algorithm has a high performance in terms of adapting to changes in mitigating emotions and load changes [2]. In similar processes, the implementation of a design based on a PID controller for the construction of the system is given [4,6,7,8]. Likewise, a system that combines the algorithm and fuzzy control is used to design a fuzzy control to control the temperature where the KEIL software is used for programming and the Simulink module in MATLAB to analyze the results; the difference between the output or input temperature and the setpoint temperature causes a response error that is consciously adjusted according to the operating principle of the controller [5,9,12,16].

Also in research, a PI controller is implemented in the predictive model (MPC) to predict and optimize the process by temperature [10]. The performance of PID, fuzzy, and Neuro-Fuzzy Inference System (ANFIS) controllers in the pasteurization process was analyzed where the best performing controllers were PI and ANFIS [17,21]. The use of a programmable controller (PLC) XC-CPU101, the XV102 HMI (Human Machine Interface) of EATON to minimize the error value with the difference of the desired temperature [14,15].

The motivation for this research is the development of new technologies in the dairy industry [13]. Based on the mentioned problem, the implementation of methods to control the

978-1-6654-0690-1/21/$31.00 ©2021 IEEE