



SJR

Scimago Journal & Country Rank

journal of physics conference series

[Home](#)
[Journal Rankings](#)
[Country Rankings](#)
[Viz Tools](#)
[Help](#)
[About Us](#)
[i](#) [x](#)

Alibaba Cloud FinTech Day

Deep dive into the future of FinTech with our most influential financial cloud experts

Alibaba Cloud

[OPEN](#)

IOP Conference Series: Materials Science and Engineering

Country	United Kingdom - SIR Ranking of United Kingdom
Subject Area and Category	Engineering Engineering (miscellaneous) Materials Science Materials Science (miscellaneous)
Publisher	IOP Publishing Ltd.
Publication type	Conferences and Proceedings
ISSN	17578981, 1757899X
Coverage	2009-2020
Scope	The open access IOP Conference Series provides a fast, versatile and cost-effective proceedings publication service for your conference. Key publishing subject areas include: physics, materials science, environmental science, bioscience, engineering, computational science and mathematics.
	Homepage How to publish in this journal Contact Join the conversation about this journal

31

H Index

Alibaba Cloud

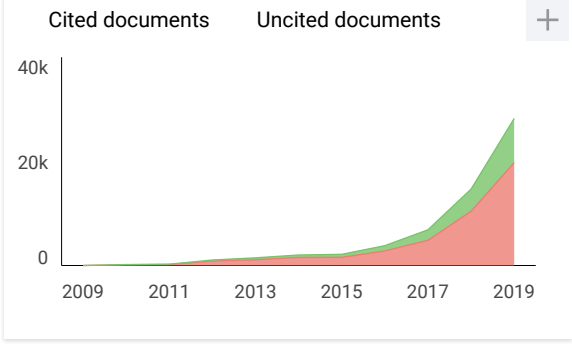
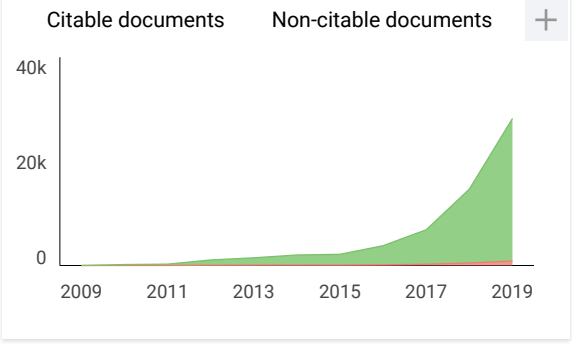
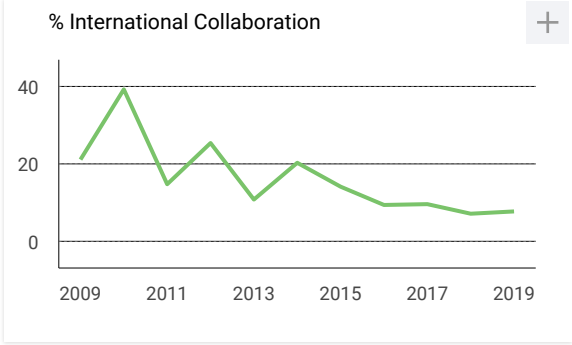
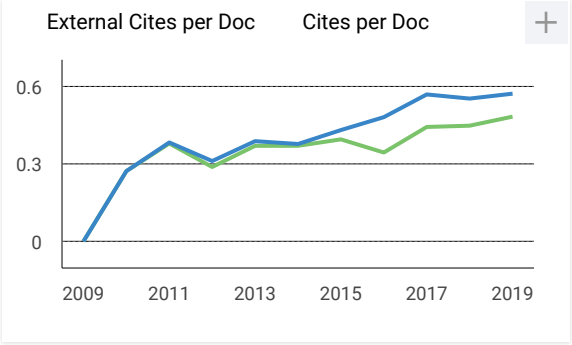
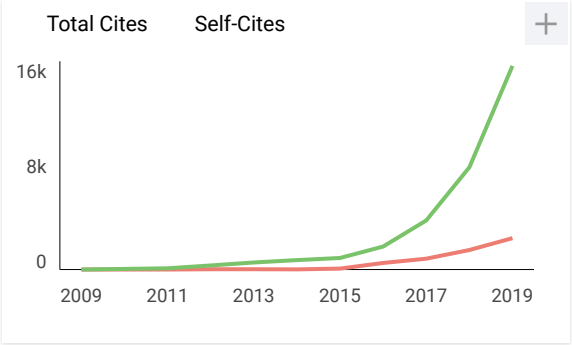
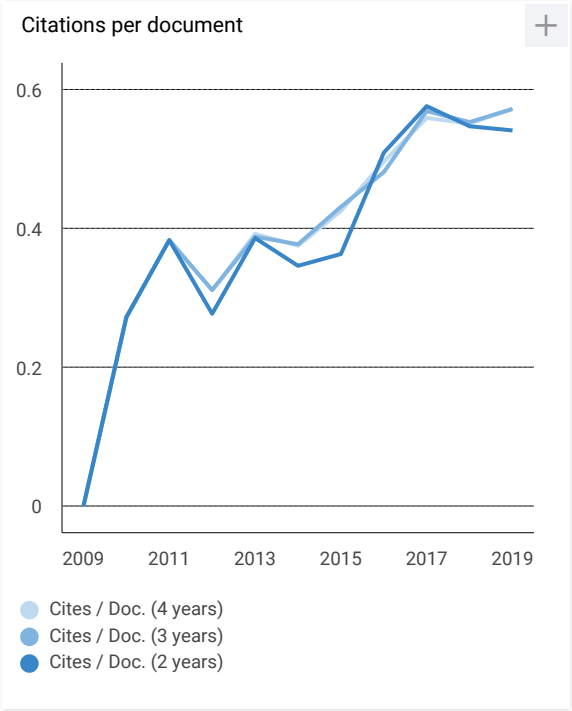
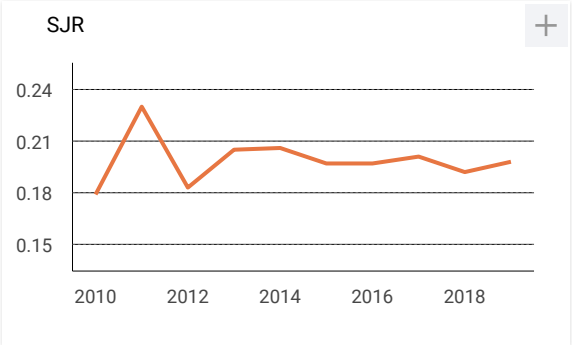
Alibaba Cloud FinTech Day

Tuesday, June 16 | 9:00-18:00 UTC+8



Powered by 2nd Gen Intel® Xeon®
Scalable Processors

[Sign Up Now](#)

**IOP Conference Series:
Materials Science and...**

Not yet assigned
quartile

SJR 2019
0.2

powered by scimagojr.com

← Show this widget in
your own website

Just copy the code below
and paste within your html
code:

```
<a href="https://www.scimagojr.com/journalsearch.php?q=19700200831&tip=sid&clean=0"
```



CERTIFICATE

To certify that:

Paulus Wisnu Anggoro

has contributed as:

PRESENTER

1st Borobudur International Symposium 2019

"Local Resources Empowerment towards Advance, Smart and Sustainable System"

October 16, 2019

Magelang, Central of Java, Indonesia

Rector of Universitas Muhammadiyah Magelang



Ir. Eko Muh Widodo, MT.

Chairman of 1st BIS



Assoc. Prof. Dr. Muji Setiyo, ST., MT.

Organized by :



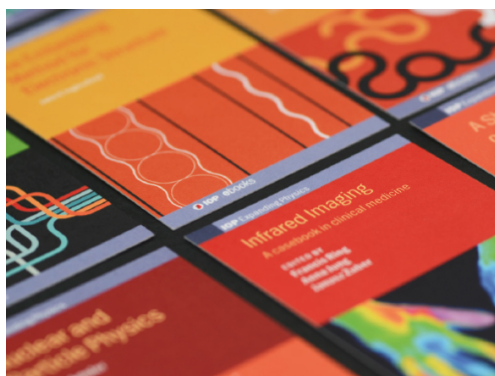
Co-host :

PAPER • OPEN ACCESS

Preface

To cite this article: 2020 *J. Phys.: Conf. Ser.* **1517** 011001

View the [article online](#) for updates and enhancements.



IOP | ebooks™

Bringing together innovative digital publishing with leading authors from the global scientific community.

Start exploring the collection—download the first chapter of every title for free.

Preface

The 1st Borobudur International Symposium on Applied Science and Engineering (BIS-ASE) 2019 is hosted by Universitas Muhammadiyah Magelang, Indonesia. The conference is also co-hosted by other twenty-one institutions as follows Badan Penelitian dan Pengembangan Kota Magelang, Universitas Muhammadiyah Surabaya, Universitas Muhammadiyah Buton, Universitas Muhammadiyah Ponorogo, Universitas Muhammadiyah Purworejo, Universitas Muhammadiyah Jember, Universitas Muhammadiyah Metro, Universitas Muhammadiyah Maluku Utara, Universitas Muhammadiyah Pekajangan Pekalongan, Universitas Muhammadiyah Riau, Universitas Aisyiyah Yogyakarta, Universitas Sains Al Qur'an Wonosobo, Universitas Tidar Magelang, FKIP Universitas Muhammadiyah Jakarta, FISIP Universitas Muhammadiyah Malang, Faculty of Law Universitas Islam Indonesia, STIKES Muhammadiyah Klaten, IAIM Sinjai, IAIN Purwokerto, Politeknik Energi dan Mineral Akamigas, and STMIK Bina Patria Magelang.

The main theme of this symposium is “Local resources empowerment towards advance, smart and sustainable system” as a part of the United Nations agenda for sustainable development goals in 2030. Therefore, we present you, four world-class keynote speakers whom able to capture the interdependence between these scientific topics. First, Professor Tony Lucey from Curtin University, Australia. Second, Professor Noorefendi Tamaldin from UTeM, Malaysia. Third, Mr Rajesh Ranolia from NIIT, India. Fourth, Yun Fatimah, PhD, Dean of the Faculty of Engineering, Universitas Muhammadiyah Magelang.

Let me inform you that the 1st BIS-ASE 2019 has received 344 submissions from 6 countries: India, The Netherlands, Malaysia, Japan, Thailand, and Indonesia. Each paper has been reviewed by the program committee. Only 232 papers were accepted for the round table session (acceptance rate: 69.46 %). All the published papers have been through a series of rigorous review process to meet the requirements and standards of international publication.

We hope that our later discussion may result transfer of experiences and research findings from participants to others, from one institution to another, from social researcher to engineering researcher and vice versa. Also, I hope this event can build a new and strong research network.

We would like to thank each co-host for the efforts to give significant contribution particularly on paper selection. We would also like to acknowledge the Rector of Universitas Muhammadiyah Magelang for the endless support to the conference. Last but not least, we would like to express our most sincere gratitude to the international advisory board, scientific committee, steering committee, organizing committee, and everybody taking parts in the success of the conference. We hope to see you in the 2nd BIS-ASE 2020.

The Editors,

Assoc. Prof. Dr. Muji Setiyo, ST., MT.
Andri Pranolo, S.Kom., M.Cs.
Zulfikar Bagus Pambuko, MEI.
Agus Setiawan, M.Eng.
Chrisna Bagus Edhita Praja, SH., MH.
Fitriana Yulastuti, S.Farm., M.Sc., Apt.
Veni Soraya Dewi, M.Si.



List of Committee

Conference Chair:

Assoc. Prof. Dr. Muji Setiyo, ST., MT.

Co- Conference Chair:

Zulfikar Bagus Pambuko, MEI.

Members:

Andri Pranolo, S.Kom., M.Cs. – Universitas Ahmad Dahlan
Agus Setiawan, M.Eng - Universitas Muhammadiyah Magelang
Chrisna Bagus Edhita Praja, SH., MH. - Universitas Muhammadiyah Magelang
Fitriana Yulastuti, S.Farm., M.Sc., Apt. - Universitas Muhammadiyah Magelang
Veni Soraya Dewi, M.Si. - Universitas Muhammadiyah Magelang

Technical Committee:

Affan Rifa'i, ST., MT
Bagiyo Condro Purnomo, ST., M.Eng
Tuessi Ari Purnomo, ST., M.Tech., MSE
Nugroho Agung P, ST., M.Kom
Oesman Raliby Al Manan, ST., M.Eng
Purwono Hendradi, M.Kom
Dr. Budi Waluyo, MT
Dimas Sasongko, M.Eng
Qosim Nurdin Haka, S.Kom
Pandu Galuh Rahmanto
Nur Hidayati, ST
Marlina Srie Rahayu, A.Md
Sella Rahmawati, S.Pd
Heni Lestari
Joko Prayitno
Firman Amirudin Baharsya, S.Pd
Sofyan Kurniawan, A.Md

Advisory Board

Prof. H. Lincoln Arsyad, M.Sc., Ph.D. - Universitas Gadjah Mada, Indonesia
Prof. Dr. Chairil Anwar - Universitas Gadjah Mada, Indonesia
Prof. Dr. H. Edy Suandi Hamid, M.Ec. - Universitas Islam Indonesia, Indonesia
Prof. Dr. H. M. Noor Rochman Hadjam, S.U. - Universitas Gadjah Mada, Indonesia
Prof. Ir. Djoko Wahyu Karmiadji, MSME, PhD, APU - BPPT, Indonesia
Ir. Eko Muh Widodo, MT. - Universitas Muhammadiyah Magelang, Indonesia
Dr. Purwati, MS. Kons. - Universitas Muhammadiyah Magelang, Indonesia
Prof. Dr. H. Khudzaifah Dimiyati, SH., M. Hum. - Universitas Muhammadiyah Surakarta, Indonesia
Prof. Dr. Harun Joko Prayitno - Universitas Muhammadiyah Surakarta, Indonesia
Prof. Dr. H. Abdul Munir Mulkhan, S.U. - Universitas Islam Negeri Sunan Kalijaga, Indonesia
Sri Sat Titi H, S.Kep., Ns., M.Kep. - STIKES Muhammadiyah Klaten, Indonesia
Dr. Rofiq Nurhadi, M.Ag. - Universitas Muhammadiyah Purworejo, Indonesia
Drs. Arif Barata Sakti, MT. - BALITBANG Kota Magelang, Indonesia
Dr. Waode Al Zarliani, SP., MM. - Universitas Muhammadiyah Buton, Indonesia

Dr. dr. Sukadiono, MM. - Universitas Muhammadiyah Surabaya, Indonesia
Dr. Firdaus, M.Ag. - Institut Agama Islam Muhammadiyah Sinjai, Indonesia
Prof. Dr. H. Ah. Rofiuddin, M.Pd. - Universitas Muhammadiyah Malang, Indonesia
Dr. Saiful Deni.M.Si. - Universitas Muhammadiyah Maluku Utara, Indonesia
Dr. Moh. Roqib, M.Ag. - Institut Agama Islam Negeri Purwokerto, Indonesia
Dr. Ir. Muhammad Hazmi, DESS. - Universitas Muhammadiyah Jember, Indonesia
Drs. H. Jazim Ahmad, M.Pd. - Universitas Muhammadiyah Metro, Indonesia
Dr. Sukris Sutiayatno, MM., M.Hum. - STMIK Bina Patria, Indonesia
Prof. Dr. Ir. Mukh Arifin, M.Sc. - Universitas Tidar, Indonesia
Warsiti, M.Kep., Sp.Mat. - Universitas 'Aisyiyah Yogyakarta, Indonesia
Dr. H. Sulton, M.Si. - Universitas Muhammadiyah Ponorogo, Indonesia
Dr. KH. Muchotob Hamzah, MM. - Universitas Sains Al-Quran, Indonesia
Prof. Dr. Drs. R.Y. Perry Burhan, M.Sc. - Politeknik Energi dan Mineral Akamigas, Indonesia
DR. H. Mubarak, M.Si. - Universitas Muhammadiyah Riau, Indonesia
Dr. Budi Agus Riswandi, S.H., M.Hum. - Universitas Islam Indonesia, Indonesia
Prof. Dr. H. Syaiful Bakhri, S.H., M.H. - Universitas Muhammadiyah Jakarta, Indonesia
Dr. Nur Izzah, S.Kp., M.Kes. - Universitas Muhammadiyah Pekajangan Pekalongan, Indonesia

Scientific Committee

Prof. Dr. Noreffendy Tamaldin - Universiti Teknikal Malaysia Melaka, Malaysia
Rajesh Ranolia, B.Com., MBA - National Institute of Information Technology, India
Prof. Tony Lucey, PhD. - Curtin University, Australia
Yun Arifatul Fatimah, ST.,MT.,Ph.D. - Universitas Muhammadiyah Magelang, Indonesia
Dr. Heni Setyowati Esti Rahayu, M.Kes. - Universitas Muhammadiyah Magelang, Indonesia
Dr. Budi Waluyo, ST, MT - Universitas Muhammadiyah Magelang, Indonesia
Dr. rer. nat., Fredy Kurniawan, S.Si., M.Si - Institut Teknologi Sepuluh Nopember, Indonesia
Prof. Suharso, Ph.D - Universitas Lampung, Indonesia
Fajar Suryawan, Ph.D - Universitas Muhammadiyah Surakarta, Indonesia
Dr. Retno Susilorini, S.T, M.T - UNIKA Soegijapranoto, Indonesia
Andri Pranolo, M.CS. - Universitas Ahmad Dahlan, Indonesia
Assoc. Prof. Lukas G. Swan - Dalhousie University, Canada
Prof. Shi-Jinn Horng, PhD. - National Taiwan University of Science and Technology, Taiwan
Rafał Dreżewski, PhD. - AGH University of Science and Technology, Poland
Prof. Wolfgang Keller, PhD. - University of Colorado, Colorado, US
Dr. Siska Desy Fatmaryanti, M.Si. - Universitas Muhammadiyah Purworejo
Rizal Arifin, Ph.D. - Universitas Muhammadiyah Ponorogo, Indonesia

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our Privacy and Cookies policy.



☐ **NOTICE:** Ensuring subscriber access to content on IOPscience throughout the coronavirus outbreak - see our remote access guidelines.

PAPER • OPEN ACCESS

Preface

Published 1 April 2020 • Published under licence by IOP Publishing Ltd

Journal of Physics: Conference Series, Volume 1517, 2019 1st Borobudur International Symposium on Applied Science and Engineering (BIS-ASE) 2019 16 October 2019, Magelang, Indonesia

2020 *J. Phys.: Conf. Ser.* **1517** 011001

<https://doi.org/10.1088/1742-6596/1517/1/011001>

Buy this article in print

Abstract

The 1st Borobudur International Symposium on Applied Science and Engineering (BIS-ASE) 2019 is hosted by Universitas Muhammadiyah Magelang, Indonesia. The conference is also co-hosted by other twenty-one institutions as follows Badan Penelitian dan Pengembangan Kota Magelang, Universitas Muhammadiyah Surabaya, Universitas Muhammadiyah Buton, Universitas Muhammadiyah Ponorogo, Universitas Muhammadiyah Purworejo, Universitas Muhammadiyah Jember, Universitas Muhammadiyah Metro, Universitas Muhammadiyah Maluku Utara, Universitas Muhammadiyah Pekajangan Pekalongan, Universitas Muhammadiyah Riau, Universitas Aisyiyah Yogyakarta, Universitas Sains Al Qur'an Wonosobo, Universitas Tidar Magelang, FKIP Universitas Muhammadiyah Jakarta, FISIP Universitas Muhammadiyah Malang, Faculty of Law Universitas Islam Indonesia, STIKES Muhammadiyah Klaten, IAIM Sinjai, IAIN Purwokerto, Politeknik Energi dan Mineral Akamigas, and STMIK Bina Patria Magelang.

The main theme of this symposium is "Local resources empowerment towards advance, smart and sustainable system" as a part of the United Nations agenda for sustainable development goals in 2030. Therefore, we present you, four world-class keynote speakers whom able to capture the interdependence between these scientific topics. First, Professor Tony Lucey from Curtin University, Australia. Second, Professor Noorefendi Tamaldin from UTeM, Malaysia. Third, Mr Rajesh Ranolia from NIIT, India. Fourth, Yun Fatimah, PhD, Dean of the Faculty of Engineering, Universitas Muhammadiyah Magelang.

Let me inform you that the 1st BIS-ASE 2019 has received 344 submissions from 6 countries: India, The Netherlands, Malaysia, Japan, Thailand, and Indonesia. Each paper has been reviewed by the program committee. Only 232 papers were accepted for the round table session (acceptance rate: 69.46 %). All the published papers have been through a series of rigorous review process to meet the requirements and standards of international publication.

We hope that our later discussion may result transfer of experiences and research findings from participants to others, from one institution to another, from social researcher to engineering researcher and vice versa. Also, I hope this event can build a new and strong research network.

We would like to thank each co-host for the efforts to give significant contribution particularly on paper selection. We would also like to acknowledge the Rector of Universitas Muhammadiyah Magelang for the endless support to the conference. Last but not least, we would like to express our most sincere gratitude to the international advisory board, scientific committee, steering committee, organizing committee, and everybody taking parts in the success of the conference. We hope to see you in the 2nd BIS-ASE 2020.

The Editors,

Assoc. Prof. Dr. Muji Setiyo, ST., MT.

Andri Pranolo, S.Kom., M.Cs.

Zulfikar Bagus Pambuko, MEI.

Agus Setiawan, M.Eng.

Chrisna Bagus Edhita Praja, SH., MH.

Fitriana Yulastuti, S.Farm., M.Sc., Apt.

Veni Soraya Dewi, M.Si.

List of Committee, Conference Photograph are available in the pdf.

This site uses cookies. By continuing to use this site you agree to our use of cookies. To find out more, see our [Privacy and Cookies policy](#).



☐ **NOTICE:** Ensuring subscriber access to content on IOPscience throughout the coronavirus outbreak - see our [remote access guidelines](#).

Table of contents

Volume 1517

2020

◀ Previous issue Next issue ▶

2019 1st Borobudur International Symposium on Applied Science and Engineering (BIS-ASE)
2019 16 October 2019, Magelang, Indonesia

Accepted papers received: 25 March 2020

Published online: 28 May 2020

[Open all abstracts](#)

Preface

OPEN ACCESS 011001

Preface

+ Open abstract View article PDF

OPEN ACCESS 011002

Peer review statement

+ Open abstract View article PDF

Papers

OPEN ACCESS 012001

Comparison of engine performance of Bajaj Qute RE60 using gasoline and LPG

E M Widodo, M Setiyo, M I Rosyidi, T A Purnomo, M Husni and S Sudaryono

+ Open abstract View article PDF

OPEN ACCESS 012002

Performance of mini air cooler on parked car under direct sunlight

M Setiyo, B Waluyo, N Widodo, M L Rochman and I B Raharja

+ Open abstract View article PDF

-
- OPEN ACCESS** 012003
Residual velocity and kinetic energy of the ballistic simulations test on hardened medium carbon steel plate
H Purwanto, M Dzulfikar, M Tauviqirrahman, I Syafaat and M Arifin
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012004
Ergonomic evaluation of low-cost prosthetic products: comparison between rigid and flexible ankle joint design
K Muslim, N L P S Setiawati, K S Girsang and Yassierli
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012005
Interaction of inertia and cavitation in textured hydrodynamically lubricated bearing in very low sliding velocity considering slip
J Jamari, F Hilmy, M Muchammad and M Tauviqirrahman
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012006
Natural zeolite study as a catalyst: A case study of pyrolysis of polyethene terephthalate (PET) waste into liquid fuel
Nuryosuwito, S Soeparman, W Wijayanti and N Hamidi
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012007
The effect of adhesive concentration variation on the characteristics of briquettes
R P Dewi and M Kholik
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012008
Different space characteristics of air temperature variation in North Sumatra Indonesia
T A E Prasetya, Munawar, S Chesoh, A Lim and D R McNeil
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012009
Design and simulation of mixer insulators to improve turbulence in intake manifold
Sunaryo, A Irfan, M Setiyo and N Amin
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012010

Plastic waste conversion into fuel by utilizing biomass waste as heating system on pyrolysis process

B Sugiarto, A Kurniawan and A Perdana

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012011

Inertia and slip effect on a single textured hydrodynamic thrust bearing using CFD methods

M Muchammad, O Triandani, M Tauviqirrahman, F Hilmy and J Jamari

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012012

Study of mechanical properties of composite strengthened mango seed powder (*mangifera indica cultivar manalagi*), brass, and magnesium oxide for brake pads material

C Pramono, X Salahudin, I Taufik, A Bagaskara and D M Irawan

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012013

Fuel control system modeling for LPG fueled engine using Adaptive Neuro-Fuzzy Inference Systems (ANFIS)

S Munahar, M Setiyo, B C Purnomo and Y Rifangi

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012014

Estimated corrosion resistance of nickel-plated fuel tanks on RON 92 and RON 90 fuels

N Mulyaningsih and B B Tidarriano

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012015

Improvement of methane composition utilizing activated carbon adsorption column for biogas purification from food waste

S Lestari, T Sriana, M S Raharjo, I N Sudiarte and M N Anugrah

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012016

Design of sustainable production performance systems for MSMEs creative industry sub sector

M R Radyanto and E N Hayati

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012017

The characteristic of bio-pellet made from teak wood waste due to the influence of variations in material composition and compaction pressure

N Iskandar, S Sulardjaka, M Munadi, S Nugroho, A S Nidhom and D F Fitriyana

[+ Open abstract](#)



[View article](#)



[PDF](#)

OPEN ACCESS

012018

Effect of pressure and welding time on physical and mechanical properties of dissimilar metal AISI 316 austenitic stainless steel and AISI 4140 alloy steel joints using friction welding

B Margono, Haikal, H I Atmaja, J Wibowo, A Alfayed and R F Rananto

[+ Open abstract](#)



[View article](#)



[PDF](#)

OPEN ACCESS

012019

The effect of water content and binder made from cassava starch and densification pressure on the quality of rice husk bio-pellets

N Iskandar, S Sulardjaka, M Munadi, S Nugroho, R C Muhamadin and D F Fitriyana

[+ Open abstract](#)



[View article](#)



[PDF](#)

OPEN ACCESS

012020

Numerical investigation of the hardness of tire rubber material by indentation method

B Setiyana, C Prabowo, J Jamari, R Ismail, S Sugiyanto and E Saputra

[+ Open abstract](#)



[View article](#)



[PDF](#)

OPEN ACCESS

012021

The effect of the carbonization period to the yield of biomass charcoals of secang, roda, ketapang and siwalan fruits using the small scale PEM A – HRV furnace

W R Hatiningrum, Suparno, A Huzein, R D Syahputra and A D Rahangmetang

[+ Open abstract](#)



[View article](#)



[PDF](#)

OPEN ACCESS

012022

Micro pave setting for the triple moon goddess jewelry set designs

A S M Atamtajani and D Yudiarti

[+ Open abstract](#)



[View article](#)



[PDF](#)

OPEN ACCESS

012023

Thermal analysis simulation of parallel cell in modular battery pack for electric vehicle application

J Raharjo, A Wikarta, I Sidharta, M N Yuniarto and M R Rusli

[+ Open abstract](#)



[View article](#)



[PDF](#)

OPEN ACCESS

012024

Economic valuation of rice agricultural land in Bogor regency

L B Sejati, Y Arifien and F Maad

[+ Open abstract](#)



[View article](#)



[PDF](#)

-
- OPEN ACCESS** 012025
Environmental testing for reliable battery management system in electric vehicle
J Raharjo, A Wikarta, I Sidharta, M N Yuniarto, M I Firdaus and M F B Zulhaimi
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012026
Effect of virtual reality usage on postural stability
D A Pujiartati, M F Ananta, K Muslim, N L P L S Setiawati and H Iridiastadi
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012027
Fiber content of analog rice production from composite flour: cassava, avocado seeds, and tofu waste
E C J Putri and S Sumardiono
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012028
Unconfined compression strength of soil using silica sand waste and dust sand foundry as a stabilizer
A S S Gunarti, S Nuryati, P A Muttaqin and I Raharja
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012029
Probabilistic stability and sensitivity analysis of rock slope subjected to seismic loading
H Farichah and D A Hutama
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012030
Correlation of modulus elasticity between Light Weight Deflectometer (LWD) and Dynamic Cone Penetrometer (DCP) for subgrade of pavement
I Sudarsono, L Aisyah and R N P Prakoso
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012031
Comparative study of the use of FWD and LWD for flexible pavement evaluation
Siegfried and F Mulyawati
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012032
Comparison of effect of chitosan and chitosan nano emulsion on growth performance, water quality and protein retention of Koi fish (*Cyprinus Caprio Koi*)
A M Sari, T Y Hendrawati, Erdawati and A I Ramadhan

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012033

Corrosion inhibitor behavior in typical car radiators

Saifudin, S Munahar and M Setiyo

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012034

The effect of waste treatment on greenhouse gas reduction and final disposal site (TPA)

Sunarto, T Sulistyaningsih, Jainuri and Salahudin

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012035

Characterization of landslide and its earthwork solutions

A Rochim and Pratikso

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012036

Modeling of oil palm frond gasification process in a multistage downdraft gasifier using aspen plus

A R Saleh, B Sudarmanta, S Mujiarto, K Suharno and S Widodo

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012037

Performance and emission characteristics of LPG in a spark-ignition engine

I H A Nagoro, E Suryono, R D Prasetyo and S H A Nandita

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012038

An overview of structural designs and building materials in shell structure for the mosque and the future development

F C Nugrahini

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012039

Sea surface temperature and chlorophyll-a condition of skipjack tuna (*Katsuwonus Pelamis*) catching area in Ternate Island marine waters

U Tangke, F D Silooy, Rochmady and Z Saing

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012040

Rock slope stability analysis using Slope Stability Rating (SSR) method

M U Botjing, N R Janat, T Hilmansyah, Asrafil and Z Saing

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012041

Alternative management of plastic waste

S M Abukasim, F Zuhria and Z Saing

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012042

The mineral content and vitamin d on bone flour fish yellowfin tuna

A Talib, A M Hariati and F Nurhidayati

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012043

Community attitudes towards biogas as an alternative energy and environmental quality improvement

M Z Arifin, M Khoir and B E Purwanto

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012044

Machinery parameter optimization of CNC milling programming towards process time

E M Widodo, T A Purnomo and N Ariyanto

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012045

Reverse innovative design and manufacturing strategy for optimizing production time of customized orthotic insoles with CNC milling

P W Anggoro, A A Anghony, M Tauviquirrahman, J Jamari and A P Bayuseno

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012046

Effectiveness of lavender sitzbath therapy on epissiorraphy of postpartum mother

D P Sari, S S T Hamranani and E Sawitri

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012047

Optimization formula of fast disintegrating tablets Ketoprofen β -cyclodextrin inclusion complex with sodium starch glycolate and crospovidone as the superdisintegrants

N Hidayati, T N S Sulaiman and R Nurhaini

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012048

Risk factors analysis of constipation in patients with acute coronary syndrome

S Zukhri, Setianingsih, R Y Hastuti and I Setyaningsih

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012049

Effects of reading dhikr Asmaul Husna Ya Rahman and Ya Rahim against changes in the level of anxiety in the elderly

N W Agustina, S Handayani and L Nurjanah

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012050

Depo Medroxy Progesterone Acetate (DMPA) injection contraception towards hypertension

C Elsera, P R Kusumaningrum, A Fitriyanti and A Murtana

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012051

Application of wavelet decomposition in volcanic seismic data

Dairoh and W Suryanto

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012052

Comparison of radiograph image information on lumbar vertebrae examination using the application of the anode heel effect theory

E P Adi and M Iqbal

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012053

Spectrum properties of self-adjoint operator

A Ekayanti and C R Indrati

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012054

Ultrasonic wave as anti-bacteria of coliform in the Kahayan River, Palangka Raya, Indonesia

L Hakim, S Sunariyati, Karelius, N Kurniawati, W Krestina and D A P Wardani

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012055

Apology response strategies used by Indonesian EFL fresh graduates: on gender and academic achievement

S Waluyo and S Sutiyatno

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012056

Students' representation based on high order thinking skills for the concept of light

S D Fatmaryanti, Ashari and V S Wahidah

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012057

The effect of problem-based learning on high school students' problem-solving skill and comprehension of biological concept based on their academic performance

F I Taharu, Safilu and L Aba

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012058

Edutainment with video scribe in thematic learning

N D Shalikhah and ANDT Mardiana

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012059

Enhanced electrical conductivity of counter electrode using hybrid of reduced graphene oxide assisted with customised triple-tail surfactant with multiwalled carbon nanotubes

Fatiatun, Firdaus, S Jumini, A B Suriani, P Marwoto, K M Wibowo and B Astuti

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012060

The influence of mathematical basic concept of materials based on internalization of Islamic values against religious attitude

N Ulia, Y Sari, S Yustiana and M Hariyono

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012061

Characteristic modifications of magnesium and its alloy for future implant material - Review

R Afandi, Sutyoko and Lutyatmi

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012062

CFD analysis of vertical axis wind turbine using ansys fluent

A A Afif, P Wulandari and A Syahriar

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012063

Utilizing a web-based technology in blended EFL academic writing classes for university students

D Turmudi

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012064

Darrieus type vertical axis wind turbine (VAWT) design

S W Wasiati, F A Augusta, V R P Purwanto, P Wulandari and A Syahrirar

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012065

Vertical axis wind turbine analysis using MATLAB

F A Augusta, A Al Afif, P Wulandari and A Syahrirar

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012066

West Java tourism geographic information system design using adobe AIR

Suhendi and A Rahmah

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012067

Fuzzy-PI algorithm application to controlling servo motor position using microcontroller AVR

Rahmat and Wiyono

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012068

Android based learning application for Wudhu and Tayamum using augmented reality technology

S P Dewi, I P Astuti, G A Buntoro, I Widaningrum and A R Yusuf

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012069

Using 3D animation combined with augmented reality for promotion media: Case study of STMIK Bina Patria

W Priyoatmoko and F N Arifah

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012070

Designing parallel computing using raspberry pi clusters for IoT servers on apache Hadoop

S Nugroho and A Widiyanto

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012071

Usability evaluation of university website: a case study

P Sukmasetya, A Setiawan and E R Arumi

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012072

Comparative study of indirect space vector and venturini modulation for matrix converter fed induction motor

M P Jati, E Purwanto and B Sumantri

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012073

Development of learning material of integer and fractions based on interactive multimedia with Islamic values

J Ahmad, I I Handayani and S Rizki

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012074

Proteus as a virtual simulation to improve readiness and process skills in laboratory experiment

Firdaus, Fatiatun, S Jumini, E Trisnowati and D Dahnuss

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012075

The relation of compressive strength and tensile strength of bamboo fibber for soil stabilization

J Siswanto, K Latifah, B Supriyadi, A Rochim and F Alzami

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012076

The potential mapping of the needs of appropriate technology of cattle farm

R A Purnomo, J J Sarungu, B R Samodro, T Mulyaningsih, E Gravitiani and A Gunardi

[+ Open abstract](#)[View article](#)[PDF](#)**OPEN ACCESS**

012077

Prototype design of automatic plant watering equipment with soil moisture detection system based on arduino uno microcontroller: case study of chili plant

A Rosadi, A Fauzan and Winarno

[+ Open abstract](#)[View article](#)[PDF](#)

-
- OPEN ACCESS** 012078
Preliminary design and soil moisture sensor yl-69 calibration for implementation of smart irrigation
I Setyowati, D Novianto and E Purnomo
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012079
Analysis of braking force efficiency measurements for various braking strategy applied for vehicle tested on roller brake tester
R M Firdaus, B Supriyo and A Suharjono
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012080
Design and consideration of off-board lithium-ion battery charger for electric vehicle
M R Rusli, A Mukhlisin, J Raharjo, M N Yuniarto, A Wikarta and H Haerudin
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012081
MERA (motorcycle emergency ride assistance): plug-in for accident detection and notification
S Balafif, D Purnomo and T Haryanti
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012082
Techno-economic analysis of satellite implementation as a broadband internet provider in Indonesia
R Mubarak, S Budiyo and P Wulandari
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012083
Development of learning material of integer and fractions based on interactive multimedia with islamic values
J Ahmad, I I Handayani and S Rizki
[+ Open abstract](#) [View article](#) [PDF](#)
-
- OPEN ACCESS** 012084
Study of rare earth elements and heavy metals in tin tailing from mining activities on North Bangka Island
D E Andini and F I P Sari
[+ Open abstract](#) [View article](#) [PDF](#)
-

OPEN ACCESS

012085

Analysis on hots-based question items of natural science subject in elementary school exam at academic year 2018

Y Sari and A P Cahyaningtyas

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012086

Preliminary sandstone reservoir depth prediction with pre-processing data using principle component analysis (PCA) and partial least square (PLS) based on well logging data attribute

E Utami, M H Purnomo, R F Rizki and T R Biyanto

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012087

Utilization of fatty acids from the edible oil industry in synthesis of 2-hydroxy propyl palmitate as a bioaditive solar fuel

R Y P Burhan, Y Zetra, Pusparatu, Suprpto and A T Hidayat

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012088

Catalytic isomerization of n-hexane over beta (BEA) zeolite by dry-gel convention (DGC) and hydrothermal (HTS) methods

Pusparatu and Y Sugi

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012089

Usability analysis of disaster information systems using usability testing

T A Purnomo, R A Widyanto, A Setiawan, P Hendradi and P Suksmasetya

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012090

Implementation of the level of detail method on augmented reality android-based applications

R A Syaputra and A Widiyanto

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012091

Readiness analysis of accreditation data: a case study for Indonesian higher education

A Primadewi, M Hanafi, D Sasongko, A Setiawan, E R Arumi, Sunarni, S Nugroho and E U Artha

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012092

Three-phase electric motor isolation diagnosis modelling caused unbalance voltage using radial basis function network

A Sahrin and M H Purnomo

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012093

Evaluation of the accuracy of winnowing, rabin karp and knuth morris pratt algorithms in plagiarism detection applications

I Widaningrum, D Mustikasari, R Arifin and H A Pratiwi

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012094

Blog-based mathematics learning devices

Ismail, Fitriani, Takdir, P Sudirman and Umar

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012095

Evaluation of wakafMu fundraising platform using HOT-FIT method

E U Artha, F Medias and Z B Pambuko

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012096

Enhancement of solar photovoltaic using maximum power point tracking based on hill climbing optimization algorithm

A Ulinuha and A Zulfikri

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012097

Real time optimization of low temperature shift converter of carbon monoxide in an industrial ammonia plant

S Y Agnesty, H H Niam, M A Wahyudi, M Yulyana and T Srianana

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012098

Experiment electrical motorcycle used solar energy with wireless transfer energy method for transportation in isolated regions

W Widjanarka and S Sutiyatno

[+ Open abstract](#)

[View article](#)

[PDF](#)

OPEN ACCESS

012099

Implementation of AES cryptography and twofish hybrid algorithms for cloud

K I Santoso, M A Muin and M A Mahmudi

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012100

Decision strategy for landslide event based on 4 parameters

P Herlambang, A Suharjono and M Mukhlisin

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012101

Microwave heating as an alternative lifting method for the heavy oil deposits

E Indriani and Purnomosidi

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012102

Coastal environment baseline on Seloko Island, Batam City, Indonesia

Mubarak, Y Badrun and S F Retnawaty

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012103

Performance and soot emissions from direct injection diesel engine fueled by diesel-jatropha-butanol-blended diesel fuel

Syarifudin and Syaiful

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012104

The influence of substrate bias and sputtering pressure on the deposited aluminium nitride for magnetoelectric sensors

H Suharyadi

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012105

Calibration of pH and oxygen sensors applied to aquaponic system

D Novianto, S Prajoko, I Setiyowati and E Purnomo

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012106

Anti-forensics: the image asymmetry key and single layer perceptron for digital data security

D Mualfah, Y Fatma and R A Ramadhan

[+ Open abstract](#) [View article](#) [PDF](#)

OPEN ACCESS

012107

Reverse innovative design and manufacturing strategy for optimizing production time of customized orthotic insoles with CNC milling

P W Anggoro^{1,3*}, A A Anhony³, M Tauviqirrahman², J Jamari^{2,3}, and A P Bayuseno^{2,3}

¹ Department of Industrial Engineering, Faculty of Industrial Technology, University of Atma Jaya Yogyakarta, Yogyakarta, Indonesia

² Department of Mechanical Engineering, Diponegoro University, Indonesia

³ Siti Badriyah Undip Research Group, Semarang, Indonesia

*Email: pauluswisnuanggoro@gmail.com

Abstract. Reverse innovative design (RID) of insole shoe orthotics for patients with diabetes and the manufacturing strategy in optimizing the production time of the insole were examined in the present work. The plantar surface of the feet from two female patients was scanned using a 3D scanner yielding a 3D mesh foot for each patient resulting in an STL file format. The geometric shapes of the 3D models of the feet were fitted very well using curve based surface modeling (CBS-modeling) for insole orthotics design and integrated with CAM (computer-aided manufacturing). Optimization of the manufacturing time was simulated in CNC milling with the Taguchi approach. The manufacture of the optimal insole design was achieved at the optimum machining parameters such as toolpath strategy (A) with raster machining, spindle speed (B) of 15000 rpm, feed rate (C) of 900 mm/minutes, and step over (D) about 0.30 mm. The optimal design of the orthotic insole has the geometric tolerance (D) of 0.75 mm for patient 1 and 1.50 mm for patient 2. The optimal machining time for the insole of patient 1 is 3.79 and 4.02 hours for patient 2. The optimal machining time for the insole of patient 1 is 227.48 minutes and 241.65 minutes for patient 2. These valuable data are needed for the real manufacturing process of insole material in CNC milling.

1. Introduction

Three-dimensional (3D) scanning, computer aided design (CAD), and computer-aided manufacturing (CAM) have played a significant role in manufacturing foot molds and custom foot orthotics components [1-3]. The availability of CAM software for facilitating CNC machines in the manufacture of ankle foot orthotics (AFO) yielded a product with excellent dimensional accuracy, good manufacturing precision, and performance similar to handcrafted AFO's [3]. Additionally, recent studies demonstrated the manufacture of orthosis by a CNC machine yielded a product with positive subjective comfort ratings and similar to the biomechanical gait parameters of orthoses fabricated using traditional methods [4]. Correspondingly, 3D scanning tools, CAD, and CNC machines are the most compact tools available on the market for many design professionals because these systems are easily approachable and affordable, as well as having a tremendous clinical applicability in the designing of insole shoe



orthotics [5].

Further, the use of CAD in the shoe and sandal industry is necessary because it can shorten the presentation time of a novel product for consumers and reduce the product development costs [5]. Currently, many CAD tools are available such as Inventor, Solidworks, Power SHAPE, Art CAM, Toolmaker, Copy CAD, the PS Mold Maker, and Ortho model, which can assist design engineers in quickly bringing the concept about with realistic precision and consistent with the 3D CAD models [6]. Additionally, the availability of CAD software can help for various 3D models leading to shifting product development from the physical model to digital ones or from the 2D drawing process design of the 2.5D / 3D image model [1, 6]. Here 3D modeling has become an important part of the digital development process that may include design, modeling, and simulation [1]. If a digital form of a similar product for a new design is available in the database, searching techniques can be used to find product models with similar and fixed designs [1, 9, 12-14]. In this way, a novel design can be improved by reuse, in whole or in part, from a previous design.

As a response to the rapid progress in the 3D data acquisition, reverse engineering (RE) has gained widespread acceptance in the design community. During this time, RE can be used for designing or modifying a product from an existing product. Now RE plays an important role within the company for engineering design. A number of studies on the RE product design of shoe insole orthotics have been also reported [3, 5, 6]. Here, the output of 3D scanning of a foot model in the form of a 3D mesh or point cloud can be directly processed on 3D printers or CNC machines [14, 15]. However, most of the previous studies have only focused on the development of RID (Reverse Innovative Design) for the insole shoe orthotics without performing an optimized design approach. After the 3D scanning process of obtaining foot images and converting them into the digital form data, the designed model can be directly fabricated by additive manufacturing through (3D) printing or a CNC machine [5, 8, 9, 13]. The utilization of a CNC machine for manufacturing CAD shoe insoles based on models of the normal human foot is very common, but this manufacturing process was done without the levels of design optimization in CAE as required in the method of RID [1, 12, 13] that was shown in Figure 1

The main objective of present research is to investigate the RID application for designing custom insole shoe orthotics for patients with diabetes. In this way, characteristics of the patient's foot surface are obtained at once from the 3D data scan, while Geomagic Studio X is used to digitize the geometric pattern in 3D CAD systems.

2. Material and Method

2.1. Use of 3D scanner for measurement of the foot

In the present study, the feet of two female patients between 50-75 years old and weight between 55-70 kg were scanned for the 3D model of insole shoe orthotics design. Both patients' feet have characteristics of a bone protruding near the second toe of their feet (swollen bone). Figure 1 presents the workflow for designing the 3D model of the insole shoe orthotics. The 3D data acquisition process started by a 3D scan of the foot using a non-contact HandySCAN scanner 700TM that is insensitive to vibration and unable to stick to the object. The 3D scanner is equipped with a white light laser to make data processing faster in the range from 5-10 minutes and to produce accuracy levels of about 5 μ m.

The HandySCAN 700TM is equipped with seven intersecting laser beams to speed up shooting with a high precision of about 0.030 mm (0.0012 in). The process of 3D scanning the foot surface in both patients was done by attaching small black stickers as sensors on some parts of the surface contour of the foot.

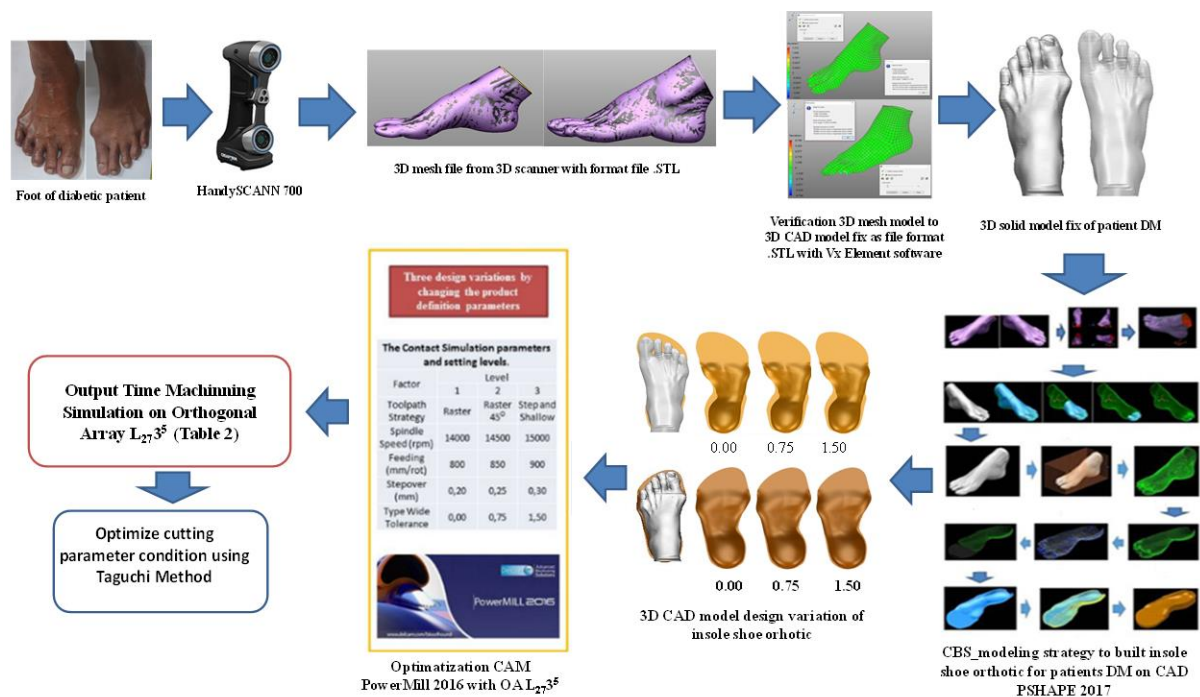


Figure 1. Methodology of the RID applied on special customized iso_product DM

2.2. Processing the STL file into a 3D mesh foot

3D CAD data of the foot were initially verified by color mapping with Geomagic Studio X software before they could be processed further. This verification enabled the size difference to be distributed in the input data of the 3D mesh and results of the RE are as represented with the corresponding color symbol. In this way, the color mapping was performed by comparing the 3D CAD surface and the 3D mesh STL with the same orientation. Comparative analysis of the characteristics of Geomagic Studio X and PowerSHAPE 2016 was performed in the present study. This color mapping took the sample points on the two images, which were compared and calculated for the gap between the dots, and subsequently displayed in shades of red to blue. For this purpose, the software of Geomagic Studio X was used to capture the output of the 3D scanner in digital form, which was displayed on the computer screen. Geomagic Studio X got data directly from a file that had been already scanned, while 3D scanning checked whether the processing of the network to get a 3D solid model mounted on the foot.

2.3. Base curved modeling of 3D CAD insoles

PowerShape 2016 software developed the 3D model of insole orthotics through several stages. The first stage included an application of CBS modeling for the initial 3D digital data that had been verified in the previous phase (Table 1). The CBS modeling reconstructed the 3D model of the insole shoe orthotics with an accurate result. This approach has been successfully applied for designing insole shoe orthotics for feet both without and with deformities [9, 12-14]. Accordingly, CBS modeling yielded a well-formed 3D surface using the created curves.

Furthermore, the solid 3D model of insole shoe orthotics could be obtained with a shaped fit to the original form of the foot surface. In this way, the software of PowerShape 2016 created design variations by changing the definition parameters of the product. In this way, the original 3D CAD models were enhanced by insole design parameters in the direction of axis X-Y (2D). This magnification provided a wide tolerance of 0.0, 0.75, and 1.50 dmm. The results of the design variables are considered as one of the factors to determine the optimal new designs.

2.4. The manufacture of insole shoe orthotics with a simulation in CAM

The optimal design of the new 3D model of insole shoe orthotics, at this stage, was obtained by performing a simulation-based Taguchi optimization in CAM [12, 13, 14]. Prior to the simulation, the selection of the cutting condition parameters is essential with respect to machining time. This condition is valuable data for determining the real process of manufacturing the insole with various materials. Five factors were selected as follows: machining toolpath strategy, spindle speed, feed rate, step over, and typical insole product based on the width of the tolerance. The first of the four factors is related directly to the process of machining in CAM and CNC machines. Instead, a factor of typical insole products was included in the orthogonal array (OA) to get the new design of the optimal model. Each factor was assigned three levels. The response was measured as the machining time in the CAM PowerMILL 2016 simulation of each treatment. Orthogonal array in this research is defined as $L_{27}3^4$. There are 27 treatment-appropriate factor levels in OA and are set out to get a response of machining time (Table 2). The machining time was calculated when the cutter milling began in the simulation until the toolpath strategy simulation ended. The process was shown in Figure 2

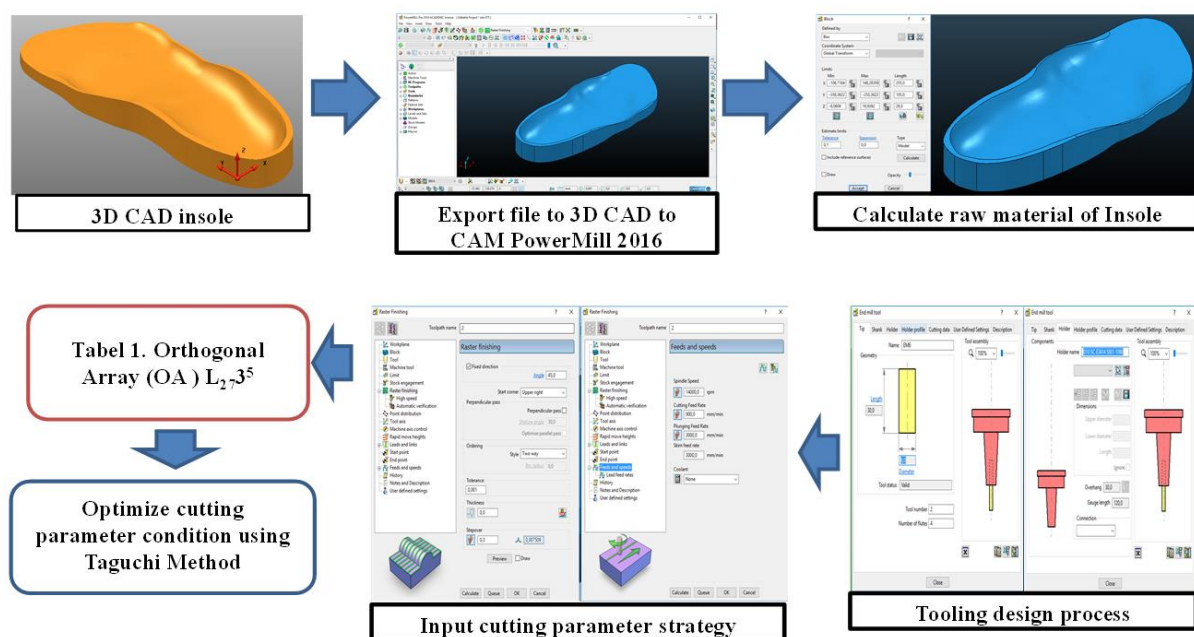


Figure 2. workflow for optimizing simulation process manufacturing of the insole shoe orthotics using CAM

3. Results

3.1. 3D scanning/digitizing of each foot and 3D CAD model of insoles

The shape of the foot for both patients and the results of the output scanning in the STL file and verification results by Geomagic Studio X are given in Figure 3. In this way, the 3D CAD model of the insole with CBS modeling was obtained, while stages of developing 3D CAD insole models from the fixed solid model of each patient's foot are presented in detail in Figure 4. The original 3D CAD model of the insoles that fit the foot surface contours of both patients is presented in Figure 8a. Moreover, the design variations of the insoles by changing the product definition parameters are displayed in Figures 5 b, c. Conversely, the simulation results of the insole shoe orthotics with PowerMILL 2016 on roughing and the finishing processes are given in Figure 2. The manufacturing simulation results of the 3D CAD model in CAM are shown in Figure 6 and the results for each machining time are presented in Table 3. These results were then examined using S/N ratio and ANOVA analysis to determine the significant factors that contributed to the optimum machining time.

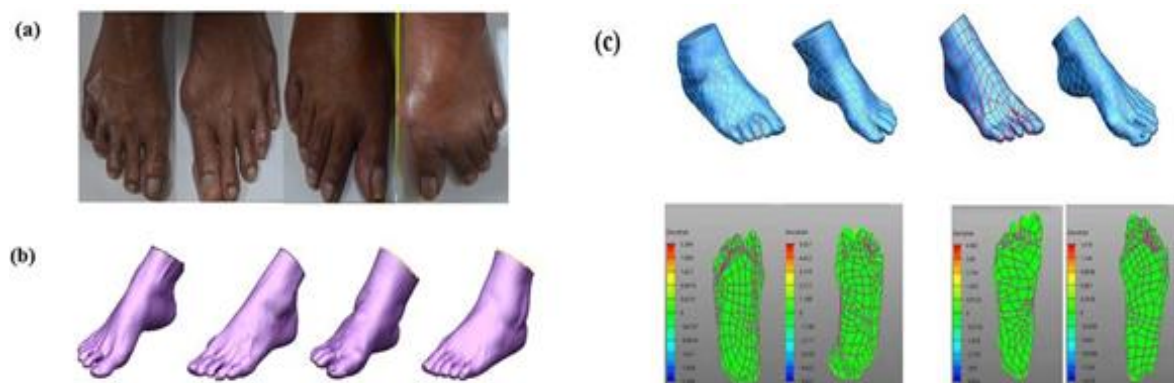


Figure 3. Three Dimensional (3D) Foot model of diabetic patients: (a) physical model of the patient's foot; (b) the output of 3D scanning in term of the STL file format; (c) output verification of 3D solid model of Geomagic Studio X and PowerSHAPE 2016

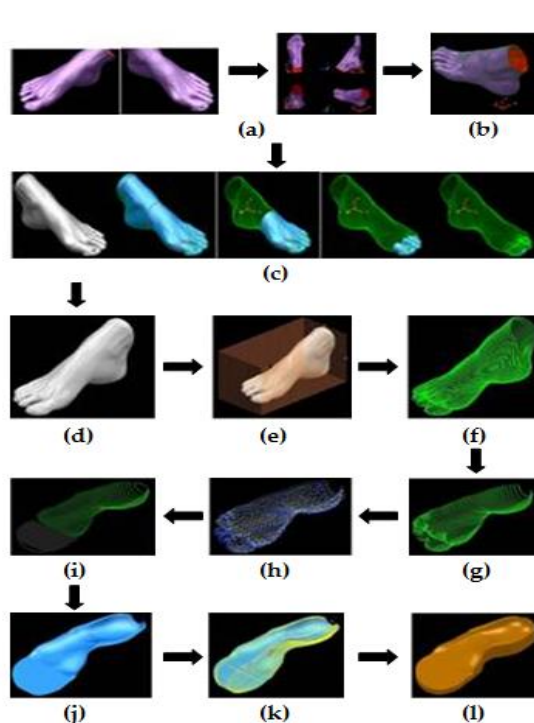


Figure 4. CBS-modeling iso_product DM involved in PowerSHAPE 2016 (a) Mesh importing & pre processes; (b) Rewiring; (c) Repoint, built and verification 3d surface to solid foot with solid doctor; (d) 3D solid model foot from mesh; (e) Oblique processing; (f) Foot wireframe; (g) Wire support; (h) Repoint wireframe curve; (i) Wire reconstruction; (j) Surface generating; (k) Surface curve editing; (l) 3D solid iso_diabetes [12-14]

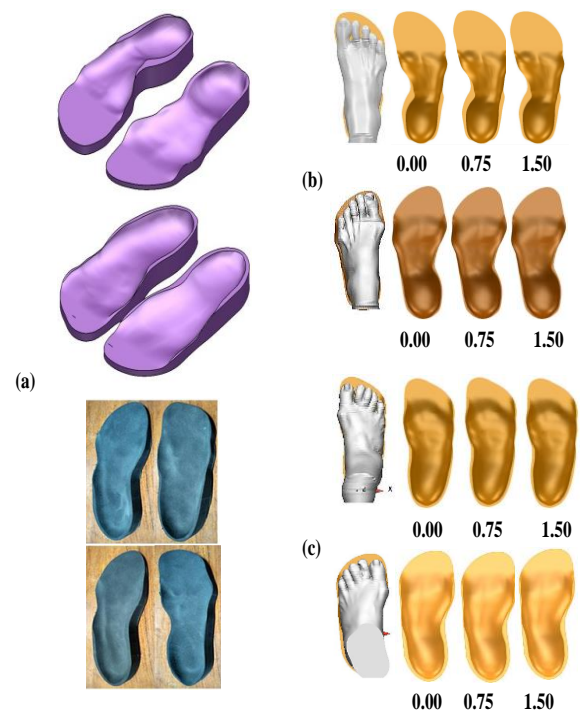


Figure 5. The RID output for the insole shoe orthotics: (a) the two CBS modeling of pairs of the original 3D CAD models and real product ISO_diabetes; (b) the design variations by changing the product parameters of patient 1; (c) the design variations by changing the product parameters of patient 2

3.2. Effect of machining parameters on machining time of the insoles

In the present study, the term 'signal' represents the desired value (mean) for the response characteristic and the term 'noise' relates to the undesirable value (S.D) for the response. Thus, the S/N ratio represents the ratio of the mean to the S.D. In the Taguchi method, the S/N ratio is indicated for the quality of characteristics deviating from the desired value. The performance characteristic for the machining time (T_m) has been taken. Tables 1 and 5 present the results of the ANOVA analysis and the S/N ratio for T_m using the input data from the design of experiments for patients 1 and 2 (Table 1 and table 2).

Table 1. Parameter Control machining

Factor	Level		
	1	2	3
A: toolpath strategy	raster 45	raster 90	step & shallow
B: spindle speed (rpm)	13500	14000	15000
C: feed rate (mm/min)	850	900	950
D: step over (mm)	0,1	0,20	0,30
E: tolerance	0.5	0.75	1.50

Table 2 Experimental design, the measured results and their calculated S/N ratios

No	Code Value						Actual values				Machining Time		Machining Time	
	A	B	C	D	E	tool path	Spindle speed	Feed rate	step over	type of insoles	Simulation of patient 1	Simulation of patient 2	Simulation of patient 1	Simulation of patient 2
							(rpm)	(mm/rot)	(mm)	(mm)	minutes	Minutes	minutes	Minutes
1	1	1	1	1	1	Raster	14000	800	0.20	0.00	320.24	322.40	335.40	337.40
2	1	1	1	1	2	Raster	14000	800	0.20	0.75	318.40	320.40	333.40	335.50
3	1	1	1	1	3	Raster	14000	800	0.20	1.50	316.83	329.83	331.83	334.83
.....														
25	3	3	2	1	1	Step & Shallow	15000	850	0.20	0.00	325.22	328.22	340.22	343.22
26	3	3	2	1	2	Step & Shallow	15000	850	0.20	0.75	380.03	382.03	395.03	397.03
27	3	3	2	1	3	Step & Shallow	15000	850	0.20	1.50	321.70	322.70	336.70	337.70

Table 3(a). Results of the ANOVA for Sq and % Rho for patient 1

SOURCE	Sq	v	MQ	F _{ratio}	Sq'	Rho%
A	10.662,407	1	10662.4	4,2926	10.658,114	25.251
B	65.764,00	1	657.641	0,02648	65,737590	0,156
C	1.957,445	1	1957.45.00	0,78806	1.956,657	4,636
D	27.525,715	1	27525.7	11,08170	27.514,634	65,186
E	2.014,864	1	2014.86	0,81117	2.014,053	4,772
e	0.000	5	0	0	0	
St	42.226	17	2483,89		0,0000127	
mean	2.483,894	27				
ST	0	27			42.209,196	100

Table 3(b). Results of the ANOVA for Sq and % Rho for patient 2

Source	Sq	v	MQ	F _{ratio}	Sq'	Rho%
A	240654.5406	1	240654.5	3.435372	240651.1053	20.208
B	229873.4108	1	229873.4	3.281471	229870.1293	19.303
C	231551.0404	1	231551	3.305419	231547.735	19.444
D	256904.7324	1	256904.7	3.667346	256901.0651	21.573
E	231899.4217	1	231899.4	3.310392	231896.1113	19.473
e	0	5	0	0	0	
St	1190883.146	17	70051.95		0.0000127	
mean	70051.94976	27				
ST	0	27			1190866.146	100

Moreover, Table 3 presents the experimental results corresponding to the S/N ratio and the effect of each machining parameter on T_m at different levels. The F -ratio and % Rho (% contribution) for step over have the highest values in the table, which indicates that during machining of the insole for both patients (1 and 2), step over is more of a significant factor towards machining time than spindle speed and feeding rate. Based on table 3 In this paper, the ANOVA and effect of column were used to investigate the effects of the setting parameter such as toolpath strategy (A), cutting speed (B), feed rate (C), step over (D), and number flute tolerance (E) on R_a value for patient 1 and 2. Table 3.a. shown the F -ratio and the Rho% that indicate the significance level. The F -value (11.08) and Rho% (65.186%) for factor D is the most prominent, which indicates that feed rate (D) was significantly contributed on the optimum value of surface roughness. The second significant factor is toolpath strategy A (25.25%), followed by and spindle speed E (4.77%), feed rate C (4.64%) and cutting speed B (0.156%). Table 3.b. shown the F -ratio and the Rho% that indicate the significance level. The F -value (3.67) and Rho% (21.57%) for factor D is the most prominent, which indicates that feed rate (D) was significantly contributed on the optimum value of surface roughness. The second significant factor is toolpath strategy A (20.21%), followed by cutting speed C (19.44%), tolerance E (19.47%), and cutting speed B (19.3%).

3.3. Optimized machining parameters for the low machining time of the insole

In this study, ANOVA and column effects were used to analyze the effects of toolpath strategy, spindle speed, feed rate, step over, and type of insole shoe orthotics on machining time simulations. Column effects of the Taguchi method as a simplified ANOVA have subjectively identified columns that may influence the response time [11]. The experimental designs were evaluated at a confidence level of 95% (the level of significance is 5%). ANOVA analyses for the machining time (T_m) confirmed that the most effective variable in the T_m value is the step over. The other variables influencing the T_m response are tool path strategy, spindle speed, feed rate, and typical insole product. Therefore, step over (factor D) is the most significant factor affecting T_m value at the reliability level of 95 %.

In the milling operations, the machining time is mainly controlled by the cutting parameters. The S/N ratio analyses of the first patient recommended the optimum machining parameters for minimal T_m corresponding to the combination factors of $A_1B_3C_3D_3E_2$, in which raster machining of toolpath strategy (A) at level 1, spindle speed (B) at level 3 (15000 rpm), feeding factor (C) at level 3 (900 mm/rot), the step over control factor (D) with best results at level 3 (0.3 mm), and type of insole factor (E) at level 2 were obtained. In contrast, the optimum cutting parameters for the second patient corresponded to the factors of $A_1B_3C_3D_3E_3$ in which the toolpath strategy (A) of raster machining at level 1, the spindle speed of factor (B) at level 3 (15000 rpm), the feeding factor (C) at level 3 (900 mm/rot), the step over control of factor (D) at level 3 (0.3 mm), and typical insole of factor (E) at level of 3 could be determined. The results of the optimum cutting parameters are much valuable for designing a machining approach for the insole in real CNC machines. The results of this research have been proven by making an orthotic ankle foot and used by both diabetic patients with good results [9, 13, 14, 15].

4. Conclusions

RID was successfully applied in the design of a 3D foot mesh on the original solid models of both patients, as well as a features-based 3D CAD model with parameter CBS modeling. The design varied by changing the product definition of the parameter and a new design of insole shoe orthotics can be optimized by a CAM simulation. Manufacturing simulations provided that the optimal cutting parameters for patient 1 were raster machining strategy at the toolpath spindle speed of 15000 rpm, the feed rate of 900 mm/minutes, step over of 0.3 mm, and the typical insole product with a wide tolerance 0.75 mm. For patient 2, raster machining strategy at the toolpath spindle speed of 15000 rpm, the feed rate of 900 mm/minutes, step over of about 0.3 mm, and the typical insole product with a wide tolerance of 1.50 mm were recommended. The optimal machining time for the insole production for patient 1 is 3.79 hours and 4.03 hours for patient 2. The results of the optimum cutting parameters can be used in the real manufacturing process in CNC machines.

References

- [1] Ye X, Liu H, Chen L, Chen Z, Pan X, Zhang S 2008 Reverse innovative design - an integrated product design methodology. *Comput. Aided Design*. **vol. 40**, pp. 812-827.
- [2] Buzzi M, Colombo G, Facoetti G, Gabbiadini S, Rizz C 2012 3D modelling and knowledge: tools to automate prosthesis development process. *Int J Interact Des Manuf*. **vol. 6**, pp. 41-53.
- [3] Manmadhachary A, Ravi Kumar Y, Krishnanand L 2016 Improve the accuracy, surface smoothing and material adaption in STL file for RP medical models. *J Manuf Process*. **vol. 21**, pp 46–55.
- [4] Wan FKW, Yick KL, Yu WWM 2017 Validation of a 3D foot scanning system for evaluation of forefoot shape with elevated heels. *Measurement*. **vol. 99**, pp. 134–144.
- [5] Babu TS and Thumbanga RD 2011 Reverse engineering CAD/CAM and process applications in less pattern casting-A case study. *Int J Mech*. **vol. 5(1)**, pp. 40-47.
- [6] Uccioli L 2006 The role of footwear in the prevention of diabetic foot problems. *The diabetic foot. Part of the series contemporary diabetic*. Springer. pp. 523-541.
- [7] Bernab   JA, Germani M, Mandolini M, Mengonia M, Nester C, Preece S, Raffaelli R 2013 CAD tools for designing shoe lasts for people with diabetes. *Computer Aided Design*. **vol. 45**, pp. 977-990.
- [8] Xia Z 2014 Application of reverse engineering based on computer in product design. *Int. J. Multimed. Ubiquitous Eng*. **vol. 9(5)**, pp. 343-353.
- [9] Anggoro PW., Bawono B, Tauviqirrahman M, Jamari J, Bayuseno AP, Wicaksono A 2019 Reverse Innovative Design of Insole Shoe Orthotic for Diabetic Patient. *Journal Engineering Applied Science*. **vol. 14(1)**, pp. 106- 113.
- [10] Taguchi G and Konishi S 1987 Taguchi methods, orthogonal arrays and linear graphs: Tool for quality engineering. *American Supplier Institute, Dearborn*, pp 35-38.
- [11] Ross, PJ 1998 Taguchi techniques for quality engineering: loss function, orthogonal experiments, parameter and tolerance design. *McGraw-Hill*, New York.
- [12] Anggoro PW, Bawono B, Wijayanto A, Jamari J, Bayuseno AP 2016 Parameter optimization of strategies at CNC milling machines Roland Model MDX 40R CAM against surface roughness made insole shoe orthotic Eva rubber foam. *Int J Mechatronic Mech Eng.*, **vol. 06(4)**, pp 96-104
- [13] Anggoro PW, Tauviqirrahman M, Jamari J, Bayuseno AP, Bawono B, Avellina MM 2018 Computer-aided reverse engineering system in the design and production of orthotic insole shoes for patients with diabetes. *Cogent Engineering*, **vol. 5**, pp. 1-20, <https://doi.org/10.1080/23311916.2018.1470916>

- [14] Anggoro PW, Tauviquirrahman M, Jamari J, Bayuseno AP, Wibowo J, Saputro, YD 2019 Optimal Design and Fabarication of Shoe Last of Ankle Foot Orthotics for Patients with Diabetes. *International Journal of Manufacturing, Materials and Mechanical Engineering*, **vol. 9**, issues 2, pp 62-80
- [15] Anggoro, P.W., Bawono, B., Tauviquirrahman M., Jamari J., Bayuseno A.P. (2019): Design and manufacturing orthotic shoes insoles for optimal surface roughness using CNC milling. *Journal Engineering and Science Technology*, **vol. 14(4)**, pp 1799-1819.