IOP Conference Series team

Anete Ashton
Publisher, Conference Series

Anete Ashton is the Publisher for the proceedings programme at IOP Publishing. With an MA in linguistics and over ten years’ experience in proceedings publication she has developed and grown the IOP Conference Series and has commissioned some of the most prestigious conferences in physics and related subject areas.

E-mail Anete Ashton
Tel +44 (0)117 930 1280

Steph Gill
Commissioning Editor

Steph joined the Conference Series team after eight years in the Production department. She has a degree in Media and Film from the University of Winchester.

E-mail Steph Gill
Tel +44 (0)117 930 1252

Kayleigh Parsons
Conference Publishing Co-ordinator, Conference Series

Kayleigh looks after the day-to-day operations of IOP Conference Series, including commissioning content and liaising with conference organizers/editors. Kayleigh joined IOP Publishing back in 2008 working in Publishing, she then took 18 months off to travel but re-joined the company in 2015. Kayleigh then joined the Conference Series team in 2018.

E-mail Kayleigh Parsons
Tel +44 (0)117 930 1888

Committee

Advisory Board

Prof. Dr. Wahyu Widada (Universitas Bengkulu)
Prof. Dr. Muhammad Ali Ramdhani, M.T. (UIN Sunan Gunung Djati Bandung)
Dr. Hadi Kuncoro, M. Farm., Apt. (Universitas Mulawarman)
Dr. Astri Rinanti, MT (Universitas Trisakti)
Dr. Hilmi Aulawi, M.T. (Sekolah Tinggi Teknologi Garut)
Dr. Juniastel Rajagukguk, M.Si (Universitas Negeri Medan)
Dr. Ir. Herman S., MBA. (Universitas Komputer Indonesia)
Dr. Endarto Y Wardhono, (Universitas Sultan Ageng Tirtayasa, Banten)
Dr. Niken Subekti, MSi (Universitas Negeri Semarang)
Dr. Sudi Dul Aji (Universitas Kanjuruhan Malang)
Dr. July Hidayat, M.Sn. (Universitas Pelita Harapan)
Dr. Jarman Arroisi, M.A. (Universitas Darussalam Gontor Ponorogo Jatim)
Dr. Ir. Suharsono. (UPN Veteran Yogyakarta)
Dr. Setia Budi, M.Sc (Universitas Negeri Jakarta)
Dr. Ade Yeti Nuryantini, S.Pd., M.Pd., M.Si. (UIN Sunan Gunung Djati Bandung)
Dr. Bebeh Wahid Nuryadin (UIN Sunan Gunung Djati Bandung)
Dr. Melati Ferianita Fachrul, MS. (Universitas Trisakti)
Dr. rer.nat. I Gusti Ngurah Agung Suryaputra, S.T., M.Sc. (Universitas Pendidikan Ganesha)
Daniel Sutopo Pamungkas, PhD (Politeknik Negeri Batam)
Cynthia Wuisang, ST, MUrbdHabMgt., PhD (Universitas Sam Ratulangi)
Ir. Isri Ronald Manganka, M.Eng., Ph.D. (Universitas Sam Ratulangi)
Scientific Committee

Prof. Dr. Asep Kadarohman, Universitas Pendidikan Indonesia, Indonesia
Prof. Dr. Didi Sukyadi, M. A., Universitas Pendidikan Indonesia, Indonesia
Prof. Dr. Anna Permanasari, Universitas Pendidikan Indonesia, Indonesia
Prof. Dr. Sumarto, Universitas Pendidikan Indonesia, Indonesia
Prof. Dr. M. Syaom Barliana, Universitas Pendidikan Indonesia, Indonesia
Prof. Dr. Ratih Hurriyati, Universitas Pendidikan Indonesia, Indonesia
Dr. Ir. Taufiq Saidi, M. Eng., Universitas Syiah Kuala, Indonesia
Dr. Erfan Handoko, M.Si., Universitas Negeri Jakarta, Indonesia
Dr. Hilmi Aulawi, MT., Sekolah Tinggi Teknologi Garut, Indonesia
Dr. Astri Rinanti, MT., Universitas Trisakti, Indonesia
Dr. Prantasi H. Tjahjanti, Universitas Muhammadiyah Sidoarjo, Indonesia
Dr. Rositayanti Hadisoebroto, ST., MT., Universitas Trisakti, Indonesia
Erfan Rohadi, ST., M.Eng., PhD. b., Politeknik Negeri Malang, Indonesia
Indrazno Siradjuddin, ST, MT, PhD., Politeknik Negeri Malang, Indonesia
Irwan Alnarus Kautsar, Ph.D., Universitas Muhammadiyah Sidoarjo, Indonesia
Muhammad Nur Hudha, M.Pd., Universitas Kanjuruhan Malang, Indonesia

Organizing Committee

Conference Chair:
Dr. Ade Gafar Abdullah, M.Si. – Universitas Pendidikan Indonesia

Co-Conference Chair:
Ari Arifin Danuwijaya, M.Ed. – Universitas Pendidikan Indonesia

Members:
Dr. Eng. Asep Bayu DaniNandiyanto – Universitas Pendidikan Indonesia
Dr. Isma Widiaty, M.Pd. – Universitas Pendidikan Indonesia
Cep Ubad Abdullah, M.Pd. – Universitas Pendidikan Indonesia
Dr. Dadang Lukman Hakim – Universitas Pendidikan Indonesia
Issues

Volume 1402, 2019

4th Annual Applied Science and Engineering Conference
24 April 2019, Bali, Indonesia
Accepted papers received: 1 November 2019
Published online: 16 December 2019

Latest issues
(complete)

- Preface, 2019 (011001-011002)
- Issue 2, 2019 (022001-022110)
- Issue 3, 2019 (033001-033110)
- Issue 4, 2019 (044001-044110)
- Issue 5, 2019 (055001-055110)
- Issue 6, 2019 (066001-066110)
- Issue 7, 2019 (077001-077109)
Table of contents

Volume 1402
2019

Previous issue  Next issue

View all abstracts

Issue 4

OPEN ACCESS 044001
Fire disaster early detection system in residential areas
L Kamelia, N Ismail and A A Firmansyah
+ View abstract  PDF

OPEN ACCESS 044002
Diversity technique evaluation for LTE high mobility user based on high altitude platform
A M Ridwan, R Alfian, H Daniil, I Iskandar and E A Z Hamidi
+ View abstract  PDF

OPEN ACCESS 044003
Heart rate monitoring system based on website
E A Z Hamidi, M R Effendi and F Ramdani
+ View abstract  PDF

OPEN ACCESS 044004
Evaluation of facilities learning practice at the Vocational High School in Electrical Engineering
S Soeprijanto, Y F Yahya and E Media
+ View abstract  PDF

OPEN ACCESS 044005
Cigarette detection system in closed rooms based on Internet of Thing (IoT)
I Sulistiyowati, Y Findawati, S K A Ayubi, J Jamaaluddin and M P T Sulistyanto
+ View abstract  PDF
**OPEN ACCESS**
The concept of the internet of things framework for remote monitoring of solar home system
M Rumbayan, D Ruindungan, S Sompie and A Sambul
+ View abstract  PDF

**OPEN ACCESS**
Sound indicators as safety of motorcycle
A Ahfas, D Hadidjaja, S Syahrorini and A Wicaksono
+ View abstract  PDF

**SMS Application in bird feed scheduling automation**
D H R Saputra, S Syahrorini, A Ahfas and J Jamaaluddin
+ View abstract  PDF

**OPEN ACCESS**
Street lighting efficiency with particle swarm optimization algorithm following Indonesian standard
M Eriyadi, A G Abdullah, S B Mulia and H Hasbullah
+ View abstract  PDF

**OPEN ACCESS**
The generator operating system automatically uses a motorized change over switch devices
D Muliyati, F Bakri, I Umami, D Sumardani and D Ambarwulan
+ View abstract  PDF

**OPEN ACCESS**
Design and development equipment to measure the motion quantities of an object that moving in air or in fluid
M A Marpaung, E Handoko and M Delina
+ View abstract  PDF

**OPEN ACCESS**
Optimization design of CAI for computer programming language to improve student's competence
M Sukardjo, L Sugiyanta and Y Supriyanto
+ View abstract  PDF

**OPEN ACCESS**
The effect of temperature on energy transfer capacity by laser
I A Rahardjo and F Wadjdi
044014 OPEN ACCESS Development of a 500-1000 watt Pico hydro Hybrid Solar Power Plant prototype
I W Ratnata, S Sumarto and W S Saputra

044015 OPEN ACCESS Evaluation of trip generation and trip attraction of shopping centre on traffic performance in Denpasar city
N M W Pratiwi, D A N Sriastuti and A A G Sumanjaya

044016 OPEN ACCESS Simple smart glasses based on microcontrollers as money detector of nominal and authenticity
M Muhammad, M Yusro and P Yuliatmojo

044017 OPEN ACCESS Development of smart and safe-bags for children based on microcontroller
A Baihaqi, W Djatmiko and M Yusro

044018 OPEN ACCESS Depth control design and simulation of hybrid underwater glider
A Latifah, D D S Fatimah, B L Hakim and D Chandrahadinata

044019 OPEN ACCESS Steering control design and simulation of hybrid underwater glider
A Latifah, D D S Fatimah, B L Hakim and Y Mauluddin

044020 OPEN ACCESS Glidding system for a fixed wing aircraft using PID control algorithm
B Setiawan, D Widiatmoko, I Siradjuddin, S Adhisuwignjo, F Ronilaya and M Syafaat

044021 OPEN ACCESS PID controller for a differential drive robot balancing system
I Siradjuddin, M Syafaat, T S Patma, S Adhisuwignjo, T Winarno, A Komarudin and D Widiatmoko
<table>
<thead>
<tr>
<th>ID</th>
<th>Title</th>
<th>Authors</th>
<th>View abstract</th>
<th>PDF</th>
</tr>
</thead>
<tbody>
<tr>
<td>044022</td>
<td>Study of LoRa (Long Range) communication for monitoring of a ship electrical system</td>
<td>B Setiawan, E S Putra, I Siradjuddin, M Junus, D Dewatama and S Wiyanto</td>
<td>View abstract</td>
<td>PDF</td>
</tr>
<tr>
<td>044023</td>
<td>Controllable and observable control design of wind generator system using PID algorithm</td>
<td>B Setiawan, S Riskitasari, R I Putri, S Adhisuwignjo, I N Syamsiana and W A Nurwicaksana</td>
<td>View abstract</td>
<td>PDF</td>
</tr>
<tr>
<td>044024</td>
<td>Electronic control for optimizing power absorption of darrieus vertical axis wind turbine by adjusting angle of attack method</td>
<td>B Setiawan, W A Nurwicaksana, I N Syamsiana, S Adhisuwignjo, S Riskitasari, G Joelianto and R I Putri</td>
<td>View abstract</td>
<td>PDF</td>
</tr>
<tr>
<td>044025</td>
<td>Designing, implementing and analysing optimal controllers on a non-linear reaction wheel pendulum</td>
<td>I Siradjuddin, E R K Pradani, E Rohadi, S Adhisuwignjo, M Kusumawardani and I M Fitriani</td>
<td>View abstract</td>
<td>PDF</td>
</tr>
<tr>
<td>044026</td>
<td>A study of a discrete Bayes and a Kalman filter computational Complexity and performance in the case of 1D robot localization</td>
<td>I Siradjuddin, I M Fitriani, R A Asmara, M Junus, T S Patma, G A Azhar and H Setiawan</td>
<td>View abstract</td>
<td>PDF</td>
</tr>
<tr>
<td>044027</td>
<td>Study of Nusantara Satu Satellite parameter evaluation for broadband application in Indonesia</td>
<td>B Maruddani, E Sandi and W Dara</td>
<td>View abstract</td>
<td>PDF</td>
</tr>
<tr>
<td>044028</td>
<td>Android-based Indonesian sign language model using robot hand</td>
<td>T Taryudi, P Yuliatmojo and M A Paripurna</td>
<td>View abstract</td>
<td>PDF</td>
</tr>
<tr>
<td>044029</td>
<td>The automatic battery charger based on floating technique</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Double layer parasitic radiator for S-Band antennas to increase gain and bandwidth performances
E Sandi, A Diamah, M W Iqbal and D N Fajriah

Design of two stage low noise amplifier at 2.4 - 2.5 GHz frequency using microstrip line matching network method
B Maruddani, M Ma'sum, E Sandi, Y Taryana, T Daniati and W Dara

Design of substrate integrated waveguide to improve antenna performances for 5G mobile communication application
E Sandi, A Diamah, M W Iqbal and D N Fajriah

Modified cooperative learning methods in teaching computer programming laboratory course for electronics engineering students
A Parastiwi, E Ekojono and A N Rahmanto

Efficiency analysis of refrigerant work fluid in the Organic Rankine Cycle (ORC) as an energy generating machine electricity 1 kW scale
M Y Abdullah, P Prabowo and B Sudarmanta

Feasibility study of installation photovoltaic system at a university in Indonesia: A case study
H Umar, M Amudy and T A Rizal

Effect of Near-Dry Machining (NDM) on surface roughness through sustainable turning of mild carbon steel using coated carbide
R Nur, M A Suyuti, M I Mukhsen and I Ikram
Comparison of predictive performance and measurement of off-grid 15 kWp solar power generation in Aceh Tamiang
R Thaib, S Rizal and T A Rizal

Utilization of Beeswax/Bentonite as energy storage material on building wall composite
R Thaib, H Hamdani and M Amin

Effect of pulley primary angle variation and roller 11 grams on 110 cc Scoopy injection engine
E Widodo, M Mulyadi, I Iswanto, P H Tjahjanti and M Anggara S B

Thermodynamic performance investigation of a diesel engine running on biodiesel derived from pangium edule and cocos nucifera
T A Rizal, H Hamdani, R Thaib, K Khairil, H Husin and M Mahidin

Infill pattern and density effects on the tensile properties of 3D printed PLA material
M Rismalia, S C Hidajat, I G R Permana, B Hadisujoto, M Muslimin and F Triawan

The effect of mother channel width on biometric flow field towards polymer electrolyte membrane fuel cell performance
A Fahruddin, D Ichsani, F Taufany and B U K Widodo

Optimizing machining time for CAD / CAM milling programming using the Taguchi method
M Mulyadi, W Alfiansyah, A Akbar, R Firdaus and N F G Andita
The effect of blade angle on two-stage water turbine against power and efficiency
D A Haryono, A Fahruddin, A Akbar and M Mulyadi
+ View abstract  PDF

High-pressurizing green algae in third generation bioethanol production
H B Aditiya, H C Theofany and M Yheni
+ View abstract  PDF

Microwave irradiation pre-treatment in third generation bioethanol production from tropical green algae
H C Theofany, M Yheni, H B Aditiya and N S Sepwin
+ View abstract  PDF

Preliminary study of acidic hydrolysis in third generation bioethanol production using green algae
M Yheni, H C Theofany, H B Aditiya and N S Sepwin
+ View abstract  PDF

Direct and indirect measurement techniques of cavitation intensity: a brief review
F Triawan, B A Budiman, I P Nurprasetio and G K Sunnardianto
+ View abstract  PDF

Finite element analysis of Miura origami column under uniaxial compressive load
S C Hidajat, I G R Permana, M Rismalia, Herianto and F Triawan
+ View abstract  PDF

Study on the compressive behavior of Miura origami column structure
I G R Permana, M Rismalia, S C Hidajat, A B Nandiyanto and F Triawan
+ View abstract  PDF

A comparative investigation of biomass pyrolysis on connecting tube performance for liquid smoke production
H Saputro, B Evan, D N Liana, B S Karsa, D S Wijayanto and H Bugis
+ View abstract  PDF
Analysis of fire rate on paper coated with the silica gel from rice husk ash
H H Sutrisno, R Wirawan, A Febriani and D Ambarwati

The influence of engineering students numerical reasoning on the academic achievement of Computer Numerical Control (CNC) course
A Dudung, D Nurhidayat and P Yuliatmojo

Modelling of regenerative braking system for electric bus
M Islameka, E Leksono and B Yuliarto

Clay stabilizer and zetpass uses for improving sand control performance and resist the sand problem at field x based on laboratory study
H S Ruseno, S Kasmungin and R Setiati

Re-design tony kart mitox gokart model (Re-design analysis of chain-drive components)
I Mubarak

Immersion cooling as the next technology for data center cooling: A review
I W Kuncoro, N A Pambudi, M K Biddinika, I Widiastuti, M Hijriawan and K M Wibowo

An experimental investigation on the effects of mineral oil flow rate on CPU immersion cooling
S N Kristian, K M Wibowo, N A Pambudi, B Harjanto, H Bugis, M K Biddinika, I W Kuncoro and M Hijriawan

How vocational high-school students understand geothermal energy
W Wahyudi, N A Pambudi, M K Biddinika, B Basori and B Rudiyanto
<table>
<thead>
<tr>
<th>Title</th>
<th>Authors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Readability of geothermal energy information in vocational textbooks</td>
<td>W Wahyudi, N A Pambudi, M K Biddinika, R Ranto and B Rudiyanto</td>
</tr>
<tr>
<td>Open Access</td>
<td>PDF</td>
</tr>
<tr>
<td>Barriers to the adoption, acceptance and public perceptions of EV in</td>
<td>F H Syamnur, N A Pambudi, M K Biddinika and N S Wardani</td>
</tr>
<tr>
<td>Indonesia: Case studies in the city of Surakarta</td>
<td>PDF</td>
</tr>
<tr>
<td>The attitude of local government officers toward renewable energy in</td>
<td>I D Pujaningrum, N A Pambudi, M K Biddinika and H Saputro</td>
</tr>
<tr>
<td>Indonesia</td>
<td>PDF</td>
</tr>
<tr>
<td>Public knowledge in changes of fossil fuel become biofuel on the</td>
<td>R Untari, N A Pambudi, M K Biddinika and B Harjanto</td>
</tr>
<tr>
<td>transportation sector</td>
<td>PDF</td>
</tr>
<tr>
<td>Organic Rankine Cycle (ORC) in geothermal power plants</td>
<td>M Hijriawan, N A Pambudi, M K Biddinika, D S Wijayanto, I W Kuncoro,</td>
</tr>
<tr>
<td></td>
<td>B Rudiyanto and K M Wibowo</td>
</tr>
<tr>
<td>The influence of acid and base solutions on the quenching process</td>
<td>A Akbar, R Firdaus and M Mulyadi</td>
</tr>
<tr>
<td>against the hardness of ST37 steel</td>
<td>PDF</td>
</tr>
<tr>
<td>Work based learning in vocational education</td>
<td>D Hafid, A Djohar, A G Abdullah and M Komaro</td>
</tr>
<tr>
<td>PDF</td>
<td></td>
</tr>
<tr>
<td>Structural, optical, and room temperature dielectric properties of</td>
<td>N Masta, R A Rafsanjani and D Triyono</td>
</tr>
<tr>
<td>La$_{1-x}$A$_x$FeO$_3$ (A = Mg, Sr, and Ba) perovskite nanomaterials</td>
<td>PDF</td>
</tr>
<tr>
<td></td>
<td>PDF</td>
</tr>
<tr>
<td>Title</td>
<td>Authors</td>
</tr>
<tr>
<td>----------------------------------------------------------------------</td>
<td>------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Microwave absorbing characteristics in multilayer absorbers based on barium ferrite and teflon</td>
<td>E Handoko, A B Susila, I Sugihartono, M A Marpaung, Z Jalil and M Alaydrus</td>
</tr>
<tr>
<td>Microwave absorption properties of single and double-layer absorbers based on BaFe_{12}O_{19} and SiO_{2}</td>
<td>M A Marpaung, E Handoko, Z Jalil and M Alaydrus</td>
</tr>
<tr>
<td>Structure and magnetic properties of barium hexaferrite BaFe_{10}CoNiO_{19} films</td>
<td>I Sugihartono, I A Rembulan, D Rakhmawati, M A Marpaung and E Handoko</td>
</tr>
<tr>
<td>Analysis of Uranyl Nitrate Hexahydrate composition for optimum neutron multiplication factor of SAMOP</td>
<td>P I Wahyono and S Syarip</td>
</tr>
<tr>
<td>Profile affective abilities of vocational students in electrical energy conservation</td>
<td>A Kurniawan, N Y Rustaman, I Kaniawati and L Hasanah</td>
</tr>
<tr>
<td>Microstructural and electrical properties of human blood</td>
<td>E Handoko, S Budi, R Fahdiran, S A Saptari, A Humairrah, Z Mutmainnah, R Puspitaningrum and M Alaydrus</td>
</tr>
<tr>
<td>Complex permittivity, complex permeability and microwave absorption properties of human blood</td>
<td>E Handoko, R Fahdiran, S Budi, S A Saptari, A Humairrah, M Alaydrus, Z Mutmainnah and R Puspitaningrum</td>
</tr>
<tr>
<td>The profile of critical thinking skills students on science learning</td>
<td>Y Hidayati and P Sinaga</td>
</tr>
</tbody>
</table>
E-mulsi: The digital module for pharmacy physics lab work
M A Dhina, G Hadisoebroto, S R Mubaroq, R V M Puspa and D A Deswati

A study of radiation dose for the anticipated accident condition in the SAMOP reactor experimental facility
M Salam, E Supriyatni and S Syarip

Analysis of fission product gas pressure and radioactivity in SAMOP reactor experimental facility
S Syarip, P I Wahyono and E T Budisantoso

Scaffolding in conceptual science
I Isrokatun, D Anggita, B S Purwono, C Sunaengsih and A A Syahid

Phase transition in one-dimensional hydrogen chain: A dependence on basis orbitals, cut off radius, and doping
T B Prayitno and R Fahdiran

Controlling band gap of monolayer MnCl$_2$ with LDA+$U$
T B Prayitno and R Fahdiran

Implications of higher order tensor in Einstein field equations on vacuum condition
T B Prayitno and R Fahdiran

Energies of the static solitary wave solutions of the one-dimensional Gross-Pitaevskii equation
T B Prayitno, E Budi and R Fahdiran
Ideal gas model of Bose-Einstein condensates confined in the parabolic trap
T B Prayitno, E Budi and R Fahdiran

Analysis characteristics of viscosity coefficient using viscometer stromer
A Malik, M A Hakiki, N Imiyati, P Kurnia, R Zakwandi, W Setya and M M Chusni

[RAV] current meter: Manufacture a measuring instrument of water current using a spring balance
A Malik, R Zakwandi, R D Agustina, R Anjani, N R Syamsudin, C Rochman and D Nasrudin

Selection method to identify the dominant elements that contribute to magnetic susceptibility in sediment
B H Iswanto and S Zulaikah

TUMPULS teaching aids as an alternative media for physics learning
D Mulhayatiah, R F Ningsih, H Y Suhendi, D Nasrudin and E K Yuningsih

REACT digital and manual worksheet for enhancing physics problem solving skill
H Y Suhendi, N Jamilah, D Mulhayatiah and R Ardiaysyah

Effects of variations in the addition of SiC_p filler to corrosion rate of metal matrix composites (MMCs) Al-Cu-Mg/SiC_p
A B Susila, E Handoko and R Fahdiran

Waste to Energy (WtE) as the basis for developing physics learning materials
D Nasrudin, F E Rachmadanti, C Rochman, D Mulhayatiah, M F Millah and A Malik
<table>
<thead>
<tr>
<th>ID</th>
<th>Title</th>
<th>Authors</th>
<th>Views</th>
<th>PDF Link</th>
</tr>
</thead>
<tbody>
<tr>
<td>044094</td>
<td>Theremin as teaching aid to improve student understanding of waves</td>
<td>D Ambarwanti, I M Astra, A A Yaqin and I Sugihartono</td>
<td>+</td>
<td><img src="https://iopscience.iop.org/issue/1742-6596/1402/4" alt="View abstract" /></td>
</tr>
<tr>
<td>044095</td>
<td>Development of tools problems-based learning model assisted by virtual experiment to increase students' generic science skills</td>
<td>B E Jiniarti, A Harjono and M Makhrus</td>
<td>+</td>
<td><img src="https://iopscience.iop.org/issue/1742-6596/1402/4" alt="View abstract" /></td>
</tr>
<tr>
<td>044096</td>
<td>A systematic effect of clay volume on porosity – p-wave velocity relationship</td>
<td>S Prakoso, M Burhannudinmur, G Yasmaniar, S Rahmawan and S Irham</td>
<td>+</td>
<td><img src="https://iopscience.iop.org/issue/1742-6596/1402/4" alt="View abstract" /></td>
</tr>
<tr>
<td>044097</td>
<td>Physics in geothermal power plants</td>
<td>D Nasrudin, D Nopilawati, C Rochman, Y N Rahayu, M F Millah and D Mulhayatiah</td>
<td>+</td>
<td><img src="https://iopscience.iop.org/issue/1742-6596/1402/4" alt="View abstract" /></td>
</tr>
<tr>
<td>044098</td>
<td>Coating of TiO₂ nanoparticles in the surface of transparent plastic grains and its application for photocatalyst under solar irradiation</td>
<td>I F Amalia, S Gumilar, A Ismail, L Amalia and M Abdullah</td>
<td>+</td>
<td><img src="https://iopscience.iop.org/issue/1742-6596/1402/4" alt="View abstract" /></td>
</tr>
<tr>
<td>044099</td>
<td>Application of the contextual teaching and learning model as an efforts to improve student results and scientific performance of student physics</td>
<td></td>
<td>+</td>
<td><img src="https://iopscience.iop.org/issue/1742-6596/1402/4" alt="View abstract" /></td>
</tr>
</tbody>
</table>
Implementation of OPTIKU *pocket book* based Android for enhancing problem solving ability

D Mulhayatiah, N Fitriyanti, W Setya, H Y Suhendi, D Nasrudin and A Malik

PASSING for experiment tool in elasticity and Hooke's law concept on springs arranged in series and parallel

H Y Suhendi, S Nurhasanah, E K Yuningsih, D Mulhayatiah and A Malik

Design and development of measurement of measuring light resistance using Light Dependent Resistance (LDR) sensors

W Setya, A Ramadhana, A Ramadhana, H Restu Putri, A Santoso, A Malik and M M Chusni

Development of Android-base media on the point of glass and lens

W Setya and R Zakwandi

How is STEM learning for children with special needs in Indonesia?

M N Hudha, D Triwahyuningsy, A Rafikayati, S Fajaruddin, I Maryani, I Widiaty, A B D Nandianto, I Hamidah and A Permanasari

Kalman filtering to real-time trace water level measurements using ultrasonic sensor

B H Iswanto, I F Parmono and M Delina

Band gap control of bilayer zigzag graphene nanoribbon by direction of magnetic moment

T B Prayitno, E Budi and R Fahdiran
The Simulation of one-time-pad quantum key distribution
M Delina, B H Iswanto, H Permana and S Muhasyah

Heat energy conversion on applied technology of geothermal energy direct utilization
U Sumotarto, F Hendrasto and A Anugrahadi

Study on mechanical properties of Metal Matrix Composites (MMCs) Al-Cu-Mg/SiC<sub>p</sub> with Powder Metallurgy
A B Susila, I Sugihartono and M A Marpaung

Theoretical study on the effects of polarons on the transport properties of anatase TiO<sub>2</sub>
A Bupu and M A Majidi
Double layer parasitic radiator for S-Band antennas to increase gain and bandwidth performances

To cite this article: E Sandi et al 2019 J. Phys.: Conf. Ser. 1402 044030

View the article online for updates and enhancements.
Double layer parasitic radiator for S-Band antennas to increase gain and bandwidth performances

E Sandi *, A Diamah, M W Iqbal and D N Fajriah

Department of Electrical Engineering, Faculty of Engineering, Universitas Negeri Jakarta, Jakarta, Indonesia

*efri.sandi@unj.ac.id

Abstract. In this paper, a parasitic radiator combination was developed to improve the gain performance and bandwidth of the S-Band frequency microstrip antenna. Previous studies focused on adding one side layer of the parasitic radiator and the same structure, so the idea emerged to develop a microstrip antenna by adding parasitic radiators from the two sides of the antenna radiator layer and the different structure of the parasitic structure. In this paper, the design of the parasitic radiator is added by combining the circular parasitic radiator patch on the upper layer of the antenna radiator and the square parasitic radiator patch on the bottom layer of the antenna radiator. This study uses a research and development approach through the calculation of parasitic radiator structure and setting the distance between layers. Next is the simulation design and fabrication of antenna samples to verify the test results. Simulation and measurement results show that by adding a parasitic combination of radiators with a distance of 0.36 $\lambda_g$ at the top layer and 0.15 $\lambda_g$ at the bottom layer of the antenna, a better gain and bandwidth performance improvement as compared to the addition of parasitic radiator designs in previous studies. This result confirms that the idea of adding a double layer parasitic radiator can be used to improve the performance of a microstrip antenna.

1. Introduction

The development of communication systems requires the design and development of antennas to improve the performance of the communication system, including the development of antennas for S-band frequencies that are widely used for cellular systems and radar surveillance. One type of antenna that is developed by many antenna researchers today is the microstrip antenna. The microstrip antenna is widely used because of its relatively small physical size, low profile and easy fabrication [1]. Besides the advantages, there are some disadvantages of microstrip antennas, which are narrow bandwidth and low gain [1-2], so antenna researchers try to develop solutions to increase antenna gain and bandwidth.

One solution to increase the bandwidth and gain of a microstrip antenna is to use a parasitic radiator. Compared to other techniques of increasing gain and bandwidth, the addition of the parasitic radiator to the microstrip antenna design resulted in significant improvement with a simple design process. The parasitic radiator method is the addition of material to the main antenna placed above or below the main antenna with a certain distance [3-4]. Some research results show that the addition of the parasitic radiator can increase the bandwidth and gain of the microstrip antenna. Parasitic additions can be done by the layer stacking method of the radiating element [4]. The proposed stacked synthesis uses the finite-difference-time-domain (FDTD) calculations. The result is a significant gain increase and wider bandwidth compare to without the stacking method [4]. The proposed compact stack-patch antenna...
design was also obtained from the addition of low temperature co-fired ceramics (LTCC) substrate for ISM 2.4 GHz and 5.8 GHz frequencies and local multipoint distribution service (LMDS) 28 GHz. The result is a 7% bandwidth increase in return loss below -10dB [5].

Other research results propose the addition of a notch and parasitic radiator patch for WLAN applications [6]. Besides the addition of notches and parasitic layers, several studies have also focused on engineering the shape of the parasitic radiator structure [7-8] and parasitic radiator development on array structures and MIMO antennas [9-11]. The results of this study conclude that the addition of the parasitic radiator can increase antenna and bandwidth gain significantly. However, the research that has been carried out only focuses on the development and addition of parasitic radiators on one side of the layer, so it is interesting to see the phenomenon that is produced when adding two sides of the parasitic radiator layer. For this reason, we will observe the effect of adding double layer parasitic radiators to increase antenna gain and bandwidth performance. Besides observing the effect of adding double layer parasitic radiators, this study will also observe the effect of the magnitude of the gap between the parasitic radiator layer and the radiating element. Setting the air gap between these layers is able to provide an increase in gain and bandwidth [12].

2. Theoretical foundations

2.1. Microstrip antenna

In this study used a circular microstrip antenna as a sample to observe the effect of adding a double layer parasitic radiator as shown in figure 1. The equation for determining the radius of a circle patch \( a \) is as follows [2],

\[
a = \frac{F}{\left(1 + \frac{2h}{\pi \varepsilon_{r} F} \left[ \ln \left( \frac{\pi F}{2\varepsilon_{r}} \right) + 1.7726 \right] \right)^{\frac{1}{2}}}
\]

With \( F \) is a function of the logarithmic radiating element, obtained from the following equation,

\[
F = \frac{8.791 \times 10^{9}}{f_{r}\sqrt{\varepsilon_{r}}}
\]

Where \( f_{r} \) is resonance frequency and \( \varepsilon_{r} \) is substrate dielectric constant.

2.2. Microstrip feed line

The approach to calculating the width of a microstrip feed line is as follows [2]:

\[
u = \frac{W_{f}}{h} = \frac{8e^{A}}{\varepsilon_{r}^{2A-2}}
\]

Where \( A \) can be calculated by approach,

\[
A = \frac{Z_{0}}{100} \left[ \frac{\varepsilon_{r} + 1}{2} \right]^{0.5} + \frac{0.11}{\varepsilon_{r} + 1} \left[ 0.23 + \frac{\varepsilon_{r} - 1}{\varepsilon_{r} + 1} \right]
\]

Then calculate the length of the microstrip line as follows,

\[
L_{f} = \frac{1}{4} \lambda_{g}
\]

Where \( \lambda_{g} \) can be determined from the following equation,

\[
\lambda_{g} = \frac{\lambda_{0}}{\sqrt{\varepsilon_{eff}}}
\]

And \( \varepsilon_{eff} \) can be determined from the following equation.
2.3. Parasitic substrate
In some previous studies, the addition of the parasitic substrate can increase gain and antenna bandwidth. Setting the distance between the parasitic substrate and the radiating element ($\lambda_g$) can be calculated through the following approach [4].

$$\lambda_g = \frac{\lambda_0}{\varepsilon_{eff}}$$  \hspace{1cm} (8)

Where $\lambda_0$ is the wavelength of the microstrip antenna.

3. Design double layer parasitic radiator

3.1. Design of circular microstrip antenna
Before adding a double layer parasitic radiator, first design a circular microstrip patch antenna as the basis for development. The circular microstrip patch antenna is designed using CST Microwave Studio which works at a frequency 3 GHz (S-band antenna). The microstrip antenna designed has a width 39 mm and has length 42.5 mm, using FR4 as substrate material which has thickness 1.6 mm. Circular patch design that has a radius ($a$) 14.5 mm with thickness 0.035 mm. The antenna design as shown in figure 1.

3.2. Antenna design with double layer parasitic radiator
The first parasitic layer is designed using patch circles that work at a frequency of 3 GHz. This parasitic is designed with a width 39 mm and has length 42.5 mm, using FR4 substrate material with thickness 1.6 mm without ground. This first layer is placed at the top of the antenna element. While the second layer is placed at the bottom of the antenna element. The second parasitic layer design uses the same size as the first parasitic layer and the antenna element, but without using the radiating element and only using the ground side. To obtain the best performance, the best distance observation between the first layer and the second layer of the parasitic radiator was carried out in this study. The ideal distance is obtained by the equation (8) approach and is optimized through the expansion of the air gap of each layer against the microstrip antenna element. The observation results obtained the best distance for the first layer (top layer) is 0.36$\lambda_g$ and the second layer (bottom layer) is 0.15$\lambda_g$. The air gap distance between the two layers produces the best gain and bandwidth performance. The antenna design with the addition of a double parasitic layer as shown in figure 2 and figure 3.
4. Result and discussion
The results of this study were obtained by comparing gain and bandwidth performance of circular microstrip antenna conventional with circular microstrip antenna using a double layer parasitic substrate. The overall performance comparison between conventional antenna with antenna using a double layer parasitic substrate as shown in Table 1.

Table 1. Overall comparison circular microstrip antenna with double layer parasitic substrate.

<table>
<thead>
<tr>
<th>Antenna</th>
<th>Antenna Dimension</th>
<th>Antenna Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Length x Width (mm)</td>
<td>Height (mm)</td>
</tr>
<tr>
<td>Conventional Antenna</td>
<td>39 x 42.5</td>
<td>1.6</td>
</tr>
<tr>
<td>Antenna with Double Layer Parasitic</td>
<td>39 x 42.5</td>
<td>34</td>
</tr>
</tbody>
</table>
From table 1, it can be illustrated that the increase in gain and bandwidth performance is significant with the addition of the double later parasitic radiator. This increase is better than the results of the previous research on adding parasitic radiators which only increased by around 10% - 20%. Simulation and Comparison of radiation patterns far-fields between circular microstrip antenna conventional with a circular antenna with addition double layer parasitic substrate as shown in figure 4 and figure 5.

**Figure 4.** Radiation pattern of far-field conventional circular microstrip.

![](image1.png)

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Frequency</td>
<td>3</td>
</tr>
<tr>
<td>Main lobe magnitude</td>
<td>4.07 dB</td>
</tr>
<tr>
<td>Main lobe direction</td>
<td>1.0 deg.</td>
</tr>
<tr>
<td>Angular width (3 dB)</td>
<td>93.3 deg.</td>
</tr>
<tr>
<td>Side lobe level</td>
<td>-11.5 dB</td>
</tr>
</tbody>
</table>

**Figure 5.** Radiation pattern of far-field circular microstrip with double layer parasitic.

The simulation result of antenna microstrip conventional show the gain is 4.07 dB, the beamwidth is 93.3° and has a sidelobe level of -11.5 dB. While the circular antenna microstrip with the addition of a double layer parasitic radiator can provide antenna gain 6.68 dB, the beamwidth 69.3° and sidelobe level -15.6 dB. These results indicate that the addition of the double layer parasitic radiator can increase gain significantly and also improve the performance of beamwidth and sidelobe level.

5. **Conclusion**

The addition of a double layer parasitic radiator has been shown to significantly increase antenna gain and bandwidth. The results of this study indicate that the addition of a double layer parasitic radiator can increase the gain by 64% and increase bandwidth by 35%. The results of this study also prove that
the addition of the double layer parasitic radiator can significantly improve the performance of the microstrip antenna radiation pattern.

Acknowledgments
The authors would like to acknowledge for Engineering Faculty Research Grant 2019, Universitas Negeri Jakarta, the Ministry of Research, Technology and Higher Education the Republic of Indonesia.

References
Journal of Physics: Conference Series

Country: United Kingdom - SJR Ranking of United Kingdom

Subject Area and Category: Physics and Astronomy
- Physics and Astronomy (miscellaneous)

Publisher: Institute of Physics

Publication type: Journals

ISSN: 17426588, 17426596

Coverage: 2005-ongoing

Scope: The open access Journal of Physics: Conference Series (JPCS) provides a fast, versatile and cost-effective proceedings publication service.

Homepage: [How to publish in this journal](#)

Contact: [Join the conversation about this journal](#)

Quartiles
- Physics and Astronomy (miscellaneous)

Citations per document

https://www.scimagojr.com/journalsearch.php?q=130053&tip=sid&clean=0
HÜSEYİN KALKAN 3 weeks ago

Cites per Document

<table>
<thead>
<tr>
<th>Year</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>0.000</td>
</tr>
<tr>
<td>2006</td>
<td>0.450</td>
</tr>
<tr>
<td>2007</td>
<td>0.419</td>
</tr>
<tr>
<td>2008</td>
<td>0.437</td>
</tr>
<tr>
<td>2009</td>
<td>0.464</td>
</tr>
<tr>
<td>2010</td>
<td>0.491</td>
</tr>
<tr>
<td>2011</td>
<td>0.521</td>
</tr>
<tr>
<td>2012</td>
<td>0.502</td>
</tr>
</tbody>
</table>

Citable Documents vs. Non-citable Documents

<table>
<thead>
<tr>
<th>Year</th>
<th>Citable Documents</th>
<th>Non-citable Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2006</td>
<td>576</td>
<td>0</td>
</tr>
<tr>
<td>2007</td>
<td>2342</td>
<td>0</td>
</tr>
<tr>
<td>2008</td>
<td>3772</td>
<td>0</td>
</tr>
</tbody>
</table>

Cited Documents vs. Uncited Documents

<table>
<thead>
<tr>
<th>Year</th>
<th>Cited Documents</th>
<th>Uncited Documents</th>
</tr>
</thead>
<tbody>
<tr>
<td>2005</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2006</td>
<td>576</td>
<td>576</td>
</tr>
<tr>
<td>2007</td>
<td>2342</td>
<td>2342</td>
</tr>
<tr>
<td>2008</td>
<td>3772</td>
<td>3772</td>
</tr>
</tbody>
</table>