Universidad Continental

FACULTAD DE INGENIERÍA

Escuela Académico Profesional de Ingeniería Mecatrónica

Tesis

Design and performance study of the heat exchanger of a fin-based thermoelectric generator via numerical simulations

Patrick Albino Cuyubamba Povez
Joel Asto Evangelista
Jean Raul Almerco Ataucusi
Yadhira Samhira Valenzuela Lino
Deyby Maycol Huamanchahua Canchanya
Nabilt Jill Moggiano Aburto

Para optar el Título Profesional de
Ingeniero Mecatrónico

Huancayo, 2022

PUBLICACIÓN - ASTO EVANGELISTA - ALMERCO ATAUCUSI

INFORME DE ORIGINALIDAD

46%	38%	37%	17%
INDICE DE SIMILITUD	FUENTES DE INTERNET	PUBLICACIONES	TRABAJOS DEL ESTUDIANTE

FUENTES PRIMARIAS

1	cris.continental.edu.pe Fuente de Internet	8%
2	Ding Luo, Ruochen Wang, Wei Yu, Weiqi Zhou. "A novel optimization method for thermoelectric module used in waste heat recovery", Energy Conversion and Management, 2020 Publicación	3%
3	Ding Luo, Zeyu Sun, Ruochen Wang. "Performance investigation of a thermoelectric generator system applied in automobile exhaust waste heat recovery", Energy, 2022 Publicación	2%
4	Ding Luo, Ruochen Wang, Wei Yu, Weiqi Zhou. "Performance optimization of a converging thermoelectric generator system via multiphysics simulations", Energy, 2020 Publicación	1%
5	journal.unimma.ac.id Fuente de Internet	1%

6	www.ansys.com Fuente de Internet	1 %
7	Submitted to Indian Institute of Technology Jodhpur Trabajo del estudiante	1 %
8	Keren Xie, Shijun Wu, Canjun Yang, Yongwei Ruan, Yuandong Hong. "A New Seafloor Hydrothermal Power Generation Device Based on Waterproof Thermoelectric Modules", IEEE Access, 2020 Publicación	1 %
9	Taeho Choi, Tae Young Kim. "Three-zone numerical modeling method for predicting system-level waste heat recovery performance of thermoelectric generator with various electrical array configurations", Energy Conversion and Management, 2021 Publicación	1 %
10	Babak Safaei, Sertan Erdem, Mohammad Karimzadeh Kolamroudi, Samaneh Arman. "State-of-the-art review of energy harvesting applications by using thermoelectric generators", Mechanics of Advanced Materials and Structures, 2023 Publicación	1 %
11	Jhon Rodrigo Ortiz Zacarias, Yordan Cesar Sullca-Mendoza, Yadhira S. Valenzuela-Lino,	1 %

Sliver Ivan Del Carpio-Ramirez et al. "Simulation of an Automated Tahitian lemon grading system based on computer vision", 2022 IEEE 13th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON), 2022
Publicación

12	Submitted to Technical University of Cluj-Napoca Trabajo del estudiante	1 %
13	www.ijraset.com Fuente de Internet	1 %
14	Xiaolong Li, Changjun Xie, Shuhai Quan, Ying Shi, Zebo Tang. "Optimization of Thermoelectric Modules' Number and Distribution Pattern in an Automotive Exhaust Thermoelectric Generator", IEEE Access, 2019 Publicación	1 %
15	vbn.aau.dk Fuente de Internet	1 %
16	www.tandfonline.com Fuente de Internet	1 %
17	Jinmeng Wu, Yan Chen, Yinke Dou, Chunyan Ma, Qian Du, Qiang Liu. "Optimal Design and Performance Analysis of Thermoelectric Power Generation Device Based on Multi -	1 %

Objective Genetic Algorithm", Advanced Theory and Simulations, 2021
Publicación

18	Xi Wang, Paul Henshaw, David S-K Ting. "Using a hyperbolic structure to enhance the dynamic performance of a thermoelectric generator", Thermal Science and Engineering Progress, 2022 Publicación	1 %
19	dergipark.org.tr Fuente de Internet	1 %
20	www.pphmj.com Fuente de Internet	1 %
21	Submitted to Sheffield Hallam University Trabajo del estudiante	1 %
22	Farayi Musharavati, Shoaib Khanmohammadi, Amirhossein Pakseresht. "Proposed a new geothermal based poly-generation energy system including Kalina cycle, reverse osmosis desalination, elecrolyzer amplified with thermoelectric: 3E analysis and optimization", Applied Thermal Engineering, 2021 Publicación	1 %
23	B. Abderezzak, S. Randi. "Experimental Investigation of Waste Heat Recovery Potential from Car Radiator with	1 %

Thermoelectric Generator", Thermal Science and Engineering Progress, 2020
Publicación

24	link.springer.com Fuente de Internet	1 %
25	Submitted to University of Hong Kong Trabajo del estudiante	1 %
26	Ahmad Abu-Heiba, Kyle R. Gluesenkamp, Timothy J. LaClair, Praveen Cheekatamarla et al. "Analysis of power conversion technology options for a self-powered furnace", Applied Thermal Engineering, 2021 Publicación	1 %
27	Jean Pierre Arce Misajel, Sario Angel Chamorro Quijano, Dominick Marco Cruz Esteban, Steve Robert Torres Rojas et al. "Design of a Prototype for Water Desalination Plant using Flexible, Low-Cost Titanium Dioxide Nanoparticles", 2021 IEEE 12th Annual Ubiquitous Computing, Electronics & Mobile Communication Conference (UEMCON), 2021 Publicación	1 %
28	Yiping Wang, Cheng Wu, Zebo Tang, Xue Yang, Yadong Deng, Chuqi Su. "Optimization of Fin Distribution to Improve the Temperature Uniformity of a Heat Exchanger in a Thermoelectric Generator", Journal of Electronic Materials, 2014	1 %

Publicación

29	journals.tabrizu.ac.ir Fuente de Internet	1 %
30	Ruochen Wang, Yuxuan Fu, Ding Luo, Jie Chen, Weiqi Zhou. "Performance evaluation of an automotive thermoelectric generator with a non-isometric distributed fin heat exchanger", Sustainable Energy & Fuels, 2022 Publicación	1 %
31	hdl.handle.net Fuente de Internet	1 %
32	Ding Luo, Ruochen Wang, Wei Yu, Weiqi Zhou. "A numerical study on the performance of a converging thermoelectric generator system used for waste heat recovery", Applied Energy, 2020 Publicación	1 %
33	coek.info Fuente de Internet	<1 %
34	Ming Qiao, Bo You, Jiazhong Xu, Bingshu Jia. "Heat transfer simulation and analysis of mandrel for heated-mandrel winding method of tapered shell", Journal of Reinforced Plastics and Composites, 2014 Publicación	<1 %
35	M. Elzalik, R. Mostafa, Hegazy Rezk, E. G.Shehata, Jean Thomas. "INC-MPPT	<1 %

	Algorithm for Maximizing Energy Conversion Efficiency of Thermoelectric Generating System", Engineering Research Journal, 2019 Publicación	
36	eprints.gla.ac.uk Fuente de Internet	<1 %
37	ojs2.utp.edu.co Fuente de Internet	<1 %
38	surface.syr.edu Fuente de Internet	<1 %
39	Submitted to University of Houston System Trabajo del estudiante	<1 %
40	Xin-liang Dong, Fan Zhou, Wen-chun Jiang, Yu-tong Xie et al. "Failure analysis of the conical gaskets in ultra-high pressure pipeline sealing devices: Experiment and numerical simulation", Engineering Failure Analysis, 2022 Publicación	<1 %
41	aaqr.org Fuente de Internet	<1 %
42	www.bg.pg.gda.pl Fuente de Internet	<1 %
43	www.diva-portal.org Fuente de Internet	<1 %
44	www.frontiersin.org Fuente de Internet	<1 %

45	"Human-Computer Interaction", Springer Science and Business Media LLC, 2019 Publicación	<1 %
46	Aibing Zhang, Dandan Pang, Baolin Wang, Ji Wang. "Dynamic responses of wearable thermoelectric generators used for skin waste heat harvesting", Energy, 2022 Publicación	<1 %
47	Ding Luo, Zerui Liu, Yuying Yan, Ying Li, Ruochen Wang, Lulu Zhang, Xuelin Yang. "Recent advances in modeling and simulation of thermoelectric power generation", Energy Conversion and Management, 2022 Publicación	<1 %
48	Md Walid Faruque, Mohammed Raihan Uddin, Sayedus Salehin, M Monjurul Ehsan. "A Comprehensive Thermodynamic Assessment of Cascade Refrigeration System Utilizing Low GWP Hydrocarbon Refrigerants", International Journal of Thermofluids, 2022 Publicación	<1 %
49	Nicolae Vlad Burnete, Florin Mariasiu, Christopher Depcik, Istvan Barabas, Dan Moldovanu. "Review of thermoelectric generation for internal combustion engine waste heat recovery", Progress in Energy and Combustion Science, 2022 Publicación	<1 %

50	api.crossref.org Fuente de Internet	<1 %
51	e-sciencecentral.org Fuente de Internet	<1 %
52	iieta.org Fuente de Internet	<1 %
53	macsphere.mcmaster.ca Fuente de Internet	<1 %
54	nottingham-repository.worktribe.com Fuente de Internet	<1 %
55	repository.up.ac.za Fuente de Internet	<1 %
56	unsworks.unsw.edu.au Fuente de Internet	<1 %
57	www.mdpi.com Fuente de Internet	<1 %
58	www.researchgate.net Fuente de Internet	<1 %
59	Ernst Heinrich Hirschel, Claus Weiland. "Selected Aerothermodynamic Design Problems of Hypersonic Flight Vehicles", Springer Science and Business Media LLC, 2009 Publicación	<1 %

60 Min He, Enhua Wang, Yuanyin Zhang, Wen Zhang, Fujun Zhang, Changlu Zhao. "Performance analysis of a multilayer thermoelectric generator for exhaust heat recovery of a heavy-duty diesel engine", Applied Energy, 2020

Publicación

<1 %

Excluir citas	Apagado	Excluir coincidencias	Apagado
Excluir bibliografía	Apagado		

Design and Performance Study of the Heat Exchanger of a Fin-Based Thermoelectric Generator via Numerical Simulations

Patrick Cuyubamba
Department of Mechatronics Engineering
Universidad Continental
Huancayo, Perú
74466185@continental.edu.pe

Joel Asto-Evangelista
Department of Mechatronics Engineering
Universidad Continental
Huancayo, Perú
42896174@continental.edu.pe

Jean R. Almerco-Ataucusi
Department of Mechatronics Engineering
Universidad Continental
Huancayo, Perú
71665906@continental.edu.pe

Yadhira S. Valenzuela-Lino
Department of Mechatronics Engineering
Universidad Continental
Huancayo, Perú
73105932@continental.edu.pe

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

Nabilt Moggiano
Engineering Research Unit
Faculty of Engineering
Universidad Continental
Huancayo, Perú
nmoggiano@continental.edu.pe

***Abstract*—Climate change is a latent concern nowadays, so the ONU proposed to adopt new alternatives for obtaining energy through clean and renewable energies; that is why the TEG (Thermoelectric Generator) have been used in different industries and vehicles as they are a system that recovers and uses the waste heat from automobile exhaust gases for waste heat recovery; therefore, it is a method that allows improving energy efficiency. The present study aims to design and study the performance of the heat exchanger of a fin-based thermoelectric generator via numerical simulations. In this way, the geometry was performed using SolidWorks software. In addition, the meshing and boundary conditions were established in ANSYS Fluent to obtain the initial temperature distributions. Additionally, these initial temperature distributions serve as boundary conditions for ANSYS Thermal-Electric to obtain the semiconductor's final temperature distributions, voltage distributions, and electric current distributions. It was obtained as a result that the semiconductor's temperature distributions reached a voltage of 80 mV in 1 second of heat transfer. Also, the droplets fin-base TEG had an average temperature of 36.85 °C on the cold side and 163.3 °C on the hot side. Finally, it was concluded that the semiconductor's final temperature distributions of the hot and cold side for the droplets fin-base TEG presented higher uniformity than the parallel plate fin-base TEG.**

Keywords—Thermoelectric Generator (TEG), heat exchanger, CFD, numerical simulations, waste heat recovery

I. INTRODUCTION

As time goes by, studies on clean, renewable energies, such as solar, wind, and others, have been increasing; however, these methods require a higher initial investment for their research [1]. In addition, to curb the effects of climate change, the ONU proposes to adopt renewable sources to meet the energy demand [2].

On the other hand, a thermoelectric generator (TEG) is an outgoing power generation system that can convert thermal energy into electrical energy. In addition, the thermoelectric conversion efficiency of TEG is currently very low since not enough system optimizations have been performed [3]. However, applying TEG in exhaust waste heat recovery and utilization is a novel way to improve energy efficiency [4].

Similarly, TEG systems are highly interested in military and space exploration applications. They are characterized by no moving parts, low noise, high reliability, zero emissions, high endurance, and long lifetime [5]. On the other hand, since this system has the potential use for thermal energy recovery, it has eventually been applied to various automobiles by installing thermoelectric devices in their exhaust pipes, which benefits the automotive sector [6] and the environment. Currently, TEG systems present an efficiency of approximately 4%; therefore, they are far from the requirements to be of commercial use since it is important for the development of thermoelectric-type materials with superior geometry since optimization methods based on the structure and geometry can improve the conversion efficiency of TEG systems [7].

Improving the structure of TEG systems contributes to work efficiency in the heat exchanger and the thermoelectric module (TEM) [8]. For example, research [7] - [9] shows a TEG system in which closed fins are pushed aside by dimpled surfaces in the heat exchanger, thus exhibiting more considerable convection and heat transfer area. Consequently, it reduced the pressure drop, so that in its results, it was obtained that the net power of the TEG system had increased by 173.60%; on the other hand, the pressure drop decreased by 20.57%.

On the other hand, it is worth highlighting the study [10] since it presented a segmented annular thermoelectric generator, which is also characterized by increasing the heat transfer