

# The 5th International Conference on Industrial, Mechanical, Electrical, and Chemical Engineering 2019 (ICIMECE 2019)

Surakarta, Indonesia • 17–18 September 2019

**Editors** • Wahyudi Sutopo, Miftahul Anwar, Muhammad Hamka Ibrahim,  
Hari Maghfiroh, Chico Hermanu Brilianto Apribowo,  
Sutrisno Ibrahim and Muhammad Hisjam



[HOME](#)[BROWSE](#)[MORE ▼](#)

## Editorial Board

### [Editors](#)

### [Journal Development Team](#)


## Editors

### Deputy Editors:



#### [Javier E. Garay](#)

University of California San Diego,  
San Diego, CA, USA

 Javier E. Garay is a professor in the department of Mechanical and Aerospace Engineering and the Materials Science and Engineering Program at the Jacobs School

of Engineering at University of California, San Diego (UCSD). He received his B.S. in Mechanical Engineering, his M.S. and Ph.D in Materials Science and Engineering all from the University of California, Davis. During his PhD studies, he also worked at the Lawrence Livermore National Laboratory where he studied material defects using positron annihilation spectroscopy. Prior to his position at UCSD, he was a professor at UC Riverside where he also served as Chair of the Materials Science & Engineering Program.

As the director of the Advanced Material Processing and Synthesis (AMPS) Lab at UCSD, Professor Garay focuses his research on materials property measurements, the integration of materials in devices with application in optical devices, magnetic devices, thermal energy storage/ management, and materials synthesis and processing with an emphasis on designing the micro/nanostructure of bulk materials/thin films for property optimization. He is also particularly interested in understanding the role of the length scale of nano-/ micro-structural features on light, heat and magnetism.



**A. T. Charlie Johnson Jr.**

University of Pennsylvania,  
Philadelphia, PA, USA

A.T. Charlie Johnson is a professor of physics in the Department of Physics and Astronomy at the University of Pennsylvania. He received his B.S. in physics from Stanford University and his Ph.D. in physics from Harvard University. He did postdoctoral fellowships at the Delft University of Technology (Applied Physics) and NIST (Cryoelectronic Metrology). His honors include the Christian R. and Mary F. Lindback Foundation Award for distinguished teaching at Penn, the Jack Raper Outstanding Technology Directions Paper Award of the International Solid State Circuit Conference, an Alfred P. Sloan Research Fellowship, and a Packard Fellowship for Science and Engineering.

Dr. Johnson's research is focused on the nano-scale transport properties (charge, energy, spin, etc.) of nanostructures and single molecules, including carbon nanotubes, graphene, DNA, synthetic proteins, and other biomolecules. He is particularly interested in the physical properties of hybrid nanostructures and their use in molecular sensing. Other research interests include the development of scanning probe techniques for electronic property measurement of nanomaterials and



nanodevices, molecular electronics and nanogaps, local probes of nanoscale systems, and nanotube and nanowire electronics.

---



### Ben Slater

University College London (UCL),  
London, United Kingdom

Ben Slater is a reader at UCL Chemistry. He received his BSc in chemistry from the University of Nottingham and was awarded his PhD at the University of Reading. He did postdoctoral work at the Royal Institution of Great Britain (Ri) and became an assistant director of the Davy Faraday Research Laboratory at the Ri in 1999. He joined UCL Chemistry in 2007 and was awarded the Royal Society of Chemistry Barrer prize in 2008.

Dr. Slater's research is focused on using atomistic computer simulation to understand and predict the structure and properties of materials. He has published extensively in the area of porous materials (including zeolites and metal-organic frameworks) and water ices. He has a particular interest in defects in materials and surface mediated processes, such as crystal growth.

---



### Masaaki Tanaka

The University of Tokyo,  
Tokyo, Japan

Masaaki Tanaka is a professor at the Department of Electrical Engineering & Information Systems Graduate School of Engineering, University of Tokyo. He received his Ph.D. in electronic engineering from the University of Tokyo in 1989. In 1992, he joined Bell Communications Research (Bellcore) at Red Bank, New Jersey, as a visiting research scientist. Since 1994, he has been at the University of Tokyo as an associate professor and professor.

Dr. Tanaka's main research field is spin electronics ("spintronics"), in which the spin degrees of freedom are used in artificially synthesized materials. Among the areas of his specific research are epitaxial growth, structural characterizations, electronic/optical/magnetic/spin-related properties (in particular, spin-dependent transport and magneto-optical properties), and device applications of various new structures. His research on structures and devices includes ferromagnetic metal / semiconductor hybrid structures, III-V-based magnetic semiconductors and their

heterostructures, group-IV-based magnetic semiconductors, ferromagnetic nanoparticles and semiconductor hybrid heterostructures, delta doping of magnetic impurities in semiconductor heterostructures, and new spin transistors (e.g., spin-MOSFET) and reconfigurable logic devices.

---



**Enge G. Wang**  
Peking University,  
Beijing, P. R. China

Professor Enge G. Wang is a professor of physics at Peking University and an academician at the Chinese Academy of Sciences.

Dr. Wang's research focuses on surface physics; the approach is a combination of atomistic simulation of nonequilibrium growth, chemical vapor deposition of light-element nanomaterials, and water behaviors in confinement system. He and his coworkers also predicted a three-dimensional Ehrlich-Schwoebel barrier, which attracted News and Views in Nature (June 2002). Another contribution is the model proposal and experimental validation of a true upward atomic diffusion. This was reported in Physics News Update in June 2003 and News and Views in Nature as well as Science Week in June 2004.

His work on water-surface coupling and the strength of hydrogen bonds at the interfaces provides a fundamental understanding of water on surface at the molecular level.

---

**Associate Editors:**

**Saman Alavi**

University of Ottawa, Ottawa, Ontario, Canada

**Alexey Arefiev**

University of California San Diego, San Diego, CA, USA

**Dario Arena**

University of South Florida, Tampa, FL, USA

**Renkun Chen**

University of California San Diego, San Diego, CA, USA



**Christophe Detavernier**

Universiteit Gent, Gent, Belgium

**Mingdong Dong**

Aarhus University, Aarhus, Denmark

**Shridhar R. Gadre**

Indian Institute of Technology Kanpur, Kanpur, India

**Fei Gao**

University of Michigan, Ann Arbor, MI, USA

**Wei-Xi Huang**

Tsinghua University, Beijing, China

**Michael Keidar**

George Washington University, Washington D. C., USA

**Irena Knezevic**

University of Wisconsin - Madison, Madison, WI, USA

**Wakana Kubo**

Tokyo University of Agriculture and Technology, Tokyo, Japan

**Jyotsana Lal**

Argonne National Laboratory, Argonne, IL, USA

**Dattatray Late**

AUM, Centre for Nanoscience and Nanotechnology, Mumbai, India

**Davide Massarotti**

Universita' degli studi di Napoli Federico II, Napoli, Italy

**Marian Paluch**

University of Silesia, Katowice, Poland

**Ras B. Pandey**

University of Southern Mississippi, Hattiesburg, MS, USA

**Wilfrid Prellier**

Laboratoire CRISMAT, Caen, France

**Alfons Schulte**

University of Central Florida, Orlando, FL, USA



**Takasumi Tanabe**

Keio University, Yokohama, Japan

**Claudia Wiemer**

National Research Council of Italy, Institute for Microelectronics and Microsystems,  
Agrate Brianza (MB), Italy

**Eva Zurek**

University at Buffalo, Buffalo, NY, USA

Editors of *Applied Physics Reviews*, *Biophysics Reviews*, *Chemical Physics Reviews*, *Applied Physics Letters*, *Journal of Applied Physics*, *The Journal of Chemical Physics*, *APL Bioengineering*, *APL Materials*, *APL Photonics*, *Biomicrofluidics*, *Chaos*, *Journal of Mathematical Physics*, *Journal of Renewable and Sustainable Energy*, *Physics of Fluids*, *Physics of Plasmas*, and *Review of Scientific Instruments* may act as Guest Editors for manuscripts transferred to *AIP Advances*.



# AIP

## Conference Proceedings

[HOME](#)[BROWSE](#)[MORE ▾](#)

### • Table of Contents

## THE 5TH INTERNATIONAL CONFERENCE ON INDUSTRIAL, MECHANICAL, ELECTRICAL, AND CHEMICAL ENGINEERING 2019 (ICIMECE 2019)

[< PREV](#) [NEXT >](#)

Conference date: 17-18 September 2019

Location: Surakarta, Indonesia

ISBN: 978-0-7354-1971-1

Editors: Wahyudi Sutopo, Miftahul Anwar, Muhammad Hamka Ibrahim, Hari Maghfiroh, Chico Hermanu Brilianto Apribowo, Sutrisno Ibrahim and Muhammad Hisjam

Volume number: 2217


Published: Apr 13, 2020

DISPLAY : 20 50 100 all

[BROWSE VOLUMES](#)



## PRELIMINARY


 No Access . April 2020

### **Preface: The 5th International Conference on Industrial, Mechanical Electrical, and Chemical Engineering 2019 (ICIMECE 2019)**

AIP Conference Proceedings 2217, 010001 (2020); <https://doi.org/10.1063/12.0000222>



## PLENARY AND KEYNOTE PAPERS

 No Access . April 2020

### **Risk estimation of construction activities of buildings**

Alusine Barrie, Jafri Mohd Rohani and Norizah Redzuan

AIP Conference Proceedings 2217, 020001 (2020); <https://doi.org/10.1063/5.0004435>

SHOW ABSTRACT



 No Access . April 2020

### **Interface damage mechanics in fiber reinforced plastic**




[BROWSE VOLUMES](#)

Bentang Arief Budiman and Putri Nur Halimah

AIP Conference Proceedings **2217**, 020002 (2020); <https://doi.org/10.1063/5.0000808>

SHOW ABSTRACT



 No Access . April 2020

## Detection of forest fire used multi sensors system for peatland area in Riau Province

Evizal Abdul Kadir, Sri Listia Rosa and Rizdqi Akbar Ramadhan

AIP Conference Proceedings **2217**, 020003 (2020); <https://doi.org/10.1063/5.0000493>

SHOW ABSTRACT



 No Access . April 2020

## Drilling of AISI 316L stainless steel: Effect of coolant condition on surface roughness and tool wear

Ahmad Zubair Sultan, Safian Sharif and Denni Kurniawan

AIP Conference Proceedings **2217**, 020004 (2020); <https://doi.org/10.1063/5.0000548>

SHOW ABSTRACT



BROWSE VOLUMES

## Project risk management in Indonesia: A research overview

Budi Hartono

AIP Conference Proceedings 2217, 020005 (2020); <https://doi.org/10.1063/5.0000621>

SHOW ABSTRACT



 No Access . April 2020

## Review on generation expansion planning optimization by considering government policy implementation impact

Sarjiya and Rizki Firmansyah Setya Budi

AIP Conference Proceedings 2217, 020006 (2020); <https://doi.org/10.1063/5.0000734>

SHOW ABSTRACT



 No Access . April 2020

## The bio-mimicry method in creative process of new product design inspired by nature solution

Ratna Purwaningsih, Purnawan Adi Wicaksono and Singgih Saptadi

AIP Conference Proceedings 2217, 020007 (2020); <https://doi.org/10.1063/5.0000926>

SHOW ABSTRACT



BROWSE VOLUMES



No Access . April 2020

## Robot control systems using bio-potential signals

Minoru Sasaki, Kojiro Matsushita, Muhammad Ilhamdi Rusyidi, Pringgo Widyo Laksono, Joseph Muguro, Muhammad Syaiful Amri bin Suhaimi and Waweru Njeri

AIP Conference Proceedings 2217, 020008 (2020); <https://doi.org/10.1063/5.0000624>

SHOW ABSTRACT



No Access . April 2020

## Performance comparison of fleet management system using IoT node device based on MQTT and HTTP protocol

Harry Kasuma Aliwarga, Alwy Herfian Satriatama and Bruno Fandi Adi Pratama

AIP Conference Proceedings 2217, 020009 (2020); <https://doi.org/10.1063/5.0003076>

SHOW ABSTRACT



No Access . April 2020

## Synthesis of hydroxyapatite from seashells via calcination at various temperature using microwave and furnace

Seow Desmond, Denni Kurniawan and Fethma M. Nor

AIP Conference Proceedings 2217, 020010 (2020); <https://doi.org/10.1063/5.0000902>

SHOW ABSTRACT



BROWSE VOLUMES

## CONTRIBUTED PAPERS



No Access . April 2020

### **Simulation study on a torsional stiffness test apparatus for space tube frame chassis**

Rafli Alnursyah, Ubaidillah, Hashfi Hazimi, Hanna Nursya'bani and Nurul Muhayat

AIP Conference Proceedings 2217, 030001 (2020); <https://doi.org/10.1063/5.0003033>

SHOW ABSTRACT



No Access . April 2020

### **Analysis curve of maximum power and torque turbine generated by vertical axis wind turbine based on number of blades**

Langlang Gumilar, Muhammad Afnan Habibi, Dwi Prihanto, Hendro Wicaksono, Jade Rosida Larasati and Achmad Gunawan

AIP Conference Proceedings 2217, 030002 (2020); <https://doi.org/10.1063/5.0000709>

SHOW ABSTRACT



No Access . April 2020

### **Optimalization harmonic shunt passive filter using detuned reactor and capacitor bank to improvement power quality in**



[BROWSE VOLUMES](#)

Langlang Gumilar, Denis Eka Cahyani, Arif Nur Afandi, Dezetty Monika and Stieven Netanel Rumokoy

AIP Conference Proceedings **2217**, 030003 (2020); <https://doi.org/10.1063/5.0000710>

SHOW ABSTRACT



 No Access . April 2020


## Problem analysis of solar water pump installations in Indonesia

Danar A. Susanto, Utari Ayuningtyas, Hermawan Febriansyah and Meilinda Ayundyahrini

AIP Conference Proceedings **2217**, 030004 (2020); <https://doi.org/10.1063/5.0000674>

SHOW ABSTRACT



 No Access . April 2020

## Challenges for standardization: Hyperspectral technology to supports Indonesian food security

Meilinda Ayundyahrini, Endi Hari Purwanto, Reza Lukiawan and Ajun Tri Setyoko

AIP Conference Proceedings **2217**, 030005 (2020); <https://doi.org/10.1063/5.0000726>

SHOW ABSTRACT



BROWSE VOLUMES


## Bontang LNG plant operational strategy to manage ethane refrigerant inventory during low NGL extraction

Rendra Prasetyo and Putri Cahyaning Prabandoro

AIP Conference Proceedings 2217, 030006 (2020); <https://doi.org/10.1063/5.0000597>

SHOW ABSTRACT



 No Access . April 2020


## Performance comparison in simulation of Mandelbrot set fractals using Numba

Gilbert Gutabaga Hungilo, Gahizi Emmanuel and Pranowo

AIP Conference Proceedings 2217, 030007 (2020); <https://doi.org/10.1063/5.0000636>

SHOW ABSTRACT



 No Access . April 2020

## An experimental study of a car maintenance workshop layout optimization

Agung Premono, Matheus Victor and Himawan Hadi Sutrisno

AIP Conference Proceedings 2217, 030008 (2020); <https://doi.org/10.1063/5.0000585>

SHOW ABSTRACT



BROWSE VOLUMES

 No Access . April 2020

## Numba acceleration of image steganography using Mendelbrot set fractals

Gahizi Emmanuel, Gilbert Gutabaga Hungilo and Pranowo

AIP Conference Proceedings 2217, 030009 (2020); <https://doi.org/10.1063/5.0000526>

SHOW ABSTRACT



 No Access . April 2020

## Clustering of the water characteristics of the Cirata reservoir using the k-means clustering method

Isma Masrofah and Bramantiyo Eko Putro

AIP Conference Proceedings 2217, 030010 (2020); <https://doi.org/10.1063/5.0000672>

SHOW ABSTRACT



 No Access . April 2020

## Production of $\text{LiNi}_{0.6}\text{Mn}_{0.2}\text{Co}_{0.2}\cdot 2\text{O}_2$ via fast oxalate precipitation for Li-ion

Arif Jumari, Khikmah Nur Rikhy Stulasti, Refarmita Nur Halimah, Agus Purwanto, Luthfiatul Azizah Aini and Rahmawati Mintarsih


AIP Conference Proceedings 2217, 030011 (2020); <https://doi.org/10.1063/5.0000646>

SHOW ABSTRACT



BROWSE VOLUMES



 No Access . April 2020


## Deep learning for recognition of Javanese batik patterns

Danis Aditya Mardani, Pranowo and Albertus Joko Santoso

AIP Conference Proceedings 2217, 030012 (2020); <https://doi.org/10.1063/5.0000686>

SHOW ABSTRACT



 No Access . April 2020

## Emotion recognition based on deep learning with auto-encoder

I. Made Nomo Wiranata, Pranowo and Albertus Joko Santoso

AIP Conference Proceedings 2217, 030013 (2020); <https://doi.org/10.1063/5.0000679>

SHOW ABSTRACT



 No Access . April 2020

## Classification of Indonesian coffee types with deep learning

Alfan Rivalto, Pranowo and Albertus Joko Santoso

AIP Conference Proceedings 2217, 030014 (2020); <https://doi.org/10.1063/5.0000678>

SHOW ABSTRACT



BROWSE VOLUMES



No Access . April 2020

## Synthesis of Co/Ni – Hydroxyapatite by electrochemical method

Adrian Nur, Anatta Budiman, Arif Jumari, Fauziatul Fajaroh, Nazriati, M. Novalianto Sangadji and Hanifah Ayu Pratiwi

AIP Conference Proceedings 2217, 030015 (2020); <https://doi.org/10.1063/5.0000640>

SHOW ABSTRACT



No Access . April 2020

## Analysis of working posture on musculoskeletal disorders of vocational garment student's in garment assembly operations practice

Irham Aribowo, Bambang Suhardi and Eko Pujiyanto

AIP Conference Proceedings 2217, 030016 (2020); <https://doi.org/10.1063/5.0000602>

SHOW ABSTRACT



No Access . April 2020

## Reprocessing through co-precipitation of NCA cathode scrap waste for cathode material of Li-ion battery

Arif Jumari, Enni Apriliyani, Soraya Ulfa Muzayanha, Agus Purwanto and Adrian Nur

AIP Conference Proceedings 2217, 030017 (2020); <https://doi.org/10.1063/5.0000647>



SHOW ABSTRACT



BROWSE VOLUMES



No Access . April 2020

## **An integrated inventory model for deteriorated and imperfect items considering carbon emissions and inflationary environment**

Dewi Sri Utami, Wakhid Ahmad Jauhari and Cucuk Nur Rosyidi

AIP Conference Proceedings **2217**, 030018 (2020); <https://doi.org/10.1063/5.0000610>

SHOW ABSTRACT



No Access . April 2020

## **The effects of carbon cap limitations on inventory and multimodal transportation**

Thina Ardliana, I. Nyoman Pujawan and Nurhadi Siswanto

AIP Conference Proceedings **2217**, 030019 (2020); <https://doi.org/10.1063/5.0000697>

SHOW ABSTRACT



No Access . April 2020

## **The sintering time of $\text{LiFePO}_4/\text{C}$ synthesis by the co-precipitation method**

Adrian Nur, Agus Purwanto, Tika Paramitha, Muhammad Nizam, Luthfi Mufidatul Hasanah,

Agnolla Emely Gupitasari and Della Intania Putri Nizi



BROWSE VOLUMES

AIP Conference Proceedings 2217, 030020 (2020); <https://doi.org/10.1063/5.0000694>

SHOW ABSTRACT



 No Access . April 2020

## **The effect UV-B mutation on biodiesel from microalgae *Botryococcus braunii* using esterification, transesterification and combination of esterification-transesterification**

Anggia Putri Ramadhani, Muhammad Hafizh Prashantyo, Thea Prastiwi Soedarmodjo and Arief Widjaja

AIP Conference Proceedings 2217, 030021 (2020); <https://doi.org/10.1063/5.0000554>

SHOW ABSTRACT



 No Access . April 2020

## **Mechanical properties of films from carboxy methyl glucomannan and carrageenan with glycerol as plasticizer**

Fadilah, Ari Diana Susanti, Sperisa Distantina, Dea Putri Purnamasari and Jihan Fahrizal Ahmad

AIP Conference Proceedings 2217, 030022 (2020); <https://doi.org/10.1063/5.0000842>

SHOW ABSTRACT



BROWSE VOLUMES



No Access . April 2020

## Synthesis of lithium nickel manganese cobalt as cathode material for Li-ion battery using difference precipitant agent by coprecipitation method

Hendri Widiyandari, Riki Ardiansah, Anisa Surya Wijareni, Mohtar Yunianto and Agus Purwanto

AIP Conference Proceedings 2217, 030023 (2020); <https://doi.org/10.1063/5.0000664>

SHOW ABSTRACT



No Access . April 2020

## Optimization model for determining economic production quantity and process mean by considering internal and external quality loss

Muhammad Habib Isna Nur Asnan, Cucuk Nur Rosyidi and Eko Pujiyanto

AIP Conference Proceedings 2217, 030024 (2020); <https://doi.org/10.1063/5.0000717>

SHOW ABSTRACT



No Access . April 2020

## A brief and rapid method of synthesizing $\text{LiFePO}_4/\text{C}$ for lithium ion battery

Atika Aulia Novita Sari, Diajeng Putri Suciutami, Luthfi Mufidatul Hasanah, Soraya Ulfa Muzayanha, Cornelius Satria Yudha, Tika Paramitha and Agus Purwanto



BROWSE VOLUMES

[SHOW ABSTRACT](#)

No Access . April 2020

## **A framework of stand up motorized wheelchair as universal design product to help mobility of the motoric disabled people**

B. Bambang Sulistiyawan, Susy Susmartini and Lobes Herdiman

AIP Conference Proceedings 2217, 030026 (2020); <https://doi.org/10.1063/5.0001084>

[SHOW ABSTRACT](#)

No Access . April 2020

## **Evaluation of injury risk manual pattern garment workshop in textile vocational school**

Abdul Rohman Heryadi, Susy Susmartini and Lobes Herdiman

AIP Conference Proceedings 2217, 030027 (2020); <https://doi.org/10.1063/5.0000675>

[SHOW ABSTRACT](#)

No Access . April 2020

## **Design of mussel Peeler machine ergonomic**


Unggul Prabowo, Agung Prakoso Wicaksono, Renanda Herlian and Yosua Heru Irawan

[BROWSE VOLUMES](#)

AIP Conference Proceedings 2217, 030028 (2020); <https://doi.org/10.1063/5.0000622>

SHOW ABSTRACT



 No Access . April 2020

## **Kinetics of hydrothermal decomposition of glucose in ethanol-water solution**

Bregas Siswahjono Tatag Sembodo, Dwi Ardiana Setyawardhani, Anisa Darma Brilliant and Kintan Marchika Putri

AIP Conference Proceedings 2217, 030029 (2020); <https://doi.org/10.1063/5.0000724>

SHOW ABSTRACT



 No Access . April 2020

## **Relationship of basic principles in ISO 14001, ISO 50001, green building and zero emission building (ZEB)**

Endi Hari Purwanto, Ajun Tri Setyoko and Auraga Dewantoro

AIP Conference Proceedings 2217, 030030 (2020); <https://doi.org/10.1063/5.0000634>

SHOW ABSTRACT



BROWSE VOLUMES


## Kesambi oil extraction using the solvent extraction method

Yunita Merlin Tamara, Wahyu Nur Hidayat, Asma Nur Azizah and Dwi Ardiana Setyawardhani

AIP Conference Proceedings 2217, 030031 (2020); <https://doi.org/10.1063/5.0000691>

SHOW ABSTRACT



 No Access . April 2020

## Development of food safety design for smes yogurt using HACCP

Ellia Kristiningrum and Ike Permatasari

AIP Conference Proceedings 2217, 030032 (2020); <https://doi.org/10.1063/5.0000627>

SHOW ABSTRACT



 No Access . April 2020

## Bio-CSTR for biogas production from POME treatment – technology: Design and analysis

Joni Prasetyo, Samuel Pati Senda, Winda Wulandari and Nabila Nabila Anindita

AIP Conference Proceedings 2217, 030033 (2020); <https://doi.org/10.1063/5.0000783>

SHOW ABSTRACT



BROWSE VOLUMES





No Access . April 2020

## Preliminary research of surface electromyogram (sEMG) signal analysis for robotic arm control

Pringgo Widyo Laksono, Minoru Sasaki, Kojiro Matsushita, Muhammad Syaiful Amri bin Suhaimi and Joseph Muguro

AIP Conference Proceedings 2217, 030034 (2020); <https://doi.org/10.1063/5.0000542>

SHOW ABSTRACT



No Access . April 2020

## Performance evaluation of the sensors accuration on river monitoring system based-on heterogeneous wireless sensor network

Amin Suharjono, Roni Apriantoro, Muhammad Mukhlisin, Ariaji Prichi Gamayuda and Annissa Mahardika

AIP Conference Proceedings 2217, 030035 (2020); <https://doi.org/10.1063/5.0000501>

SHOW ABSTRACT



No Access . April 2020

## Pricing for product-service system under dual-channel supply chain

Erwin Widodo, Ismi Nur Adha Shabir and Bambang Syairudin

AIP Conference Proceedings 2217, 030036 (2020); <https://doi.org/10.1063/5.0003100>



BROWSE VOLUMES

SHOW ABSTRACT



No Access . April 2020

## Identifying factors for assessing regional readiness level to manage natural disaster in emergency response periods

Naniek Utami Handayani, Diana Puspita Sari, M. Mujiya Ulkhaq, Adi Setyo Nugroho and Ajeng Hanifah

AIP Conference Proceedings 2217, 030037 (2020); <https://doi.org/10.1063/5.0000904>

SHOW ABSTRACT



No Access . April 2020

## A data envelopment analysis approach for assessing the efficiency of sub-sectors of creative industry: A case study of batik enterprises from Semarang, Indonesia

Naniek Utami Handayani, Diana Puspita Sari, M. Mujiya Ulkhaq, Yusuf Widharto and Risa Candra Ayu Fitriani

AIP Conference Proceedings 2217, 030038 (2020); <https://doi.org/10.1063/5.0000905>

SHOW ABSTRACT



No Access . April 2020



BROWSE VOLUMES

# Development of neck surface electromyography gaming control interface for application in tetraplegic patients' entertainment

Joseph Kamau Muguro, Minoru Sasaki, Kojiro Matsushita, Waweru Njeri, Pringgo Widyo Laksono and Muhammad Syaiful Amri bin Suhaimi

AIP Conference Proceedings **2217**, 030039 (2020); <https://doi.org/10.1063/5.0000500>

SHOW ABSTRACT



1 2 3 4 5 >



## Resources

AUTHOR

LIBRARIAN

ADVERTISER

## General Information

ABOUT

CONTACT



BROWSE VOLUMES

# Emotion recognition based on deep learning with auto-encoder

Cite as: AIP Conference Proceedings 2217, 030013 (2020); <https://doi.org/10.1063/5.0000679>  
Published Online: 14 April 2020

I. Made Nomo Wiranata, Pranowo, and Albertus Joko Santoso



View Online



Export Citation

Lock-in Amplifiers  
up to 600 MHz



# Emotion Recognition Based on Deep Learning with Auto-encoder

I Made Nomo Wiranata <sup>1,b)</sup>, Pranowo <sup>1,a)</sup> and Albertus Joko Santoso <sup>1,c)</sup>

<sup>1</sup>*Magister Teknik Informatika, Universitas Atma Jaya Yogyakarta, Indonesia*

<sup>a)</sup> Corresponding author: pranowo@uajy.ac.id

<sup>b)</sup> made.wiranata23@gmail.com

<sup>c)</sup> albjoko@staff.uajy.ac.id

**Abstract.** Facial expression is one way of expressing emotions. Face emotion recognition is one of the important and major fields of research in the field of computer vision. Face emotion recognition is still one of the unique and challenging areas of research because it can be combined with various methods, one of which is deep learning. Deep learning is popular in the research area because it has the advantage of processing large amounts of data and automatically learning features on raw data, such as face emotion. Deep learning consists of several methods, one of which is the convolutional neural network method that will be used in this study. This study also uses the convolutional auto-encoder (CAE) method to explore the advantages that can arise compared to previous studies. CAE has advantages for image reconstruction and image de-noising, but we will explore CAE to do classification with CNN. Input data will be processed using CAE, then proceed with the classification process using CNN. Face emotion recognition model will use the Karolinska Directed Emotional Faces (KDEF) dataset of 4900 images divided into 2 groups, 80% for training and 20% for testing. The KDEF data consists of 7 emotional models with 5 angles from 70 different people. The test results showed an accuracy of 81.77%.

## INTRODUCTION

Emotion is an internal condition originating from inside or outside which is indicated externally or the existence of behavior. Emotion is a natural and powerful way of communication between living things. Expressions of emotions can be seen by others even though expressed verbally and non-verbally. Verbal expressions for example, in the form of words by talking about emotions being felt. Non-verbal expressions are facial expressions, physical movements, pronunciation, body cues, and emotional actions. Facial expressions can be shown by various behaviors and facial movements. Facial expressions are one of the most commonly used ways to show how you feel. Facial expressions can represent a person's emotions that can be expressed by facial movements, such as opening lips and raised eyebrows. These facial behaviors are all shaped by facial muscle movements. Facial expressions are very important in communication or interpersonal interactions because it is one of the typical indicators of emotions [1] [2] [3].

In recent years, there has been increasing growth in interest in developing technology to recognize individual emotional states [4]. Face emotion recognition is one of the important and main research fields and one of the most severe in the computer vision field. Facial emotion recognition is still one of the unique and challenging fields of research among the computer vision research community [5] [4] [6]. Through recognition of facial expressions, it is possible to improve, and better understand human interactions, actions, and even feelings [7].

In recent years there have been many advances in artificial neural networks, one of which is convolutional neural network (CNN). CNN learned the representation of new data for the first time using the convolution layer as feature extractors and the fully-connected layer for classification. The process of learning new representations on CNN can be optimized, one of which uses Convolutional Auto-Encoder (CAE). CAE is included in an unsupervised method that makes it possible to train the convolutional layer independently of the classification task to learn new data

representations. The weight learned in this first step can then be used as a starting point for initializing the convolution layer of the neural network [8] [3].

## LITERATURE REVIEW

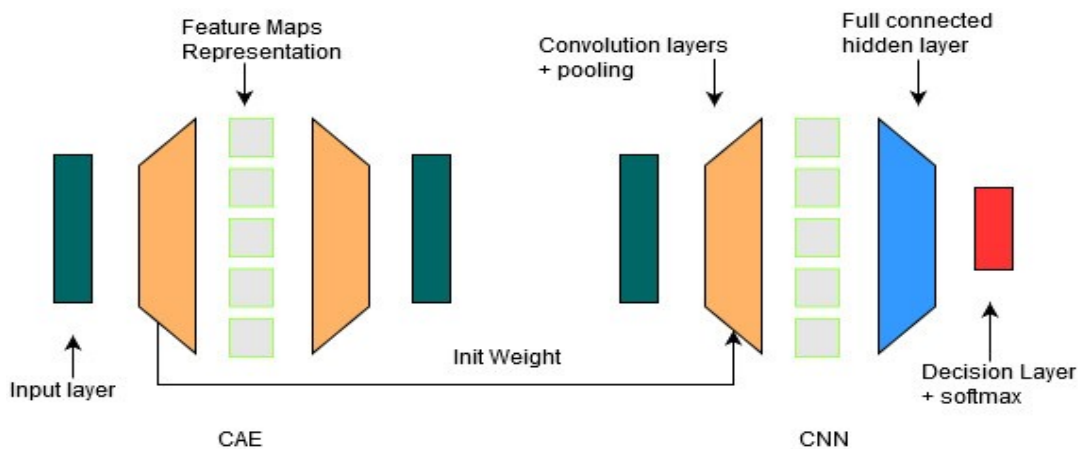
There have been several previous studies in facial expression recognition, such as research conducted by [9] using the Hierarchical Bayesian Theme Models method to recognize expressions from various angles for 7 types of expressions, namely afraid, surprise, angry, sad, disgust, happy and neutral, in this research gets 90.24% precision. In a study conducted by [10] using Facial Movement Features by extracting patch-based 3D Gabor features, selecting 'prominent' patches, and performing patch matching operations, which in this study obtained 92.93% accuracy for the Japanese Female Facial Dataset Expression (JAFFE) and 94.48% for the Cohn-Kanade (CK) dataset.

Auto-encoder is one method that is widely used in research, such as research conducted by [11] to do face recognition using the sparse auto-encoder method by using 3 identification algorithms, namely softmax algorithm, depth-learning top algorithm, and overall fine-tuning algorithm. The data used are ORL, YALE, YALE B, FERET face dataset and get different results for each dataset type. In this research, identification with softmax algorithm gets the best results on ORL dataset with an accuracy of 89.38%, whereas identification with depth-learning top algorithm gets the best results on YALE face dataset with an accuracy of 89.33% and identification with overall fine-tuning algorithm gets the best results on the FERET face dataset with an accuracy of 94.33%.

The use of CNN in various research fields has been widely carried out. Some of these include research conducted by [12] CNN used to identify facial recognition on low-resolution images, in that study CNN was successfully applied and from each of the network architectures used had a 96.02% precision for the CMU PIE dataset and 94, 63% for Extended Yale B dataset. In a study conducted by [13], CNN was used to identify Thermal Face Recognition, using the RGB-D-T Face dataset with a resolution of 640x480 and a resolution of 384x288 for RGB images with a total of 15300 images. In that study, CNN was successfully implemented and from each network architecture used it got better results from traditional recognition such as LBP, HOG and invariant moments with an accuracy of 99.40%. There are also studies of CNN combined with other methods such as the research conducted by [14] to recognize facial patterns using the CNN method and Support Vector Machine (SVM), using a FERET dataset consisting of 1400 images with different light and posture conditions. In that study, CNN and SVM were successfully implemented and produced an accuracy of 97.50%.

## METHODOLOGY

In this research, we are introducing facial emotions recognition using CAE as pre-training on CNN. To achieve this, in the first step we train CAE on the selected dataset and then, in the second step, we use the weights of the convolution layer to initialize the convolution layer on CNN. After the training, we conducted a test knowing the accuracy obtained. Visualization of weight transfer can be seen in the **FIGURE 1**.



**FIGURE 1.** Experiment Setup

## Autoencoder

CAE first uses several convolution and fusion layers to extract features from inputs into high dimensional feature map representations and then reconstruct inputs using strided transposed convolution [8]. The auto-encoder architecture used in our experiment is described in [15]. The encoding section consists of 3 times the convolution layer followed by 2x2 max-pooling and the ReLU activation layer. More detailed layer information is given in table 1.

TABLE 1. Layer Information

| Layer Type  | Filter Size | Channels | Activation |
|-------------|-------------|----------|------------|
| Input       | None        | 1(gray)  | None       |
| Convolution | 3x3         | 32       | ReLU       |
| Max-Pooling | 2x2         | 32       | None       |
| Convolution | 3x3         | 64       | ReLU       |
| Max-Pooling | 2x2         | 64       | None       |
| Convolution | 3x3         | 128      | ReLU       |

For reconstruction, we use one stride transposed convolution layer per convolution layer and Up-sampling for each max-pool layer in the encoding layers. Up-sampling is used to reverse the Down-sampling effect of the max-pooling layers. The weights of the transformed convolution results are the same as those learned in the convolution layer.

## Convolutional Neural Network

The architecture used on CNN is the same as the architecture in CAE encoding for feature extraction (convolution and max-pooling) layers and then uses three fully-connected layer layers (sizes 1024, 512 and 7) for decision making (classification), first and second has ReLU activation and the third uses Softmax activation. For the dataset, we divide the available data into training and test sets with a ratio of 80:20 to the total training data of 3920 images and test data of 560. In the test process an evaluation of network accuracy is carried out with the results obtained in the form of accuracy.

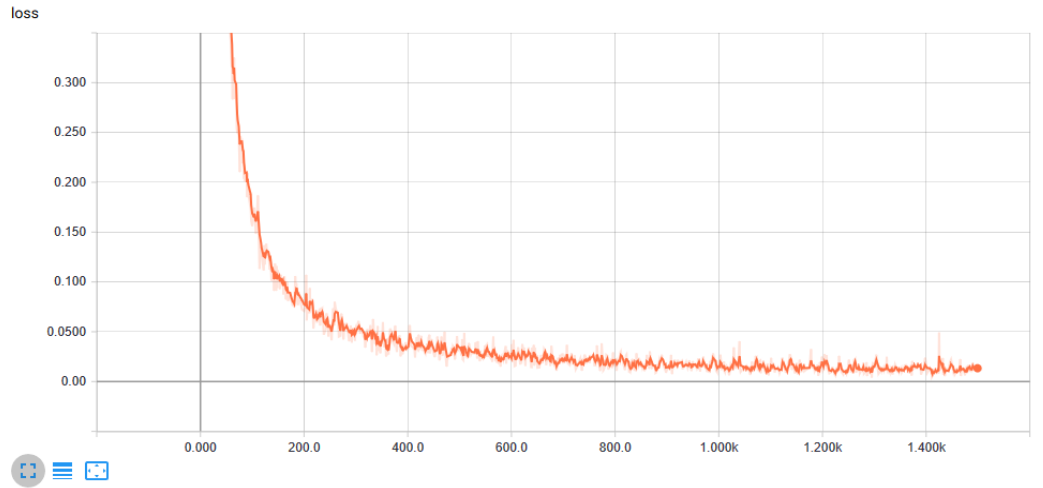
## The Karolinska Directed Emotional Faces (KDEF) Dataset

The KDEF dataset [16] is an image of human facial expressions consisting of 4900 images, made at the Karolinska Institutet, Stockholm. The images used in this set come from 70 individuals (consisting of 35 women and 35 men) who display seven different types of expressions (fear, anger, disgust, happiness, neutrality, sadness and surprise). Each expression is viewed from five different angles (full left profile, full right profile, half left profile, right half profile and straight) and photographed in two sessions. The KDEF dataset is color photographs. The model used is Caucasian amateur actors (average age, 25 years; range, 20-30 years). They were ordered to pose with a variety of different expressions.

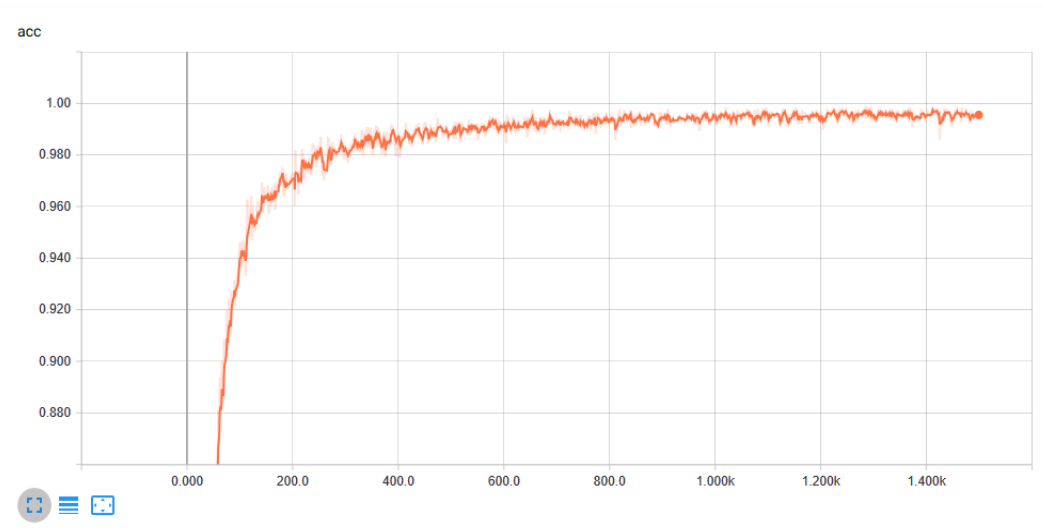
## RESULT AND DISCUSSION

Of the total dataset divided into two, 80% is used for the training process and 20% is used for the testing process. In the training process using a dataset of 3920 images with 1500 epochs. The plot loss of the training process can be seen in FIGURE 2. For the plot of training process accuracy can be seen in FIGURE 3.

In FIGURE 2 shows a graph of loss in the training process, in which the value of loss has decreased significantly from the first epoch to the 500th epoch. After the 500th epoch the loss value has decreased slowly but is not yet stable because there is still an increase in the loss value even though it is not too significant. At the 1500th epoch the loss value was 0.01289 while the lowest loss was obtained at the 1411 epoch with a loss value of 0.0047456.



**FIGURE 2.** Plot Loss In Training Process



**FIGURE 3.** Plot Accuracy In Training Process

In FIGURE 3 shows the accuracy graph in the training process, where the value of training accuracy has increased significantly from the first epoch to the 346th epoch. After the 346th epoch the training accuracy value has increased slowly but has not been stable because there is still a decrease in the value of training accuracy even though it is not too significant. At the 1500th epoch the accuracy value was 99.55% while the highest accuracy value was obtained at the 1411 epoch with an accuracy value of 99.90%. In the testing process using a dataset of 560 images with 1500 epochs. The accuracy value in the testing process is far below that of the training process which is 81.77%. while the training process can produce an accuracy of 99.55%.

## CONCLUSION

We present research on introducing emotions using convolutional auto-encoder as a pre-train on CNN on the KDEF dataset. CNN training uses weights obtained from convolutional auto-encoder in the pre-train process. The results show the training process gets an accuracy of 99.55% whereas In the process of testing the system can learn to recognize facial emotions with an accuracy of 81.77%.



## REFERENCES

1. J. Zhao, X. Mao and J. Zhang, Learning deep facial expression features from image and optical flow sequences using 3D CNN (Springer, Heidelberg, 2018), pp. 1461–1475.
2. B. Hasani and M. H. Mahoor, "Spatio-Temporal Facial Expression Recognition Using Convolutional Neural Networks and Conditional Random Fields," in 2017 12th IEEE International Conference on Automatic Face & Gesture Recognition (FG 2017) (IEEE, Washington, DC, 2017), pp. 790 – 795.
3. K. Li, Y. Jin, M. W. Akram, R. Han and J. Chen, Facial Expression Recognition With Convolutional Neural Networks Via A New Face Cropping And Rotation Strategy (Springer Berlin Heidelberg, Heidelberg, 2019), pp. 1-14.
4. H. Ranganathan, S. Chakraborty and S. Panchanathan, "Multimodal emotion recognition using deep learning architectures," in 2016 IEEE Winter Conference on Applications of Computer Vision (WACV) (IEEE, New York, 2016), pp. 1-9 .
5. D. Das and A. Chakrabarty†, "Emotion Recognition from Face Dataset Using Deep Neural Nets," in 2016 International Symposium on INnovations in Intelligent SysTems and Applications (INISTA)(IEEE, Sinaia, Romania, 2016), pp. 1-6.
6. J. Siswanto, Application of Color and Size Measurement in Food Products Inspection, (Indonesian Journal of Information Systems (IJIS), Yogyakarta , 2019), pp. 90 -107.
7. D. Hamester, P. Barros and S. Wermter, "Face expression recognition with a 2-channel Convolutional Neural Network," 2015 International Joint Conference on Neural Networks (IJCNN)(IEEE, Killarney, Ireland, 2015), pp. 1-8.
8. M. Kohlbrenner, R. Hofmann, S. Ahmmed and Y. Kashef, "Pre-Training CNNs Using Convolutional Autoencoders," 2017.
9. Q. Mao, Q. Rao, Y. Yu and M. Dong, Hierarchical Bayesian Theme Models for Multipose Facial Expression Recognition, (IEEE, Piscataway, 2017), pp. 861 - 873.
10. L. Zhang and D. W. Tjondronegoro, Facial Expression Recognition Using Facial Movement Features, ( IEEE, Piscataway, 2011 ), pp. 219 - 229.
11. Z. Zhang, J. Li and R. Zhu, "Deep Neural Network for Face Recognition Based on Sparse Autoencoder," in 2015 8th International Congress on Image and Signal Processing (CISP)(IEEE, Shenyang, China, 2015), pp. 594 - 598.
12. C. Ding, T. Bao, S. Karmoshi and M. Zhu, "Low-resolution face recognition via convolutional neural network," in 2017 IEEE 9th International Conference on Communication Software and Networks (ICCSN)(IEEE, Guangzhou, China, 2017), pp. 1157 - 1161.
13. Z. Wu, M. Peng and T. Chen, "Thermal Face Recognition Using Convolutional Neural Network," in 2016 International Conference on Optoelectronics and Image Processing (ICOIP) (IEEE, Warsaw, Poland, 2016) , pp. 6 - 9.
14. S. Guo, S. Chen and Y. Li, "Face Recognition Based On Convolutional Neural Network And Support Vector Machine," in 2016 IEEE International Conference on Information and Automation (ICIA) (IEEE, Ningbo, China, 2016) , pp. 1787 - 1792.
15. J. Masci, U. Meier, D. Ciresan and J. Schmidhuber, "Stacked Convolutional Auto-Encoders for Hierarchical Feature Extraction," in ICANN 2011: 21st International Conference on Artificial Neural Networks (Springer, Espoo, Finland, 2011) , pp. 52-59.
16. D. Lundqvist, A. Flykt and A. Öhman, "The Karolinska directed emotional faces - KDEF," in CD ROM from Department of Clinical Neuroscience, Psychology section (Karolinska Institutet, Stockholm, 1998) , pp. 1157 - 1161.