



Organized by :



UNIVERSITAS
BUDI LUHUR

Supported by :



Technical Co-sponsorship :



PROCEEDING 9th EECSI 2022

9th International Conference on Electrical
Engineering, Computer Science and Informatics

October 06-07, 2022
Jakarta, Indonesia



Co-organizers :



ISBN 978-623-92135-6-5



PROCEEDINGS

9th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI) 2022

October 6 – 7, 2022, Jakarta – Indonesia

Editors:

Mochammad Facta, Ph.D

Mohammad Syafrullah, Ph. D

Munawar Agus Riyadi, Ph. D

Imam Much Ibnu Subroto, Ph. D

Irawan, M.Kom

Organizing Committee of EECSI 2022 Conference

Advisor

- Deni Mahdiana, Universitas Budi Luhur, Jakarta, Indonesia
- Nazori AZ, Universitas Budi Luhur, Jakarta, Indonesia
- Aghus Sofwan, Universitas Diponegoro, Semarang, Indonesia
- Zainudin Nawawi, Universitas Sriwijaya, Palembang, Indonesia
- Rahmat Budiarto, Albaha University, Baha, Saudi Arabia
- Novi Marlyana, Universitas Islam Sultan Agung, Semarang, Indonesia
- Andre Sugiyono, Universitas Islam Sultan Agung, Semarang, Indonesia
- Sunardi, Universitas Ahmad Dahlan, Yogyakarta, Indonesia
- Wahyudi Hasbi, IEEE Indonesia Chair

General Chair

- Mohammad Syafrullah, Universitas Budi Luhur, Jakarta, Indonesia

General Co-Chair

- Mochammad Facta, Universitas Diponegoro, Semarang, Indonesia

Finance Chairs and Treasurer

- Wiwiek Fatmawati, Universitas Islam Sultan Agung, Semarang, Indonesia
- Widodo MS, Universitas Budi Luhur, Jakarta, Indonesia
- Martini, Universitas Budi Luhur, Jakarta, Indonesia
- Lina Handayani, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

Program Chairs

- Imam Much Ibnu Subroto, Universitas Islam Sultan Agung, Semarang, Indonesia
- Deris Stiawan, Universitas Sriwijaya, Palembang, Indonesia

Publicity Chairs

- Indra Riyanto, Universitas Budi Luhur, Jakarta, Indonesia
- Irawan, Universitas Budi Luhur, Jakarta, Indonesia
- Hendri Irawan, Universitas Budi Luhur, Jakarta, Indonesia

Technical Program Chairs

- Munawar Agus Riyadi, Universitas Diponegoro, Semarang, Indonesia
- Mochammad Facta, Universitas Diponegoro, Semarang, Indonesia
- Tole Sutikno, Universitas Ahmad Dahlan, Yogyakarta, Indonesia

Local Arrangement, Exhibits & Registration Chairs

- Wiwin Windihastuty, Universitas Budi Luhur, Jakarta, Indonesia
- Titin Fatimah, Universitas Budi Luhur, Jakarta, Indonesia
- Samsinar, Universitas Budi Luhur, Jakarta, Indonesia
- Suwasti Broto, Universitas Budi Luhur, Jakarta, Indonesia
- Bambang Pujiyono, Universitas Budi Luhur, Jakarta, Indonesia
- Windarto, Universitas Budi Luhur, Jakarta, Indonesia
- Dolly Virgian Shaka Yudha Sakti, Universitas Budi Luhur, Jakarta, Indonesia
- Wasiran, Universitas Budi Luhur, Jakarta, Indonesia
- Anindya Putri Pradiptha, Universitas Budi Luhur, Jakarta, Indonesia

Technical Program Committee

Technical Program Committee

Sasikumar A	Vel Tech Rangarajan Dr Sagunthala R&D Institute of Science and Technology	India
Hadhrami Ab Ghani	Universiti Malaysia Kelantan	Malaysia
Sharin Ab Ghani	Universiti Teknikal Malaysia Melaka	Malaysia
Ab Al-Hadi Ab Rahman	Universiti Teknologi Malaysia	Malaysia
Ghulam Abbas	GIK Institute of Engineering Sciences & Technology	Pakistan
Shahliza Abd Halim	University of Technology Malaysia	Malaysia
Malaoui Abdessamad	Sultan Moulay Slimane University of Beni Mellal	Morocco
Samsul Ariffin Abdul Karim	Universiti Malaysia Sabah	Malaysia
Norkhairani Abdul Rawi	Universiti Sultan Zainal Abidin	Malaysia
Mohd Azhar Abdul Razak	Universiti Teknologi Malaysia	Malaysia
Mouhamed Abdulla	Sheridan Institute of Technology	Canada
Mohammad Faiz Liew Abdullah	Universiti Tun Hussein Onn Malaysia (UTHM)	Malaysia
Azinoor Azida Abu Bakar	Universiti Teknologi MARA Johor	Malaysia
Iwan Adhichandra	University of Sydney	Australia
Mohd Ashraf Ahmad	Universiti Malaysia Pahang	Malaysia
Hani Ahmed	Universiti Malaysia Perlis	Malaysia

Ali Al Janaby	Ninevah University	Iraq
Omar Al saif	Northern Technical University	Iraq
Haider AL-Hashimi	Basra University	Iraq
Ahmed Al-Naib	Northern Technical University	Iraq
Karim Al-Saedi	Mustansiriyah University	Iraq
Jose Alanis	Universidad Tecnologica de Puebla	Mexico
Hamid Alasadi	IRAQ- BASRA	Iraq
Mudrik Alaydrus	Universitas Mercu Buana	Indonesia
Michele Albano	Aalborg University	Denmark
Mohammed Alghamdi	Al-Baha University	Saudi Arabia
Jawad Ali	University of Technology - Iraq	Iraq
Mohammed Ali	Osmania University (A I C T E)	India
Mohammad Alibakhshikenari	Universidad Carlos III de Madrid	Spain
Sinan Alkassar	Ninevah University	Iraq
Farah Alkhalid	University of Technology	Iraq
Manilal Amipara	Gujarat Technological University	India
Dian Andriana	Indonesian Institute of Sciences	Indonesia
Rakan Antar	Northern Technical University	Iraq
Farrukh Arslan	Purdue University	USA
Dominik Aufderheide	South Westphalia University of Applied Sciences Soest	Germany
Azizul Azizan	Universiti Teknologi Malaysia (UTM)	Malaysia

Eduard Babulak	Liberty University	USA
Ashish Bagwari	IEEE Member, UTU	India
Bakhyt Bakiyev	University of Birmingham	United Kingdom (Great Britain)
M'hamed Bakrim	University of Cadi Ayyad Marrakesh	Morocco
Nguyen Bao	University of Technology and Education, Ho Chi Minh City	Vietnam
Maushumi Barooah	Gauhati University	India
João Paulo Barraca	University of Aveiro	Portugal
Ruri Basuki	University of Dian Nuswantoro	Indonesia
Vikash Bhardwaj	DEWAN VS Group of Institutions	India
Aniruddha Bhattacharjya	Koneru Lakshmaiah Education Foundation	India
Yogesh Bhomia	Amity University	India
Puneeth Bhurat	Vijaya Sales Corporation	India
Sergey Biryuchinskiy	Vigitek, Inc.	USA
Ankur Bist	KIET, Ghaziabad	India
Tee Boon Tuan	Universiti Teknikal Malaysia Melaka	Malaysia
Angelo Bruno	Senior Member	Italy
Filipe Caldeira	Polytechnic Institute of Viseu	Portugal
Rodrigo Campos Bortoletto	Instituto Federal de São Paulo	Brazil
Alessandro Carrega	UNIGE	Italy

Maria Chiara Caschera	CNR	Italy
Mayank Chaturvedi	Griffith University	Australia
Datta Chavan	Bharati Vidyapeeth Deemed University College of Engineering, Pune	India
Noraini Che Pa	Universiti Putra Malaysia	Malaysia
Tai-Chen Chen	MAXEDA Technology	Taiwan
Theofilos Chrysikos	University of Patras	Greece
Young Mo Chung	Hansung University	Korea (South)
Jose Cordeiro	School of Technology of Setubal / I. P. S.	Portugal
Pablo Corral	Universidad Miguel Hernandez de Elche	Spain
Paolo Crippa	Marche Polytechnic University	Italy
Siriporn Dachasilaruk	Naresuan University	Thailand
Ahmad Nazri Dagang	Universiti Malaysia Terengganu	Malaysia
Narottam Das	CQUniversity Australia	Australia
Giuseppe De Francesco	Global Shares	Ireland
Sorin Ioan Deaconu	Politehnica University Timisoara	Romania
Jayanta Debnath	Marshall University	USA
George Dekoulis	Aerospace Engineering Institute	Cyprus
Tresna Dewi	Politeknik Negeri Sriwijaya	Indonesia
Giuseppe Di Lucca	University of Sannio	Italy
Luca Di Nunzio	University of Rome "Tor Vergata"	Italy

Moussa Diaf	Université Mouloud Mammri	Algeria
Nishant Doshi	PDPU	India
Nikolaos Doukas	Hellenic Army Academy	Greece
Supriya Dubey	SRM Institute of Science and Technology, Ghaziabad	India
Noha El-Ganainy	Norwegian University for Science and Technology NTNU	Norway
Noriko Etani	Kyoto University	Japan
Mochammad Facta	Diponegoro University	Indonesia
Farikhin Farikin	Diponegoro University	Indonesia
Miguel Franklin de Castro	Federal University of Ceará	Brazil
Franco Frattolillo	University of Sannio	Italy
Dhomas Hatta Fudholi	Universitas Islam Indonesia	Indonesia
Raad Sami Fyath	Al-Jadriya	Iraq
Vicente García Díaz	University of Oviedo	Spain
Dodi Garinto	Politeknik Manufaktur Astra	Indonesia
Antonios Gasteratos	Democritus University of Thrace	Greece
Mihai Gavrilas	Technical University of Iasi	Romania
Siamack Ghadimi	Lund University LTH	Sweden
Alireza Ghasempour	University of Applied Science and Technology	USA
Nurzal Effiyana Ghazali	Universiti Teknologi Malaysia	Malaysia
Amin Gholoobi	Open University of Cyprus	Cyprus

Baby Gobin	University of Mauritius	Mauritius
Bok-Min Goi	Universiti Tunku Abdul Rahman (UTAR)	Malaysia
Diogo Gomes	Universidade de Aveiro	Portugal
Renaldi Gondosubroto	GReS Studio	Indonesia
Dadang Gunawan	Universitas Indonesia	Indonesia
Brij Gupta	Asia University	Taiwan
Rohit Gupta	IIT Delhi	India
Ali Hamad	University of Baghdad	Iraq
Hedi Hamdi	University Of Manouba	Tunisia
Seng Hansun	Universitas Multimedia Nusantara	Indonesia
Hao Hao	RMIT University	Australia
Dedid Happyanto	Politeknik Elektronika Negeri Surabaya	Indonesia
Maha Harzallah	ISITCOM	Tunisia
Zulfatman Has	University of Muhammadiyah Malang	Indonesia
Taufik Hasan	Institut Teknologi Telkom	Indonesia
Norazlan Hashim	Shah Alam, Selangor	Malaysia
Muhammad Hasibuan	University Gadjah Mada	Indonesia
Iswadi Hasyim Rosma	Universitas Riau	Indonesia
Hendry Hendry	Chaoyang University of Technology	Taiwan
Roberto Carlos Herrera Lara	National Polytechnic School	Ecuador

Muhammad Suzuri Hitam	Universiti Malaysia Terengganu	Malaysia
Kenneth Hopkinson	Air Force Institute of Technology	USA
Jia Hou	Soochow University	China
Duy Huynh	Ho Chi Minh City University of Technology (HUTECH)	Vietnam
Fakrulradzi Idris	Universiti Teknikal Malaysia Melaka	Malaysia
Noor Ifada	University of Trunojoyo Madura	Indonesia
Amil Ahmad Ilham	Hasanuddin University	Indonesia
Paulus Insap Santosa	Universitas Gadjah Mada	Indonesia
Kashif Ishaque	Karachi Institute of Economics and Technology	Pakistan
Hossein Jafari	Intelligent Fusion Technology, Inc.	USA
Ramkumar Jaganathan	Dr NGP Arts and Science College	India
Sudhanshu Jha	University of Allahabad, Prayagraj, INDIA	India
U c Jha	Uttar Pradesh Technical University	India
Jin Jin	University of Toronto	Canada
Endra Joelianto	Institut Teknologi Bandung	Indonesia
Mohd Muzafa Jumidali	Universiti Teknologi MARA Pulau Pinang	Malaysia
Mohammed Kaabar	Washington State University	USA
Yasin Kabalci	Nigde Omer Halisdemir University	Turkey
Katerina Kabassi	Ionian University	Greece
Emil Kaburuan	Mercu Buana University	Indonesia

Sandeep Kakde	Y C College of Engineering	India
Raveendranathan Kalathil Chellappan	College of Engineering Thiruvananthapuram	India
Dimitrios Kallergis	University of West Attica	Greece
S Kannadhasan	Study World College of Engineering	India
Chutisant Kerdvibulvech	National Institute of Development Administration	Thailand
Nor Hisham Khamis	Universiti Teknologi Malaysia	Malaysia
Muhammad Imran Khan	University College Cork	Ireland
H Kiwan	University of Regina	Canada
Jens Klare	Fraunhofer FHR	Germany
Mushtaque Korai	Yanbu Industrial College	Saudi Arabia
Muhamad Koyimatu	Universitas Pertamina	Indonesia
Dragana Krstić	University of Niš	Serbia
Cheruku Kumar	Amity University Rajasthan	India
Puneet Kumar	SIoT Lab Santa Clara University	USA
Sandeep Kumar	Central Research Laboratory, Bharat Electronics Ltd.	India
Samir Ladaci	National Polytechnic School of Algiers	Algeria
Weng Siew Lam	Universiti Tunku Abdul Rahman (UTAR)	Malaysia
Magfirawaty Magfirawaty	Politeknik Siber dan Sandi Negara	Indonesia
TC Manjunath	Dayananda Sagar College of Engineering, Bangalore, Karnataka	India

Sukrisno Mardiyanto	Institut Teknologi Bandung	Indonesia
Nikhil Marriwala	Kurukshetra University	India
Zahéra Mekkioui	University of tlemcen	Algeria
Arif Muntasa	Trunojoyo University	Indonesia
Petrus Mursanto	Universitas Indonesia	Indonesia
Imamul Muttakin	Universitas Sultan Ageng Tirtayasa	Indonesia
Ruzelita Ngadiran	Universiti Malaysia Perlis & Centre of Excellence Advanced Computing (ADVCOMP), UniMAP	Malaysia
Muhammad Niswar	Universitas Hasanuddin	Indonesia
Kuntoro Nugroho	National Taiwan University of Science and Technology	Taiwan
Robertus Nugroho	Soegijapranata Catholic University	Australia
Özgür Özdemir	Konya Technical University	Turkey
Rosaura Palma-Orozco	Instituto Politécnico Nacional	Mexico
Giovanni Palmerini	Sapienza Università di Roma	Italy
Hilman Pardede	National Research and Innovation Agency of Indonesia	Indonesia
Shashikant Patil	Mumbai University	India
Phani Krishna Penumarthy	Gigamon	USA
Thinagaran Perumal	University Putra Malaysia	Malaysia
Ricardus Pramunendar	Universitas Dian Nuswantoro	Indonesia
Tri Priyambodo	Universitas Gadjah Mada	Indonesia
Aris Puji Widodo	Diponegoro University	Indonesia

Era Purwanto	Electronic Engineering Polytechnic Institute Of Surabaya	Indonesia
Ali Rafiei	University of Technology Sydney	Australia
Helmy Rahadian	Universitas Dian Nuswantoro	Indonesia
Harikumar Rajaguru	Bannari Amman Institute of Technology	India
Grienggrai Rajchakit	Maejo University	Thailand
Shuvendu Rana	SRM University AP	United Kingdom (Great Britain)
Priya Ranjan	Bhuvaneshvar Institute of Technology	India
Oday Ridha	University of Baghdad	Iraq
Munawar Riyadi	Diponegoro University	Indonesia
Olympia Roeva	Institute of Biophysics and Biomedical Engineering	Bulgaria
Yatendra Sahu	Maulana Azad National Institute of Technology, Bhopal	India
Yassine Salih-Alj	Al Akhawayn University	Morocco
Sayantam Sarkar	MVJ College of Engineering	India
Iwan Setyawan	Satya Wacana Christian University	Indonesia
Nadheer Shalash	Al-Mamoon University College	Iraq
Aditi Sharma	Parul University, Vadodara	India
Fatina Shukur	University of Kufa	Iraq
Preecha Somwang	Rajamangala University of Technology Isan	Thailand
Ickho Song	Korea Advanced Institute of Science and Technology	Korea (South)
Harco Leslie Hendric Spits Warnars	Bina Nusantara University	Indonesia

Deris Stiawan	University of Sriwijaya	Indonesia
Joey Suba	University of the Assumption	Philippines
Imam Much Ibnu Subroto	Universitas Islam Sultan Agung	Indonesia
Suherman Suherman	Universitas Sumatera Utara	Indonesia
Sangheetha Sukumaran	Kerala Technological University	India
Hung-Min Sun	National Tsing Hua University	Taiwan
Andi Sunyoto	Universitas Amikom Yogyakarta	Indonesia
Nico Surantha	Bina Nusantara University	Indonesia
TH Sutikno	Institute of Advanced Engineering and Science	Indonesia
Tole Sutikno	Universitas Ahmad Dahlan	Indonesia
Wiwin Suwarningsih	National Research and Innovation Agency (BRIN)	Indonesia
Muhammad Syafrullah	Universitas Budi Luhur	Indonesia
Robert Szabolcsi	Óbuda University	Hungary
Srinivasulu Tadisetty	Kakatiya University College of Engineering and Technology	India
George Tambouratzis	Institute for Language & Speech Processing	Greece
Alessandro Testa	Ministry of Economy and Finance	Italy
Hapnes Toba	Maranatha Christian University	Indonesia
Tien Choon Toh	Universiti Tunku Abdul Rahman	Malaysia
Ming-Fong Tsai	National United University	Taiwan
Gloria Virginia	Duta Wacana Christian University	Indonesia

Matthias Vodel	University of Applied Sciences Mittweida	Germany
Theophilus Wellem	Satya Wacana Christian University	Indonesia
Eliana Werbin	Universidad Nacional de Córdoba	Argentina
Thaweesak Yingthawornsuk	King Mongkut's University of Technology Thonburi	Thailand
Phang Yook Ngor	Universiti Teknologi MARA Kampus Bandaraya Melaka	Malaysia
Anton Yudhana	Ahmad Dahlan University	Indonesia
Intan Yulita	Universitas Padjadjaran	Indonesia
Muhammad Yusuf	University of Trunojoyo, Madura	Indonesia
Peng Zhang	Stony Brook University	USA
Zhe Zhang	Aerospace Information Research Institute, Chinese Academy of Sciences	China
Piotr Zwierzykowski	Poznan University of Technology	Poland

Other reviewers

Additional Reviewers

Hadhrami Ab Ghani	Universiti Malaysia Kelantan	Malaysia
Shahliza Abd Halim	University of Technology Malaysia	Malaysia
Samsul Ariffin Abdul Karim	Universiti Malaysia Sabah	Malaysia
Norkhairani Abdul Rawi	Universiti Sultan Zainal Abidin	Malaysia
Azinoor Azida Abu Bakar	Universiti Teknologi MARA Johor	Malaysia
Mohd Ashraf Ahmad	Universiti Malaysia Pahang	Malaysia
Ali Othman Al Janaby	Ninevah University	Iraq
Karim Hashim Al-Saedi	Mustansiriyah University	Iraq
Jose David Alanis	Universidad Tecnologica de Puebla	Mexico
Hamid Alasadi	IRAQ- BASRA	Iraq
Michele Albano	Aalborg University	Denmark
Jawad K. Ali	University of Technology - Iraq	Iraq
Mohammed Mahmood Ali	Osmania University (A I C T E)	India
Sinan H. Alkassar	Ninevah University	Iraq
Farah Alkhalid	University of Technology	Iraq
Manilal Amipara	Gujarat Technological University	India
Dian Andriana	Indonesian Institute of Sciences	Indonesia
Farrukh Arslan	Purdue University	USA
Azizul Azizan	Universiti Teknologi Malaysia (UTM)	Malaysia
Eduard Babulak	Liberty University	USA
Bakhyt Bakiyev	University of Birmingham	United Kingdom (Great Britain)
M'hamed Bakrim	University of Cadi Ayyad Marrakesh	Morocco
Ruri Basuki	University of Dian Nuswantoro	Indonesia
Vikash Bhardwaj	DEWAN VS Group of Institutions	India
Yogesh Bhomia	Amity University	India
Sergey B. Biryuchinskiy	Vigitek, Inc.	USA

Ankur Bist	KIET, Ghaziabad	India
Tee Boon Tuan	Universiti Teknikal Malaysia Melaka	Malaysia
Angelo Bruno	Senior Member	Italy
Rodrigo Campos Bortoletto	Instituto Federal de São Paulo	Brazil
Maria Chiara Caschera	CNR	Italy
Theofilos Chrysikos	University of Patras	Greece
Young Mo Chung	Hansung University	Korea (South)
Ali Najdet Coran	Northern Technical University	Iraq
Paolo Crippa	Marche Polytechnic University	Italy
Siriporn Dachasilaruk	Naresuan University	Thailand
Ahmad Nazri Dagang	Universiti Malaysia Terengganu	Malaysia
Sorin Ioan Deaconu	Politehnica University Timisoara	Romania
Moussa Diaf	Université Mouloud Mammri	Algeria
Esmeralda Contessa Djamal	Universitas Jenderal Achmad Yani	Indonesia
Noriko Etani	Kyoto University	Japan
Amrul Faruq	Malaysia-Japan International Institute of Technology, Universiti Teknologi Malaysia	Indonesia
Raad Sami Sami Fyath	Al-Jadriya	Iraq
Mihai Gavrilas	Technical University of Iasi	Romania
Alireza Ghasempour	University of Applied Science and Technology	USA
Baby Gobin	University of Mauritius	Mauritius
Bok-Min Goi	Universiti Tunku Abdul Rahman (UTAR)	Malaysia
Renaldi Gondosubroto	GReS Studio	Indonesia
Ali H. Hamad	University of Baghdad	Iraq
Seng Hansun	Universitas Multimedia Nusantara	Indonesia
Dedid Cahya Happyanto	Politeknik Elektronika Negeri Surabaya	Indonesia
Maha Harzallah	ISITCOM	Tunisia
Zulfatman Has	University of Muhammadiyah Malang	Indonesia
Norazlan Hashim	Shah Alam, Selangor	Malaysia
Muhammad Said Hasibuan	University Gadjah Mada	Indonesia

Iswadi Hasyim Rosma	Universitas Riau	Indonesia
Hendry Hendry	Chaoyang University of Technology	Taiwan
Kenneth Mark Hopkinson	Air Force Institute of Technology	USA
Jia Hou	Soochow University	China
Fakrulradzi Idris	Universiti Teknikal Malaysia Melaka	Malaysia
Indra Indra	Universitas Budi Luhur	Indonesia
Sudhanshu Kumar Jha	University of Allahabad, Prayagraj, INDIA	India
U c Jha	Uttar Pradesh Technical University	India
Jin Jin	University of Toronto	Canada
Katerina Kabassi	Ionian University	Greece
Emil R. Kaburuan	Mercu Buana University	Indonesia
Sandeep Kakde	Y C College of Engineering	India
Raveendranathan Kalathil Chellappan	College of Engineering Thiruvananthapuram	India
ayoub E. Kamal	Ntu	Iraq
S Kannadhasan	Study World College of Engineering	India
Chutisant Kerdvibulvech	National Institute of Development Administration	Thailand
Muhammad Imran Khan	University College Cork	Ireland
H Kiwan	University of Regina	Canada
Jens Klare	Fraunhofer FHR	Germany
Mushtaque Korai	Yanbu Industrial College	Saudi Arabia
Muhamad Koyimatu	Universitas Pertamina	Indonesia
Dragana Krstić	University of Niš	Serbia
Weng Siew Lam	Universiti Tunku Abdul Rahman (UTAR)	Malaysia
Magfirawaty Magfirawaty	Politeknik Siber dan Sandi Negara	Indonesia
Sukrisno Mardiyanto	Institut Teknologi Bandung	Indonesia
Nikhil Marriwala	Kurukshetra University	India
Arief Marwanto	Universitas Islam Sultan Agung (UNISSULA) Semarang	Indonesia
Arif Muntasa	Trunojoyo University	Indonesia
Petrus Mursanto	Universitas Indonesia	Indonesia
Imamul Muttakin	Universitas Sultan Ageng Tirtayasa	Indonesia
Ruzelita Ngadiran	Universiti Malaysia Perlis & Centre of Excellence	Malaysia

	Advanced Computing (ADVCOMP), UniMAP	
Muhammad Niswar	Universitas Hasanuddin	Indonesia
Kuntoro Adi Nugroho	National Taiwan University of Science and Technology	Taiwan
Rosaura Palma-Orozco	Instituto Politécnico Nacional	Mexico
Giovanni B Palmerini	Sapienza Università di Roma	Italy
Hilman F Pardede	National Research and Innovation Agency of Indonesia	Indonesia
Shashikant S. Patil	Mumbai University	India
Teguh Prakoso	Diponegoro University	Indonesia
Ricardus Anggi Pramunendar	Universitas Dian Nuswantoro	Indonesia
Era Purwanto	Electronic Engineering Polytechnic Institute Of Surabaya	Indonesia
Harikumar Rajaguru	Bannari Amman Institute of Technology	India
Grienggrai Rajchakit	Maejo University	Thailand
Priya Ranjan	Bhuvaneshvar Institute of Technology	India
Sirimonpak S	KMUTT	Thailand
Arshad Salih	Lect.	Iraq
Iwan Setyawan	Satya Wacana Christian University	Indonesia
Nadheer A. Shalash	Al-Mamoon University College	Iraq
Aditi Sharma	Parul University, Vadodara	India
Fatina Shukur	University of Kufa	Iraq
Harco Leslie Hendric Spits Warnars	Bina Nusantara University	Indonesia
Joey Suba	University of the Assumption	Philippines
Chudanat Sudthongkhong	KMUTT	Thailand
Suherman Suherman	Universitas Sumatera Utara	Indonesia
Hung-Min Sun	National Tsing Hua University	Taiwan
Andi Sunyoto	Universitas Amikom Yogyakarta	Indonesia
Nico Surantha	Bina Nusantara University	Indonesia
Wiwin Suwarningsih	National Research and Innovation Agency (BRIN)	Indonesia
George Tambouratzis	Institute for Language & Speech Processing	Greece
Alessandro Testa	Ministry of Economy and Finance	Italy
Hapnes Toba	Maranatha Christian University	Indonesia
Triwiyanto Triwiyanto	Politeknik Kesehatan Surabaya, Kementerian	Indonesia

	Kesehatan RI	
Gloria Virginia	Duta Wacana Christian University	Indonesia
Theophilus Wellem	Satya Wacana Christian University	Indonesia
Eliana Werbin	Universidad Nacional de Córdoba	Argentina
Thaweesak Yingthawornsuk	King Mongkut's University of Technology Thonburi	Thailand
Phang Yook Ngor	Universiti Teknologi MARA Kampus Bandaraya Melaka	Malaysia
Zhe Zhang	Aerospace Information Research Institute, Chinese Academy of Sciences	China

TOC

2022 9th International Conference on Electrical Engineering, Computer Science and Informatics (EECSI)

Parallel Room 1

<i>Experimental Convolutional-Recurrent Network in ECG Rhythm for Atrial Fibrillation Classification</i> Annisa Darmawahyuni (University of Sriwijaya, Indonesia), Bambang Tutuko (Intelligent System Research Group Computer Science Faculty Universitas Sriwijaya Indonesia, Indonesia), Muhammad Naufal Rachmatullah (Universitas Sriwijaya, Indonesia), Siti Nurmaini (University of Sriwijaya, Indonesia), Firdaus Firdaus (Universitas Sriwijaya, Indonesia)	1
<i>Comparison of Machine Learning Performance for Covid-19 X-ray Image Classification Based on Texture Features</i> Yessi Jusman (Universitas Muhammadiyah Yogyakarta, Indonesia), Wikan Tyassari (University of Muhammadiyah Yogyakarta, Indonesia), Ibnu Rahmat Siddik (Universitas Muhammadiyah Yogyakarta, Indonesia), Rika Nursanthika (Universitas Muhammadiyah Yogyakarta, Indonesia), Veby Yuly Sherly (Universitas Muhammadiyah Yogyakarta, Indonesia)	7
<i>Natural language Processing and Ontology based Decision Support System for Diabetic Patients</i> Ritesh Chandra (Indian Institute of Information Technology Allahabad, India), Sadhana Tiwari (Indian Institute of Information Technology Allahabad, India), Abhaya Shukla (Manipal Institute of Technology, India), Sonali Agarwal (Indian Institute of Information Technology, Allahabad, India), Muhammad Syafrullah (Universitas Budi Luhur, Indonesia), Krisna Adiyarta (Universitas Budi Luhur, Indonesia)	13
<i>Time and Frequency Domain Feature Selection Using Mutual Information for EEG-based Emotion Recognition</i> Adhi Dharma Wibawa (Institut Teknologi Sepuluh Nopember, Indonesia), Nur Fatih (Institut Teknologi Sepuluh Nopember, Indonesia), Yuri Pamungkas (ITS Surabaya, Indonesia), Monica Pratiwi (Institut Teknologi Sepuluh Nopember, Indonesia, Indonesia), Prio Adi Ramadhani (Institut Teknologi Sepuluh Nopember, Indonesia), Suwadi Suwadi (Institut Teknologi Sepuluh Nopember, Indonesia, Indonesia)	19
<i>Evaluation of Gated-Recurrent Unit for Estimating Finger-Joint Angle using Surface Electromyography Signal</i> Zamroni Ilyas (University of Jember, Indonesia), Khairul Anam (University of Jember, Indonesia), Widjonarko Widjonarko (Universitas Jember, Indonesia), Cries Avian (National Taiwan University of Science and Technology, Taiwan), Aris Zainul Muttaqin (University of Jember, Indonesia), Mochamad Edoward Ramadhan (Ramadhan, Indonesia)	25
<i>Classification of Covid-19 Variants Using Boosting Algorithm</i> Izzudin Muhammad (Institut Teknologi Sepuluh Nopember, Indonesia), Imam Mukhlash (Institut Teknologi Sepuluh Nopember Surabaya, Indonesia), Mohammad Jamhuri (Institut Teknologi Sepuluh Nopember, Indonesia), Mohammad Iqbal (Institut Teknologi Sepuluh Nopember, Indonesia), Mohammad Isa Irawan (Institut Teknologi Sepuluh Nopember, Indonesia)	29
<i>Anomaly detection on MNIST stroke simulation dataset</i> Ojas Vishwakarma (IIIT Allahabad, India), Sonali Agarwal (Indian Institute of Information Technology, Allahabad, India), Soundra Pandian (Ministry of Electronics and Information Technology New Delhi India, India), Muhammad Syafrullah (Universitas Budi Luhur, Indonesia), Krisna Adiyarta (Universitas Budi Luhur, Indonesia), Sanjay Kumar Sonbhadra (Siksha O Anusandhan Bhubaneswar India, India)	35
<i>Detection of Fetal Cardiac Chamber Three Vessel Trachea View using Deep Learning</i> Ade Sapitri (Universitas Sriwijaya, Indonesia)	43
<i>Support Vector Machine Method for Predicting Children's Emotions</i> Fildzah Aure Gehara Zhafirah (Electronic Engineering Polytechnic Institute of Surabaya, Indonesia), Rika Rokhana (Politeknik Elektronika Negeri Surabaya & Institut Teknologi Sepuluh Nopember, Indonesia)	49
<i>Decision Support System using Weighting Similarity Model for Constructing Ground-Truth Dataset</i> M. Miftakul Amin (Politeknik Negeri Sriwijaya, Indonesia), Deris Stiawan (University of Sriwijaya, Indonesia), Ermatita Ermatita (Sriwijaya University & Computer Science Faculty, Indonesia), Imam Much Ibnu Subroto (Universitas Islam Sultan Agung, Indonesia), Lukman Lukman (Direktorat General of Higher Education Research and Technology, Indonesia)	56

<i>Comparison Of Naive Bayes And Support Vector Machine For Detecting Hoax In Indonesian Tweet Case Study Of Tweet Covid-19</i>	
Indra Indra (Universitas Budi Luhur, Indonesia), Suci Setiawati (Universitas Budi Luhur, Indonesia), Sukha Vaddhana (Universitas Budi Luhur, Indonesia), Anindita Septiarini (Universitas Mulawarman, Indonesia)	61
<i>Pot Detection System Using YOLO</i>	
Adlian Jefiza (Politeknik Negeri Batam, Indonesia), Muhammad Zainuddin Lubis (Politeknik Negeri Batam, Indonesia), Diono Diono (Politeknik Negeri Batam, Indonesia), Ahmad Maulana Prabu (Politeknik Negeri Batam, Indonesia)	67
<i>Comparative Study Of Convolutional Neural Network And Haar Cascade Performance On Mask Detection Systems Using Matlab</i>	
Faisal Ali Mahaputra (Mercu Buana University, Indonesia), Imelda Simanjuntak (Universitas Mercu Buana, Indonesia), Yuliza Yuliza (University of Mercu Buana, Indonesia), Heryanto Heryanto (Universitas Pertahanan, Indonesia), Agus Rochendi (Badan Riset dan Inovasi Nasional, Indonesia), Lukman Silalahi (Universitas Mercu Buana, Indonesia)	74
<i>Cyberattack Feature Selection using Correlation-Based Feature Selection Method in an Intrusion Detection System</i>	
Deris Stiawan (University of Sriwijaya, Indonesia), Ahmad Heryanto (Sriwijaya University, Indonesia), Mohd. Yazid Idris (Universiti Teknologi Malaysia, Malaysia), Rahmat Budiarto (Al Baha University, Saudi Arabia)	79
<i>Market Basket Analysis Using FP-Growth Algorithm On Retail Sales Data</i>	
Muhammad Raihan Pradana (Universitas Budi Luhur, Indonesia), Muhammad Syafrullah (Universitas Budi Luhur, Indonesia), Hendri Irawan (Universitas Budi Luhur, Indonesia), Irawan Irawan (Universitas Budi Luhur, Indonesia), Joko Christian Chandra (Universitas Budi Luhur, Indonesia), Achmad Solichin (Universitas Budi Luhur, Indonesia)	86

Parallel Room 2

<i>Optimizing SVM Hyperparameters using Predatory Swarms Algorithms for Use Case Points Estimation</i>	
Ardiansyah Ardiansyah (Universitas Ahmad Dahlan, Indonesia), Ridi Ferdiana (Universitas Gadjah Mada, Indonesia), Adhistrya Erna Permanasari (Universitas Gadjah Mada, Indonesia)	90
<i>A dynamic task scheduling model for mobile cloud computing</i>	
Zahraa A. Jaaz (Universiti Tenaga Nasional (UNITEN), Malaysia), Shaymaa Adnan Abdulrahman (Imam Jaafer Alsadiq & Ainsams, Iraq), Hanaa M. Mushgil (AlNahrain University, Iraq)	96
<i>Author Classification on Bibliographic Data Using Capsule Networks Architecture</i>	
Firdaus Firdaus (Universitas Sriwijaya, Indonesia), Wais Alqarni (Intelligent System Research Group, Indonesia), Siti Nurmaini (University of Sriwijaya, Indonesia), Annisa Darmawahyuni (University of Sriwijaya, Indonesia), Ade Sapitri (Universitas Sriwijaya, Indonesia), Muhammad Naufal Rachmatullah (Universitas Sriwijaya, Indonesia), Suci Dwi Lestari (Universitas Sriwijaya, Indonesia)	101
<i>Improving the Accuracy of Text Classification Using the Over Sampling Technique in the Case of Sinovac Vaccine</i>	
Muhammad Rizky Pribadi (Universitas Multi Data Palembang, Indonesia), Hindriyanto D Purnomo (Satya Wacana Christian University, Indonesia), Hendry Hendry (Chaoyang University of Technology & Satya Wacana Christian University, Taiwan), Kristoko Dwi Hartomo (Universitas Kristen Satya Wacana, Indonesia), Irwan Sembiring (Universitas Kristen Satya Wacana Salatiga, Indonesia), Ade Iriani (Satya Wacana Christian University, Indonesia)	106
<i>Prediction of Non-Performing Loans For Credit Application Analysis of Rural Bank Using Random Forest</i>	
Mutiara Annisa (Universitas Budi Luhur, Indonesia), Rusdah Rusdah (Universitas Budi Luhur, Indonesia)	111
<i>Data Fusion for Predictive Maintenance of Industrial Assets Using Digital Twin</i>	
Christian Avornu (Huzhou University, China)	115
<i>Best Lecturer Decision Support System Using Method Analytical Hierarchy Process (AHP) and Method SAW</i>	
Nurhayati Nur Nurhayati (Universitas Budi Luhur, Indonesia), Dwi Pebrianti (International Islamic University Malaysia, Malaysia), Luhur Bayuaji (UMP, Malaysia), Muhammad Syafrullah (Universitas Budi Luhur, Indonesia)	122
<i>Implementation of LSSVM in Classification of Software Defect Prediction Data with Feature Selection</i>	
Thingkilia Finnatia Husin (Universitas Multi Data Palembang, Indonesia), Muhammad Rizky Pribadi (Universitas Multi Data Palembang, Indonesia), Yohannes Yohannes (Universitas Multi Data Palembang, Indonesia)	126
<i>Research on optimization strategy of medical data information security and privacy</i>	
Haider Abdulshaheed (Baghdad College, Iraq), Sura Abdulmunem Mohammed Al-Juboori (Ministry of Higher Education and Scientific Research, Iraq), Intisar A.M Al-Sayed (Ashur University College, Iraq), Israa Al Barazanchi (College of Computing and Informatics & Universiti Tenaga Nasional (UNITEN), Malaysia), Hassan Muwafaq Gheni (Al Mustaqbal University College & Babylon University Collage of Engineering, Iraq), Zahraa A. Jaaz (Universiti Tenaga Nasional (UNITEN), Malaysia)	132

<i>Predicting Risk Matrix in Software Development Projects using BERT and K-Means</i>	
Marzuki Pilliang (Esa Unggul, Indonesia), Munawar Munawar (Esa Unggul University, Indonesia), Muhammad Hadi (Esa Unggul University, Indonesia), Gerry Firmansyah (Esa Unggul University, Indonesia), Budi Tjahjono (Esa Unggul University, Indonesia)	137
<i>Development of Knowledge Management System with Soft System Methodology in Aquatic Organization</i>	
Anugerah Widi (University of Multi Data Palembang, Indonesia), Eko Sedyono (Universitas Kristen Satya Wacana, Indonesia), Kristoko Dwi Hartomo (Universitas Kristen Satya Wacana, Indonesia), Irwan Sembiring (Universitas Kristen Satya Wacana Salatiga, Indonesia), Ade Iriani (Satya Wacana Christian University, Indonesia), Hendry Hendry (Chaoyang University of Technology & Satya Wacana Christian University, Taiwan)	143
<i>An Information Security Policy Development Process in Higher Education Institution: A Case Study</i>	
Wan Basri Wan Ismail (Management & Science University, Malaysia), Setyawan Widyarto (Universiti Selangor, Malaysia), Krisna Adiyarta (Universitas Budi Luhur, Indonesia), Muhammad Syafrullah (Universitas Budi Luhur, Indonesia), Laili Mardziah Tajuddin (Universiti Selangor, Malaysia)	147
<i>Optimization of Sentiment Analysis using Naïve Bayes with Features Selection Chi-Square and Information Gain for Accuracy Improvement</i>	
Denni Kurniawan (Universitas Budi Luhur, Indonesia)	153
<i>Hybrid Method for Churn Prediction Model in The Case of Telecommunication Companies</i>	
Dwi Pebrianti (International Islamic University Malaysia, Malaysia), Desti Destiansari Istinabiyah (Budi Luhur University, Indonesia), Luhur Bayuaji (FSKPP, Universiti Malaysia Pahang, Malaysia), Rusdah Rusdah (Universitas Budi Luhur, Indonesia)	161

Parallel Room 3

<i>Intelligent Sentiment Analysis on Cellphone Checking by Police Officer</i>	
Barep Prasetyo (Indonesia), Yaya Sudarya Triana (University of Mercu Buana, Indonesia), Rahmat Budiarto (Al Baha University, Saudi Arabia), Deris Stiawan (University of Sriwijaya, Indonesia)	167
<i>Fuzzy Cognitive Maps for Intelligent Agent's Artificial Situational Awareness in Collaborative Driving Context</i>	
Rinta Kridalukmana (Diponegoro University, Indonesia), Dania Eridani (Diponegoro University, Indonesia), Risma Septiana (Diponegoro University, Indonesia), Adian Fatchur Rochim (Diponegoro University, Indonesia), Charisma Setyobudhi (Diponegoro University, Indonesia)	173
<i>Monitoring System of Natural Disaster from Twitter Messages Using Support Vector Machine</i>	
Casi Setianingsih (Telkom University, Indonesia)	179
<i>Forecasting indoor temperature for smart buildings with ARIMA, SARIMAX, and LSTM: A fusion approach</i>	
Shashi Shekhar Kumar (Indian Institute of Information Technology Allahabad, India), Ashutosh Kumar (Indian Institute of Information Technology Allahabad, India), Sonali Agarwal (Indian Institute of Information Technology, Allahabad, India), Muhammad Syafrullah (Universitas Budi Luhur, Indonesia), Krisna Adiyarta (Universitas Budi Luhur, Indonesia)	186
<i>User Satisfaction Analysis of PeduliLindungi Application Using End User Computing Satisfaction (EUCS) Method</i>	
Ahmad Reza Yudistira (Telkom University, Indonesia), Hilal H. Nuha (Telkom University, Indonesia), Kusuma Adi Achmad (Telkom University & City Government of Pekalongan, Indonesia)	193
<i>The Analysis of Readiness and Acceptance of Learning Management System (LMS) Usage in Universities of East Java</i>	
Fahrobby Adnan (University of Jember, Indonesia), Maulida Dwi Agustiningsih (KH Achmad Siddiq State Islamic University, Indonesia), Lutfi Ariefianto (University of Jember, Indonesia)	198
<i>Utilization of Smart Greenhouse to Increase Chrysanthemum Growth in the Vegetative Phase by Monitoring Using Firebase</i>	
Muhammad Tito Maiza Henanda (Telkom University, Indonesia), Hilal H. Nuha (Telkom University, Indonesia), Endro Ariyanto (Telkom University, Indonesia)	204
<i>Smart Attendance for Lecture with Physical Distancing Based on The Internet of Things (IoT)</i>	
Nur Fauzan Jundi Rabbany (Telkom University, Indonesia), Hilal H. Nuha (Telkom University, Indonesia), Muhammad Johan Alibasa (Telkom University, Indonesia)	210
<i>Combining Dynamic K-Means and Binary Search Centroid to Optimize Clustering Results on Home Industry Datasets</i>	
Hadi Santoso (ISB Atma Luhur, Indonesia), Hilyah Magdalena (ISB Atma Luhur, Indonesia)	215

<i>Comparison of Anomaly Based and Signature Based Methods in Detection of Scanning Vulnerability</i> Ismail Puji Saputra (Universitas Muhammadiyah Metro & Universitas Amikom Yogyakarta, Indonesia), Ema Utami (Universitas Amikom Yogyakarta, Indonesia), Alva Muhammad (Universitas Amikom Yogyakarta, Indonesia)	221
<i>Feature Selection using Chi Square to Improve Attack Detection Classification in IoT Network: Work in Progress</i> Zulhipni Reno Saputra Elsi (Univeritas Sriwijaya & Univeritas Muhammadiyah Palembang, Indonesia), Deris Stiawan (University of Sriwijaya, Indonesia), Ahmad Fali Oklilas (Faculty of Computer Science, Universitas Sriwijaya, Indonesia), Susanto Susanto (Sriwijaya University & Universitas Bina Insan, Indonesia), Kurniabudi Kurniabudi (STIKOM Dinamika Bangsa, Indonesia), Yesi Novaria Kunang (Universitas Sriwijaya & Universitas Bina Darma, Indonesia), Mohd. Yazid Idris (Universiti Teknologi Malaysia, Malaysia), Rahmat Budiarto (Al Baha University, Saudi Arabia)	226
<i>Implementation of the Affine Segmentation Point Method and Image Blending Techniques in Creating New Songket Motifs</i> Agung Ramadhani (Universitas Putra Indonesia YPTK Padang, Indonesia), Jufriadif Na'am (Universitas Putra Indonesia YPTK Padang, Indonesia), Gunadi Widi Nurcahyo (Universitas Putera Indonesia YPTK Padang, Indonesia), Yuhandri Yunus (Universitas Putra Indonesia YPTK Padang, Indonesia)	233
<i>Auto-Generating Business Process Model From Heterogeneous Documents: A Comprehensive Literature Survey</i> Uce Indahyanti, UI (Institut Teknologi Sepuluh Nopember Surabaya & Universitas Muhammadiyah Sidoarjo, Indonesia), Arif Djunaidy (Institut Teknologi Sepuluh Nopember, Indonesia), Daniel Siahaan (Institut teknologi Sepuluh Nopember, Indonesia)	239
<i>Usability Analysis of My TelU Application Using System Usability Scale</i> Fajar Angga Sigalingging (Telkom University & Telkom Indonesia, Indonesia), Muhammad Johan Alibasa (Telkom University, Indonesia), Hilal H. Nuha (Telkom University, Indonesia)	244
<i>E-counseling-based Expressive Writing Therapy Platform for Overcoming Student Mental Health Problems</i> Tiffany Nabarian (Nurul Fikri College of Technology, Indonesia), Yekti Wirani (Nurul Fikri College of Technology, Indonesia), Miftahussaadah Putri Siddiq (Nurul Fikri College of Technology, Indonesia), Aseptianova Aseptianova (University of Muhammadiyah Palembang, Indonesia), M. Zalili Aziz (University of Muhammadiyah Palembang, Indonesia), Ananto Dwi Saputro (Badan Siber dan Sandi Negara, Indonesia)	250

Parallel Room 4

<i>Multi-Criteria Decision-Making Method for Supplier Selection in Transformer Production</i> Utku Balci (Galatasaray University, Turkey)	256
<i>Analysis of Starting Current And Electrical Energy In Three Phase Induction Motor As A Chemical Processing System In. PT RIAU ANDALAN PULP & PAPER</i> Fadhli Palaha (Sekolah Tinggi Teknologi Pekanbaru, Indonesia), Yolnasdi Yol (Sekolah Tinggi Teknologi Pekanbaru, Indonesia), Ermawati Erma (Sekolah Tinggi Teknologi Pekanbaru, Indonesia), Engla Harda Arya (Sekolah Tinggi Teknologi Pekanbaru, Indonesia), Machda Machadalena (Sekolah Tinggi Teknologi Pekanbaru, Indonesia), Eki Ki Rinal (Sekolah Tinggi Teknologi Pekanbaru, Indonesia)	264
<i>Design and Implementation of an Internet of Things Based Smart Energy Meter using Radio Frequency communication protocol</i> Ahmed Ibrahim Elkassar (Arab Academy for Science and Technology, Egypt), Eman Hamdan (Arab Academy for Science and Technology, Egypt), Walid A.M. Ghoniem (Arab Academy for Science and Technology, Egypt), Ahmed Abouelfarag (Arab Academy for Science and Technology, Egypt)	270
<i>Construction of Slow and Fast Field Antenna for Detecting Lightning Strikes in South Sumatera</i> Wiwini Oktaviani (Universitas Sriwijaya, Indonesia), Muhammad Abu Bakar Sidik (Faculty of Engineering, Universitas Sriwijaya Ogan Ilir, Indonesia), Mohd Riduan Ahmad (Universiti Teknikal Malaysia Melaka, Malaysia), Muhammad Irfan Jambak (Universitas Sriwijaya, Indonesia), Rio Yusdzali (Universitas Sriwijaya, Indonesia)	276
<i>Preliminary Analysis on State Vector and Computational Time of Dynamic State Estimation</i> Nurul Fauzana Imran Gulcharan (Universiti Teknologi Petronas, Malaysia), Hanita Daud (Universiti Teknologi PETRONAS, Malaysia), Nursyarizal Bin Mohd Nor (Universiti Teknologi Petronas, Malaysia), Taib Ibrahim (Malaysia)	283
<i>Identification of impedance changes in metal using RFID RC522 based on arduino uno</i> Vector Pratomo (Universitas Pancasila, Indonesia), Wisnu Broto (Universitas Pancasila, Indonesia), Gunady Haryanto, GH (University of Pancasila, Indonesia), Untung Priyanto (Pancasila University, Indonesia)	288

<i>Deep Learning Neural Networks Diagnosis of Power Transformer through Its DGA Data</i> Hansel Matthew (Universitas Indonesia, Indonesia), Aqila Dzikra Ayu (Universitas Indonesia, Indonesia), Iman Herlambang Suherman (Universitas Indonesia, Indonesia), Aries Subiantoro (Universitas Indonesia, Indonesia), Benyamin Kusumoputro (Universitas Indonesia, Indonesia)	292
<i>Simulation of D-shaped Optical Fiber Sensor for Adulterant Traces in Liquid Petrochemical</i> Najwa Azzahari (Universiti Teknologi Malaysia, Malaysia), Husni Hani Jameela Sapongi (Laser Center, Universiti Teknologi Malaysia, Malaysia)	297
<i>Control and Monitoring System Design Tunnel Light Using NodeMCU and Arduino Nano and networking</i> Albert Gifson Hutajulu (ITPLN, Indonesia), Juara Mangapul Tambunan (ITPLN, Indonesia), Hendrianto Husada (INSTITUT TEKNOLOGI PLN Jakarta, Indonesia), Yani Prabowo (Computer Science & Universitas Budi Luhur, Indonesia)	301
<i>IoT-Based Smart Parking Management System Using ESP32 Microcontroller</i> Joni W. Simatupang (President University, Indonesia & NTUST, Taiwan), Aida Mahdalena Lubis (President University, Indonesia), Vincent Vincent (Institut Teknologi Bandung, Indonesia)	305
<i>Lamp Brightness Control System Using First Order Sugeno Fuzzy Model</i> Wahyudi Wahyudi (Departemen Teknik Elektro UNDIP, Indonesia)	311
<i>Carbon Monoxide Monitoring System based on IoT with Low Power Sensor Node for Indoor Applications</i> Amalia Nur Hikmah (National Chin-Yi University of Technology, Taiwan, Taiwan), C. Bambang Dwi Kuncoro (National Chin-Yi University of Technology, Taiwan)	316
<i>The Fuzzy PID Controller Performance in BLDC Motor Rotor Speed Variable</i> Nana Sutarna (Politeknik Negeri Jakarta, Indonesia), Bernadeta Purwanti (Politeknik Negeri Jakarta, Indonesia), Lingga Suhadha (Politeknik Negeri Jakarta, Indonesia)	321

Parallel Room 5

<i>An integrated model based on the location-based services for Higher Educational Systems LBS-HES</i> Ahmed Alshafut (IT, Saudi Arabia)	327
<i>Analysis Perceptions Regarding Student Exchange Using Simple Random Sampling and AHP Methods</i> Orissa Octaria (University of Multi Data Palembang & Satya Wacana Christian University, Indonesia), Kristoko Dwi Hartomo (Universitas Kristen Satya Wacana, Indonesia), Irwan Sembiring (Universitas Kristen Satya Wacana Salatiga, Indonesia), Hindriyanto D Purnomo (Satya Wacana Christian University, Indonesia), Ade Iriani (Satya Wacana Christian University, Indonesia), Eko Sedyono (Universitas Kristen Satya Wacana, Indonesia)	331
<i>People Tracking and Re-Identifying in Distributed Contexts: Extension Study of PoseTRelD</i> Ratha Siv (University of Mons, Belgium), Matei Mancas (University of Mons, Belgium), Bernard Gosselin (University of Mons, Belgium), Dona Vally (Institute of Technology of Cambodia, Cambodia), Sokchenda Sreng (Institute of Technology of Cambodia (ITC), Cambodia)	337
<i>Spelling Checking with Deep Learning Model in Analysis of Tweet Data for Word Classification Process</i> Arif Ridho Lubis (Politeknik Negeri Medan, Indonesia), Mahyuddin K. M. Nasution, yudi (Universitas Sumatera Utara & Fakultas Ilmu Komputer dan Teknologi Informasi (Fasilkom-TI) USU, Indonesia), Opim Salim Sitompul (Universitas Sumatera Utara, Indonesia), Elviawaty Muisa Zamzami (Universitas Sumatera Utara, Indonesia)	343
<i>Sentiment Analysis of Text Memes: A Comparison Among Supervised Machine Learning Methods</i> Endah Asmawati (Institut Teknologi Sepuluh Nopember & Universitas Surabaya, Indonesia), Ahmad Saikhu (Institut Teknologi Sepuluh Nopember, Indonesia), Daniel Siahaan (Institut teknologi Sepuluh Nopember, Indonesia)	349
<i>Ensemble Image Colorization using Convolutional Neural Network</i> Kriztoper D Urmeneta (University of the Philippines Visayas Tacloban College, Philippines), Victor Romero II (University of the Philippines, Philippines)	355
<i>Improving Recommender Systems Performance with Cross-domain Scenario: Anime and Manga Domain Studies</i> Rizal Broer Bahaweres (UIN Jakarta - IPB University & Computer-iEEE, Indonesia), Ahmad Ruslan Almujaiddi (State Islamic University Syarif Hidayatullah Jakarta, Indonesia)	361

<i>Brain Tumor Detection on Magnetic Resonance Imaging (MRI) Images Using Convolutional Neural Network</i> Rarasmarya Indraswari (Institut Teknologi Sepuluh Nopember, Indonesia), Indira Ardan (Institut Teknologi Sepuluh Nopember (ITS), Indonesia), Agus Arifin (Institut Teknologi Sepuluh Nopember Surabaya, Indonesia), Aris Tjahyanto (Sepuluh Nopember Institute of Technology, Indonesia), Nur Aini Rakhmawati (Institut Teknologi Sepuluh Nopember Surabaya, Indonesia), Renny Kusumawardani (Institut Teknologi Sepuluh Nopember (ITS), Indonesia)	367
<i>Fine-Grained Sentiment Analysis on PeduliLindungi Application Users with Multinomial Naive Bayes-SMOTE</i> Imam Suyuti (Universitas Sebelas Maret, Indonesia), Dewi Retno Sari S. (Universitas Sebelas Maret, Indonesia)	374
<i>Sentiment analysis on E-Marketplace User Opinions Using Lexicon-Based and Naive Bayes Model</i> Safitri Juanita (Universitas Budi Luhur, Indonesia), Krisna Adiyarta (Universitas Budi Luhur, Indonesia), Muhammad Syafrullah (Universitas Budi Luhur, Indonesia)	379
<i>Extraction of Event Sentence Information in the Covid-19 Distribution Location Detection System based on the Indonesian Language Corpus</i> Erwin E (Universitas Sriwijaya, Indonesia), Fathoni Fathoni (Universitas Sriwijaya, Indonesia), Abdiansah Abdiansah (Universitas Sriwijaya, Indonesia)	383
<i>Hops Plants Disease Detection using Feature Selection based BPSO-SVM</i> Athiyatul Farhanah (Telkom University, Indonesia), Wikky Fawwaz Al Maki (Telkom University, Indonesia)	389
<i>Analysis of Job Placement Based on Employee Competency Using Profile Matching</i> Hari Soetanto (Universitas Budi Luhur, Indonesia), Painem Painem (Universitas Budi Luhur, Indonesia), Utomo Budiyanto (Budi Luhur University, Indonesia)	394

Parallel Room 6

<i>Compact MIMO Antenna Array for 5G Applications</i> Sabah Ghadeer (Universiti Teknologi Malaysia (UTM), Iraq), Sharul Kamal A. Rahim (Universiti Teknologi Malaysia, Malaysia), Taha Elwi (UPM, Malaysia)	399
<i>Large Scale Lightning Electromagnetic Interference to 4G Mobile Communication Network</i> Muhammad Ammar Jamal Akbar (Universiti Teknikal Malaysia Melaka, Malaysia), Mohd Riduan Ahmad (Universiti Teknikal Malaysia Melaka, Malaysia), Shamsul Ammar Shamsul Baharin (Universiti Teknikal Malaysia Melaka, Malaysia), Mardina Abdullah (Universiti Kebangsaan Malaysia, Malaysia), Mohamad Zoinol Abidin Bin Abd Aziz (Universiti Teknikal Malaysia Melaka & Hang Tuah Jaya, Malaysia), Gaopeng Lu (University of Science and Technology of China & School of Earth and Space Sciences, China)	403
<i>Development of Autonomous Control System using Self-Organizing Map and Autoregressive Self-Organizing Map</i> Aqila Dzikra Ayu (Universitas Indonesia, Indonesia), Hansel Matthew (Universitas Indonesia, Indonesia), Iman Herlambang Suherman (Universitas Indonesia, Indonesia), Aries Subiantoro (Universitas Indonesia, Indonesia), Benyamin Kusumoputro (Universitas Indonesia, Indonesia)	407
<i>Design and Analysis of Multi-Core Fiber with SDM (Space Division Multiplex) Technology in Singapore to Surabaya via Southern Sea of Java</i> Tri Kushartadi (University of Indonesia, Indonesia), Teuku Rafi (Universitas Indonesia, Indonesia), Akhmad Sarif (Universitas Indonesia, Indonesia), Catur Apriono (Universitas Indonesia, Indonesia)	414
<i>On the Performance of a Composite Right Left Hand Electromagnetic Bandgap Structure</i> Rana Riad Al-Taie (AL-Mustansiriya University, Iraq), Mustafa Mahdi Ali (Mustansiriyah University, Iraq & Iraqi Engineering Union, unknown), Yasir Al-adhami (Al-Turath University, Iraq), Hind Salim Ghazi Action (Al-Turath University College Computer Engineering, Iraq), Noor Noori (Universiti Putra Malaysia, Malaysia), Taha Elwi (UPM, Malaysia)	420
<i>Triple band fractal based on T stub waveguide for sub-6 of 5G</i> Ahmed Raed Al-Tameemi (Al-Nisour University College, Iraq), Goh Chin Hock (Universiti Tenaga Nasional, Malaysia), Taha Elwi (UPM, Malaysia), Taha Raad Al-Shaikhli (Al-Nisour University College, Iraq), Jamal Kamil Kh. Abbas (Al-Nisour University College, Iraq), Bashar Sami Bashar (Al-Nisour University College, Iraq), Mohammed Abed Jawad (Al-Nisour University College, Iraq)	424
<i>Stock Prediction of Multivariable Using Bi-Long Short Term Memory and Capsule Neural Network</i> Ade Ridwan Nugraha (Universitas Jenderal Ahmad Yani, Indonesia), Esmeralda Contessa Djamal (Universitas Jenderal Achmad Yani, Indonesia), Ridwan Ilyas (Universitas Jenderal Achmad Yani, Indonesia)	429

<i>Meta-Heuristic Algorithm to Research on Path Planning Problem of Optical Fiber Transmission Network</i>	
Suhad Qasim (University of Al- Nahrine, Iraq), Noor ALfaisaly (AL Nahrain University, Iraq), Ammar Ibrahim Majeed (Al-Nahrain University, Iraq)	435
<i>Wifi-6 Antenna Design to Increase Data Traffic Offloading with HFSS and PCAAD Software</i>	
Ruliyanta Ruliyanta (Universiti Teknikal Malaysia Malaka, FKEKK Jl. Durian Tunggal Ayer Keroh Malaka & Universitas Nasional, Jakarta, Indonesia), Mohd Riduan Ahmad (Universiti Teknikal Malaysia Melaka, Malaysia), Azmi Awang Md Isa (Universiti Teknikal Malaysia Melaka, Malaysia), Viktor Vekky Ronald Repi (Universitas Nasional, Indonesia)	441
<i>A Novel Conformal MIMO Antenna Array based a Cylindrical Configuration for 5G Applications</i>	
Ahmed Raed Al-Tameemi (Al-Nisour University College, Iraq), Taha Elwi (UPM, Malaysia), Goh Chin Hock (Universiti Tenaga Nasional, Malaysia), Taha Raad Al-Shaikhli (Al-Nisour University College, Iraq), Bashar Sami Bashar (Al-Nisour University College, Iraq), Mohammed Abed Jawad (Al-Nisour University College, Iraq), Jamal Kamil Kh. Abbas (Al-Nisour University College, Iraq)	446
<i>An Investigation of Ultrashort Pulses Propagation in Atmospheric Turbulence of FSO Communications</i>	
Ucuk Darusalam (Universitas Nasional, Indonesia), Purnomo Sidi Priambodo (Universitas Indonesia, Indonesia)	452
<i>Optimizing Detection Using Multiple Threshold to Combat Low SNR Regime in CRN</i>	
Arief Marwanto (Universitas Islam Sultan Agung (UNISSULA) Semarang, Indonesia), Haikal Satria (Universiti Teknologi Malaysia, Malaysia), Sharifah Kamilah Syed Yusof (Universiti Teknologi Malaysia, Malaysia)	457

Construction of Slow and Fast Field Antenna for Detecting Lightning Strikes in South Sumatera

Wiwin A. Oktaviani Anwar
Student of Doctoral Programme in
Engineering Sciences
Sriwijaya University
Jalan Sriwijaya Negara Bukit Lama
Ilir Barat I Palembang, Indonesia
03013622025001@student.unsri.ac.id

Muhammad Abu Bakar Sidik
Doctoral Programme in Engineering
Sciences
Sriwijaya University
Jalan Sriwijaya Negara Bukit Lama
Ilir Barat I Palembang, Indonesia
abubakar@unsri.ac.id

Mohd Riduan Ahmad
Atmospheric and Lightning Research
Lab, Centre for Telecommunication
Research and Innovation (CeTRI)
Fakulti Kejuruteraan Elektronik dan
Kejuruteraan Komputer (FKEKK)
Universiti Teknikal Malaysia Melaka
(UTeM) Hang Tuah Jaya, Durian
Tunggal, Melaka, Malaysia
riduan@utem.edu.my

Muhammad Irfan Jambak
Doctoral Programme in Engineering
Sciences
Sriwijaya University
Jalan Sriwijaya Negara Bukit Lama
Ilir Barat I Palembang, Indonesia
irfjambak@unsri.ac.id

Rio YUSDIZALI
Dept. of Electrical Engineering
Sriwijaya University
Jalan Sriwijaya Negara Bukit Lama
Ilir Barat I Palembang, Indonesia
03041381621096@student.unsri.ac.id

Abstract— Two antennas - a slow-field antenna and a fast-field antenna - are constructed to measure the electric field generated by lightning. A 50-ohm RG-58 coaxial cable connects each antenna to a high-speed buffer circuit. The OPA633 is utilized in both buffer circuits, which have identical designs. The only difference between the two buffer circuits is the buffer capacitance value, which is 15 pF for the fast field and 10 nF for the slow field. The electric field measured by this circuit represents the electric field strength normal to the ground. Both buffer circuits function well up to frequencies of 100 kHz for the slow field and 1 MHz for the fast field, according to the test findings and circuit simulation with NI MULTISIM 13.0. This measuring equipment has successfully captured electromagnetic waves from lightning with noise levels as low as 180 mV.

Keywords—slow field, fast field, buffer circuit, parallel plate antenna, lightning detection

I. INTRODUCTION

Lightning is a very complex discharge process that emits energy and electromagnetic radiation. Lightning occurs when two different regions of the atmosphere receive a charge large enough to produce an electric field. The increase in the electric field turns the air into a conductor. As a result, the lightning channel acts as an effective transmitting antenna for electromagnetic waves over a wide frequency range from ULF to VHF [1]. The lightning strike is an atmospheric discharge phenomenon regarded as one of the world's most severe natural disasters. This discharge can harm living beings or buildings directly or indirectly through induced currents that result in a rise in electric potential between one or more sites of contact. Forest fires, building damage, disruption to various electronic and telecommunications systems, damage to electrical power systems, and harm or death to humans and animals were examples of physical impairment [2]–[4]. This reason is the fundamental foundation of lightning protection.

Cloud-to-ground (CG) lightning is one of the four types of lightning that causes the most damage to people, facilities, structures, and equipment [5]. One of the most often used approaches for studying and characterizing the features of CG lightning flashes – such as current amplitude, current derivative, polarity, multiplicity, and total flash duration – was indirect lightning measurement. It utilized sensors and remote

devices to capture the emitted electric fields formed during the discharge. These measurements led to the identification of several features of the CG flash that were important for formulating lightning protection standards and establishing a lightning warning network and localization system.

One feasible way for researchers to measure electric fields was to use two parallel plate antennas with identical characteristics [6]–[11] separated by a distance known as the baseline. Lightning electromagnetic radiations propagate vertically throughout all directions from the discharge channel, where they are recognized and recorded by the parallel plate antenna. Different field signatures are sensed by this antenna, which is linked to an electrical circuit through a coaxial cable. Lightning generates electric and magnetic field signatures recorded by the parallel plate antenna system. Detailed information about the parallel plate antenna system and calibration was found in [12]. This measuring system had some advantages, such as simplicity of implementation, low cost, and excellent capability to provide valuable information [5].

This paper presents the design of a parallel plate antenna and the electronic circuit, which was functioned to detect the intensity of the slow and fast electromagnetic fields generated by lightning discharges in the Southern Equator. The measuring system was installed on the roof of the PTBA Building at the Faculty of Engineering, Sriwijaya University Palembang Campus, South Sumatra. Preliminary findings are also presented in this paper.

II. METHOD

A. Electromagnetic Field Measurement System

The fast and slow electromagnetic fields are measured using two antennas separated by about 2 m. The physical dimensions and design of the antenna were based on research by Galvan and Fernando [12] that was later adjusted by other researchers [13]–[16]. Figures 1 and 2 show the physical features of the antennas used in this study and the configuration of the measuring equipment.

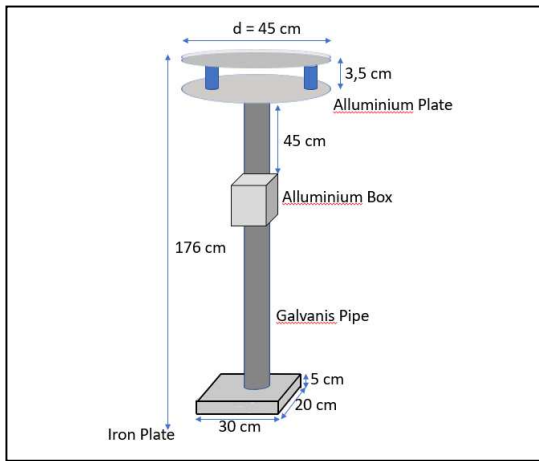


Fig 1. The physical dimensions and design of the antenna used in the study

In principle, any shape may be utilized for the antenna that measures the vertical electric field. The circular antenna is utilized in this study since a circle has no sharp edges like a rectangular shape at which corona may occur at the corner or tapered part, impacting the measurement. The air gap between plates, d , is set to 3.5 cm to keep the capacitance between parallel plates small, according to equation $C = (eA)/d$. The value of C will affect the value of the decay time constant τ_d .

As shown in Figure 2, measurement of changes in the intensity of electromagnetic fields generated during flash is carried out using broadband E-field parallel plate antenna connected to the:

1. Buffer circuit as a signal amplifier/buffer in the certain frequency range in the form of : (a) slow-field buffer that works at the frequency of 1Hz-100 kHz to record static components and induction changes in electromagnetic fields from lightning strikes that occur at a radius of less than 30 km from the observation station [17]; (b) fast-field buffers are used to record the activity of electromagnetic radiation fields with frequencies of 1 Hz – 3 MHz, indicating a series of processes from a series of CG-flashes pulses and also to observe amplitude and rise time values.
2. Picoscope 5000 series data acquisition device integrated into a PC.

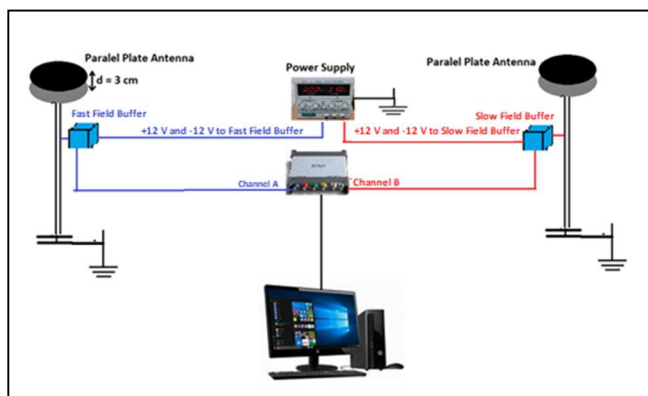


Fig 2. System measurement configuration

The 50- Ω coaxial cable (type RG-58) connects both antennas with a series of buffers. The cable length leading to the fast-field buffer input is 23 cm long, and the slow-field buffer input along 28 cm. Both buffer outputs are connected to a Picoscope 5000 series input using a 6 m long coaxial cable. The fast-field buffer circuit is connected to channel A

(CH. A) on a Picoscope, while a slow-field buffer circuit is connected to channel B (CH. B). The equivalent circuit of the measurement system is shown in Fig 3.

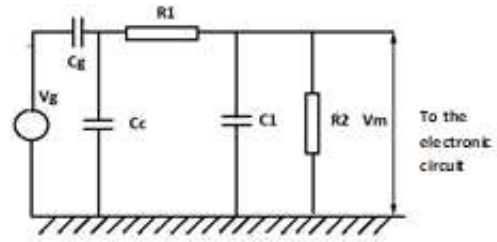


Fig 3. The equivalent circuit of measurement system [12],[18],[19].

The parallel plate antenna has a capacitance of 60.5 pF (C_g). It is connected to the electronic circuit through an RG58 coaxial cable with a capacitance value of 93.5085 pF/m (C_c). Capacitor C_1 is an electrical element to measure the voltage change on the antenna plate (V_g). This voltage change is proportional to the electric field change produced by a lightning flash. For the fast field antenna, the value of C_1 is 15 pF, while for the slow field is 10 nF. A 50-ohm resistor, R_1 , is placed at the entry of the electrical circuit to terminate the characteristic impedance of the coaxial cable, which connects the antenna and the electrical circuit. Since the input impedance of the buffer amplifier is very high, resistor R_2 is shunted with C_1 to extend the decay time constant, R_2C_1 . The value of R_2 is 100 M Ω .

A high-speed buffer circuit is required to obtain accurate lightning E-field measurement results. IC OPA 633 KP from Burr Brown was utilized as a high-speed buffer. The IC OPA 633 KP is a high-speed buffer amplifier with monolithic gain with a bandwidth of 260 MHz and a high slew rate (2500 V/ μ s) [20]. Another advantage of this IC is that its high output current capability allows the OPA633 to drive the 50 Ω cable used in our measurement system

B. Calculation of Capacitance Values and Buffer Circuit Initiation Frequency

The first step was calculating the capacitance values of the fast-field buffer circuit and slow field (C_b), the connecting coaxial cable from the antenna to each input buffer circuit buffer (C_{c-in}), and the connecting coaxial cable from the buffer circuit output buffer to the Picoscope input (C_{c-out}). The capacitance value of this coaxial cable was determined by its length multiplied by its specific capacitance value. The circuit capacitance value is listed in Table 1.

TABLE I. THE CAPACITANCE VALUE OF THE ELECTROMAGNETIC FIELD MEASUREMENT SYSTEM

No	Component	Capacitance
1	Parallel plate antenna, C_o	60,5 pF
2	Buffer fast field, C_{ff}	15 pF
3	Buffer slow field, C_{sf}	10 nF
4	Coaxial cable – input buffer fast field, $C_{c-in-ff}$	21,507 pF
5	Coaxial cable – input buffer slow field, $C_{c-in-sf}$	26,182 pF
6	Coaxial cable buffer fast field – input Picoscope	1533.539 pF
7	Coaxial cable buffer slow field – input Picoscope	1366.159 pF

The next step determined each buffer circuit's decay time and the initial frequency response. By using the capacitance values listed in Table 1, it is obtained:

The decay time constant (τ) for fast-field buffer antenna is calculated using Eq. 1.

$$\tau = R \cdot C_T = R \cdot (C_a + C_{c-in-ff} + C_{ff}) \quad (1)$$

$$\begin{aligned} \tau &= (100M\Omega) (60.5 \text{ pF} + 21,507 \text{ pF} + 15 \text{ pF}) \\ &= 9,7007 \text{ ms} \end{aligned}$$

And the decay time constant (τ) antenna for the slow-field buffer is obtained using Eq. 2.

$$\tau = R \cdot C_T = R \cdot (C_a + C_{c-in-sf} + C_{sf}) \quad (2)$$

$$\begin{aligned} \tau &= (100M\Omega) (60.6 \text{ pF} + 26,182 \text{ pF} + 10 \text{ nF}) \\ &= 1008,2007 \text{ ms} \end{aligned}$$

Those decay time constants are large enough to record lightning-generated electric field signals accurately with reasonable accuracy.

From the value of τ , the initial frequency response (f_o) in the fast-field buffer amplifier circuit is calculated using Eq. 3.

$$f_o = \frac{1}{2\pi\tau} = \frac{1}{2 \cdot 3,14 \cdot (0,0097\text{s})} = 16,4 \text{ Hz} \quad (3)$$

And for slow-field buffer amplifier circuit is obtained using Eq. 4.

$$f_o = \frac{1}{2\pi\tau} = \frac{1}{2 \cdot 3,14 \cdot (1,0082\text{s})} = 0,16 \text{ Hz} \quad (4)$$

C. Testing of Buffer Circuit

Before being used for actual measurement, the slow and fast field buffer circuits needed to be tested. The arrangement of the measurement circuit is shown in Figure 4. Direct measurements on the buffer circuit were performed by connecting the buffer output to the Channel A of the Picoscope. And the buffer input was connected to the generator function in the Picoscope device. Two 9 V batteries were used to power the buffer circuit. Then, the circuit was injected with various values of the sine wave frequency. The frequency was set in Picoscope application software on the PC. The frequency response waveform of the buffer circuit will appear on the PC screen.

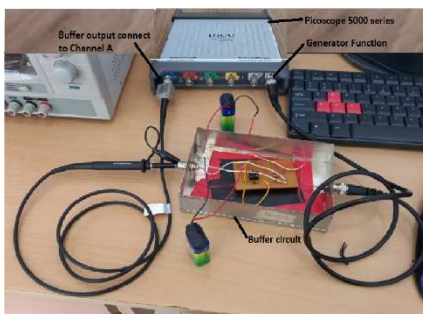
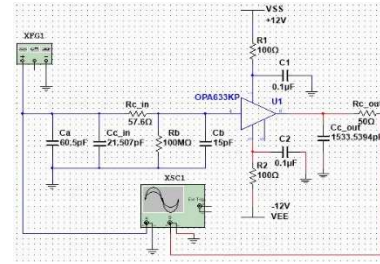


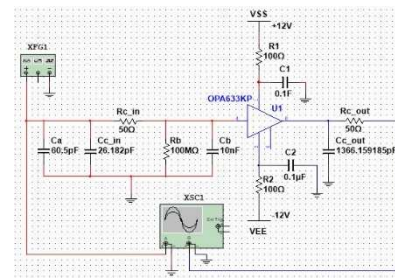
Fig 4. Buffer test circuit

D. Simulating the system using MULTISIM

The circuit was then simulated using NI MULTISIM 13.0 software to determine the frequency response of the measurement system. Figure 5 depicts the simulation equivalent circuit of a fast-field buffer and a slow-field buffer.



(a)



(b)

Fig 5. The simulation test circuit of (a) fast filed antenna and (b) slow field antenna

The electronic components used in this study refer to the previous research[12], [13]. Two high-frequency ceramic capacitors of 0.1 μF (C_1 & C_2) were used in both buffer circuits to bypass the power supply connection. They are placed as close as possible to the power supply pins of the buffer for high-frequency decoupling. The 100-ohm resistors R_1 & R_2 were connected in series with the power supply pins to protect the circuit against damage caused by high currents. The 50-ohm resistor, R_{c-out} , was placed in series at the output buffer to match the impedance of the circuit to the line's characteristic impedance.

The parameter used to assess circuit performance was the ratio between the input voltage of the buffer circuit (V_m) and the voltage change on the antenna plate (V_g). A buffer circuit filters the frequency spectrum of the lightning flash signal [21] without amplifying it [17]; thus, a suitable buffer circuit has a ratio value close to 1. For simulation, the frequency values tested on both circuits were 1 Hz, 10 Hz, 100 Hz, 1 kHz, 10 kHz, 100 kHz, and 1 MHz, and specifically for fast-field buffer circuits, one test frequency value of 10 MHz was added.

E. Himawari-8 Satellite Cloud Type Imaging

The Himawari-8 geostationary satellites operated by the Japan Meteorological Agency (JMA) support weather forecasting, tropical cyclone tracking, and meteorology research. Most meteorological agencies in East Asia, Southeast Asia, Australia, and New Zealand utilize satellites for their weather monitoring and forecasting operations. One Japanese institution that operates the Himawari-8 data archiving and redistribution service is JAXA (Japan Aerospace Exploration Agency) Himawari Monitor which provides Himawari-8 download system services and data processing (<http://www.eorc.jaxa.jp/ptree/index.html>).

On the Jaxa Himawari Monitor website, there is a cloud-type option that lists the cloud top pressure and optical thickness measurements made for each cloudy pixel throughout the day. As demonstrated in the figure's color caption section, this information may be used to categorize various types of clouds. The names of the cloud categories used here merely approximate the climatological link between the satellite-measured optical characteristics and the traditional morphological cloud types. Cloud types are indicated by color coding at the bottom of the satellite image, where cumulus clouds are shown in pink.

Additionally, a cloud thickness menu that shows the optical thickness parameter of the cloud at visible wavelengths is available on this page (approximately 0.6 microns). If the cloud equally covers the pixels, the cloud thickness determines the amount of apparent solar reflectivity recorded by the satellite from the cloudy scene. Figure 6 illustrates the association between cloud type and cloud thickness.

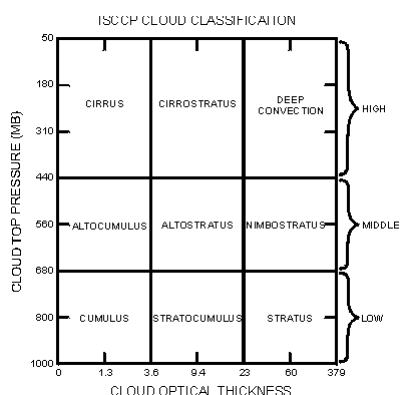


Fig 6. ISCCP Cloud Classification [21]

III. RESULT AND DISCUSSION

A. Buffer Circuit Performance

The buffer circuit was simulated with NI MULTISIM 13.0 software. The simulation results of the fast-field buffer and slow-field buffer circuits are shown in Figure 7. The result indicates that both buffer circuits have a good response and perform well up to 1 MHz for the fast field and 100 kHz for the slow field. The proposed buffer circuit may therefore be used to measure the E-field produced by lightning.

As previously stated, the buffer circuit is initially evaluated using a generator function to determine how the buffer circuit responds to frequency. Figure 8 demonstrates that both buffer circuits have a good frequency response, shown by frequency response waveforms that are almost pure sinusoidal. The waveform has a little ripple, especially at low frequencies (1 Hz to 100 Hz), although the ripple lessens as the frequency increases. This result demonstrates that the buffer circuit still generates tolerable noise.

This test also measured the voltage, as shown in Table 2. These results indicate that the buffer circuit is functioning well, as indicated by the value of the measuring voltage V_m which is close to the voltage optical value on the antenna, V_g .

TABLE II. BUFFER VOLTAGE MEASUREMENT

Buffer Circuit	Frekuensi (Hz)	V_g (V)	V_m (V)
Slow-field	1	2,091	2
	10	4,041	4
	100	4,106	4
	1000	4,041	4
	10000	4,041	4
	100000	3,341	4
Fast-field	1000000	0,6241	4
	1	2,091	2
	10	4,041	4
	100	4,041	4
	1000	4,041	4
	10000	4,041	4
	100000	4,041	4
	1000000	4,041	4

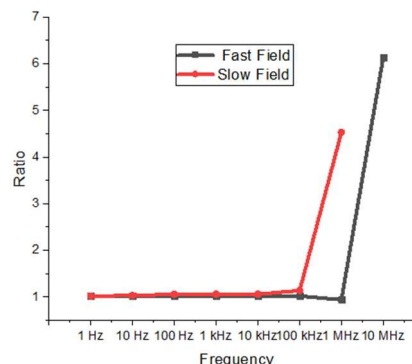


Fig 7. The comparison ratio (V_m/V_g) between slow and fast field buffers

B. Result of Measurement System Field Test

Field tests are the next step to see if the measuring system—the antenna and a buffer circuit—delivers accurate E-field measuring. The measuring system is located on top of the PTBA Building ($-3^\circ 22' 13.87''$, $103^\circ 42' 37.14''$), Faculty of Engineering Sriwijaya University, Palembang Campus, which has a height of 9.17 m from ground level.

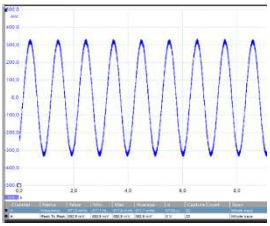

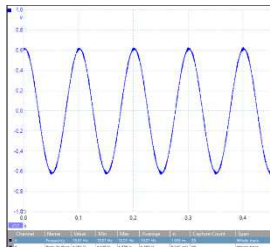
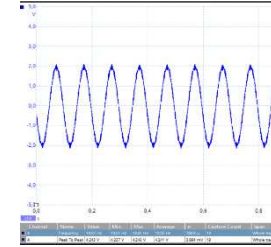
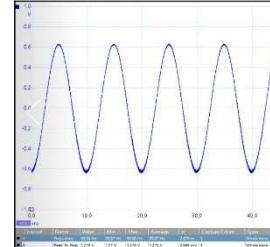
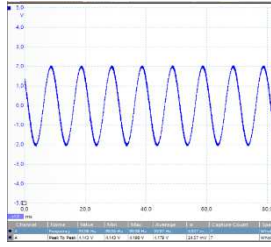
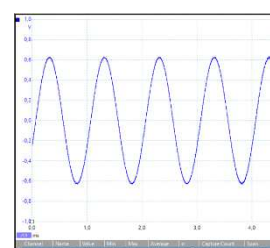
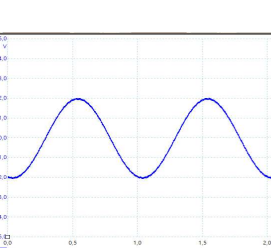
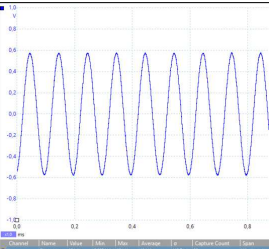
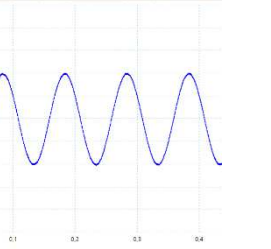
The Picoscope display was configured as follows to obtain the measurement of E-field emission, particularly the return stroke wave :

- Recording time : 500 ms
- Number of samples : 10 MS.
- Hardware resolution : 12 bit
- Trigger Mode : single
- Coupling mode : AC.
- Voltage range channel A : $\pm 5V$ (fast field)
- Voltage range channel B : $\pm 2V$ (slow field)
- Pre-trigger time : 20%
- Trigger level : 2V for channel A (fast field)

The recording time, the number of samples, hardware resolution, and pre-trigger time are based on prior studies [22]–[24]. The system managed to capture a return stroke of lightning E-field waves on 8 June 2022, as shown in Figure 9. The 180 mV range of noise is still present in the collected waves for both antennas, but it is tolerable.

The return stroke wave taken by the fast field antenna is shown in Figure 9 as a blue line, while the return stroke wave captured by the slow field antenna is shown as a red line. The waveform changes of both antennas co-occurred, indicating that the RS wave captured by the measurement system was within a radius of 30 km from the station.

Buffer Circuit Testing Result

Frequency	Slow Filed Buffer	Fast Field Buffer
1 Hz		
10 Hz		
100 Hz		
1 kHz		
10 kHz		

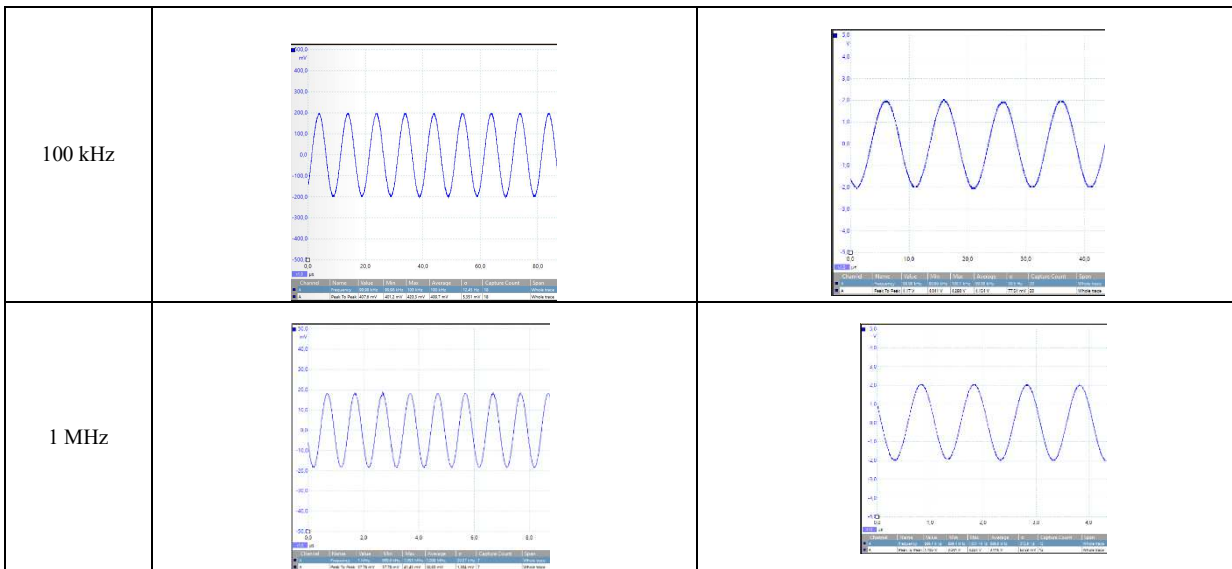
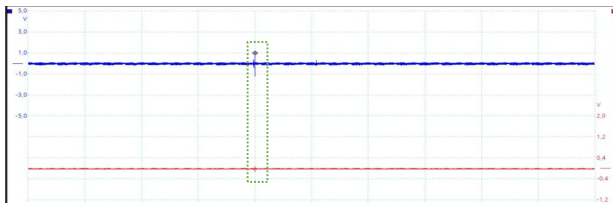
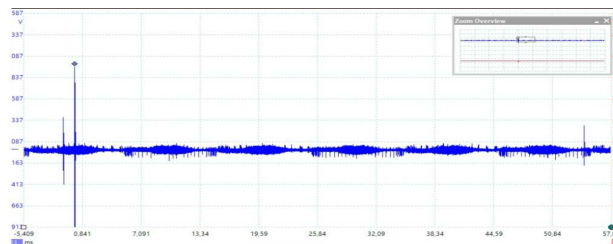


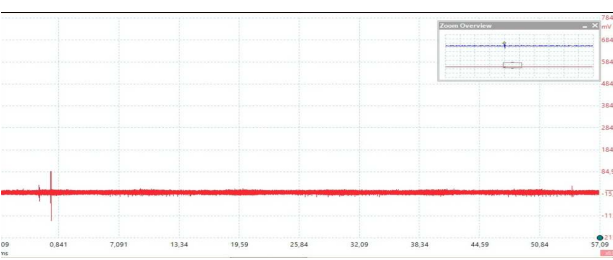
Fig 8. The frequency response waveform of the buffer circuit



(a) Lightning E-field in slow and fast field buffer on June 8th, 2022



(b) Enlarged image of fast field wave on June 8th, 2022



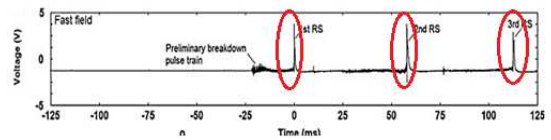
(c) Enlarged image of slow field wave on June 8th, 2022

Fig 9. Lightning E-field recorded by the proposed measurement system

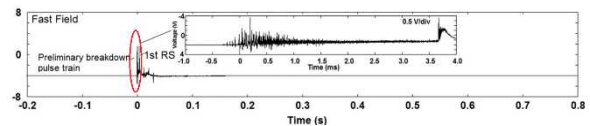
The captured waveform resembles the return stroke (RS) wave observed in several other areas, such as Malaysia and Sweden [25] and Padang, West Sumatra [24], as shown in

Figure 10. RS waves are characterized by sudden high spikes on the microsecond and sub-microsecond timescales [26].

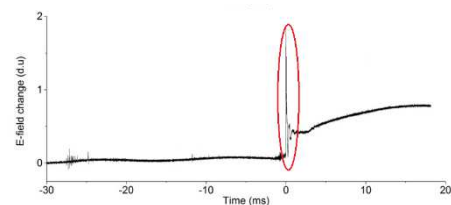
The data from sensors were also confirmed by comparing the changes in the electric field recorded by the measurement system with the Himawari-8 IR-enhanced satellite imaging results. The image showed lightning flash occurrences accompanied by lightning cloud activity (cumulonimbus) in the Palembang region, as shown in Figure 11. The cumulus cloud activity in the Palembang region appeared on June 8th, 2022 at 01.00 UTC (08.00 WIB), as shown in the Himawari satellite image. This image indicated that lightning activity occurred simultaneously with the detected waves.



(a)



(b)



(c)

Fig 10. Examples of return stroke waveforms taken during a thunderstorm in (a) Malaysia, (b) Sweden, and (c) Padang, West Sumatra [24], [25].

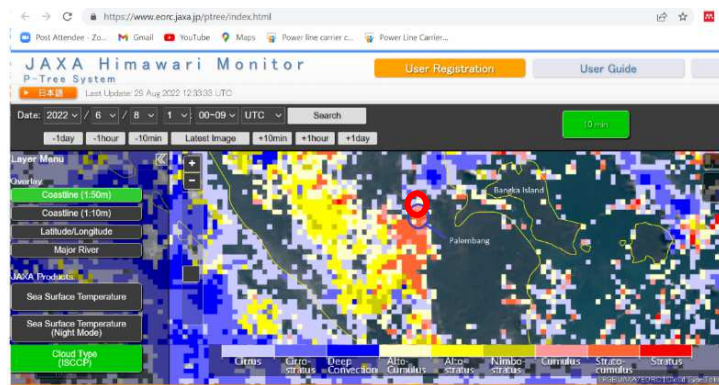


Fig 11. JAXA Himawari Monitor's cloud-type for the Palembang area at 01.00 UTC on June 8th, 2022

IV. CONCLUSION

The developed system has proven capable of receiving and recording the lightning-generated electric fields on June 2022 in Palembang, South Sumatra. Since this system is also meant to be a lightning locating system in South Sumatra, the study described in this paper still needs development and improvement. Further works will involve creating a VHF antenna to complement the current system and formulating a mathematical model for signal pre-processing based on the South Sumatra lightning emission signal characteristics to improve lightning strike location detection.

REFERENCES

- [1] P. B. Adhikari, "Measurement of Electric Field Due to Lightning Radiation," in *The 8th International Conference on Computer Engineering and Networks (CENet2018)*, Cham, 2020, pp. 38–43. doi: 10.1007/978-3-030-14680-1_5.
- [2] BBC News, "Jaipur: Lightning strike kills 16 taking selfies in India - BBC News," 12 July, 2021. <https://www.bbc.com/news/world-asia-india-57801398> (accessed 16 January, 2022).
- [3] J. Salerno, L. Msalu, T. Caro, and M. Mulder, "Risk of injury and death from lightning in Northern Malawi," *Natural Hazards*, vol. 62, Jul. 2012, doi: 10.1007/s11069-012-0113-9.
- [4] U.S. Department of Health & Human Services, "Lightning Strike Victim Data | Lightning | CDC," *Centre for Disease Control and Prevention*. <https://www.cdc.gov/disasters/lightning/victimdata.html> (accessed 16 January, 2022).
- [5] A. Santa-Acosta, L. M. Morales-Garcia, and H. E. Rojas-Cubides, "Practical Method to Evaluate the Effects of the Sensor and the Environment on the Measurement of Lightning-Generated Electric Field Signatures," *Engineering Journal*, vol. 25, no. 8, pp. 137–152, Aug. 2021, doi: 10.4186/ej.2021.25.8.137.
- [6] W. Ibrahim, M. R. Ghazali, S. A. Ghani, and Z. Abdul-Malek, "Measurement of vertical Electric fields from lightning flashes using parallel plate antenna," Jun. 2011, pp. 466–471. doi: 10.1109/INECCE.2011.5953927.
- [7] W. I. Ibrahim and M. R. Ghazali, "Measurements of electric and magnetic fields due to lightning strokes based on single-station detection," in *2012 IEEE Asia-Pacific Conference on Applied Electromagnetics (APACE)*, Dec. 2012, pp. 268–273. doi: 10.1109/APACE.2012.6457674.
- [8] D. Periannan *et al.*, "Performance Analysis of Flame Retardant 4 Copper Plate Antenna for Lightning Remote Sensing," *IOP Conf. Ser.: Earth Environ. Sci.*, vol. 228, p. 012006, Feb. 2019, doi: 10.1088/1755-1315/228/1/012006.
- [9] B. Y. Seah *et al.*, "The Performance Evaluation of Capacitive Antenna with Various Structures and Permittivity Values," in *2018 International Conference on Electrical Engineering and Computer Science (ICECOS)*, Pangkal Pinang, Oct. 2018, pp. 457–460. doi: 10.1109/ICECOS.2018.8605184.
- [10] M. M. Ismail, M. Rahman, V. Cooray, S. Sharma, P. Hettiarachchi, and D. Johari, "Electric Field Signatures in Wideband, 3 MHz and 30 MHz of Negative Ground Flashes Pertinent to Swedish Thunderstorms," *Atmosphere*, vol. 6, no. 12, Art. no. 12, Dec. 2015, doi: 10.3390/atmos6121837.
- [11] P. B. Adhikari, "Various Types of Lightning Electric Field Signatures Observed in Kathmandu, Nepal," vol. 7, no. 1, p. 6, 2019.
- [12] A. Galván and M. Fernando, "Operative characteristics of a parallel-plate antenna to measure vertical electric fields from lightning flashes," 2000. Accessed: 25 February, 2022. [Online]. Available: <http://urn.kb.se/resolve?urn=urn:nbn:se:uu:diva-40072>
- [13] C. M. Edirisinghe, I. M. K. Fernando, and U. Sonnadara, "Construction of a high speed buffer amplifier to measure lightning generated vertical electric fields," Mar. 2001.
- [14] A. Hazmi, P. Emeraldi, M. I. Hamid, and N. Takagi, "Some Characteristics of Multiple Stroke Negative Cloud to Ground Lightning Flashes in Padang," *International Journal on Electrical Engineering and Informatics*, vol. 8, pp. 438–450, Jun. 2016, doi: 10.15676/ijeei.2016.8.2.14.
- [15] K. Mehranzamir, H. N. Afrouzi, Z. Abdul-Malek, Z. Nawawi, M. A. Bakar Sidik, and M. Irfan Jambak, "Hardware Installation of Lightning Locating System Using Time Difference of Arrival Method," in *2019 International Conference on Electrical Engineering and Computer Science (ICECOS)*, Batam Island, Indonesia, Oct. 2019, pp. 29–34. doi: 10.1109/ICECOS47637.2019.8984497.
- [16] F. A. Haris, M. Z. A. A. Kadir, S. Sudin, D. Johari, and M. N. Hamzah, "Measurement of Negative Lightning Return Strokes Using a Proposed Small-Scale Parallel Plate Antenna at the Central Region in Peninsular Malaysia," *J. Phys.: Conf. Ser.*, vol. 2107, no. 1, p. 012016, Nov. 2021, doi: 10.1088/1742-6596/2107/1/012016.
- [17] M. R. M. Esa, M. R. Ahmad, and V. Cooray, "Wavelet analysis of the first electric field pulse of lightning flashes in Sweden," *Atmospheric Research*, vol. 138, pp. 253–267, Mar. 2014, doi: 10.1016/j.atmosres.2013.11.019.
- [18] C. M. Edirisinghe, I. M. K. Fernando, and U. Sonnadara, "Construction of a high speed buffer amplifier to measure lightning generated vertical electric fields," Mar. 2001.
- [19] K. Mehranzamir, H. N. Afrouzi, Z. Abdul-Malek, M. Nafea, and S. A. Rufus, "Detecting Sensor Coordination in a Calibrated Lightning Locating System," in *ICECOS - Int. Conf. Electr. Eng. Comput. Sci., Proceeding*, 2019, pp. 35–40. doi: 10.1109/ICECOS47637.2019.8984443.
- [20] B. Burr, "OPA633 data sheet, product information and support | TI.com," 1993. <https://www.ti.com/product/OPA633> (accessed 29 July, 2022).
- [21] International Satellite Cloud Climatology Project, "ISCCP: ISCCP Cloud Types," *International Satellite Cloud Climatology Project*. <https://isccp.giss.nasa.gov/cloudtypes.html> (accessed 30 August, 2022).
- [22] A. Nag and V. A. Rakov, "Positive lightning: An overview, new observations, and inferences," *Journal of Geophysical Research: Atmospheres*, vol. 117, no. D8, 2012, doi: 10.1029/2012JD017545.
- [23] C.-L. Wooi, Z. Abdul-Malek, B. Salimi, N. A. Ahmad, K. Mehranzamir, and S. Vahabi-Mashak, "A Comparative Study on the Positive Lightning Return Stroke Electric Fields in Different Meteorological Conditions," *Advances in Meteorology*, vol. 2015, p. e307424, May 2015, doi: 10.1155/2015/307424.
- [24] A. Hazmi, P. Emeraldi, M. I. Hamid, N. Takagi, and D. Wang, "Characterization of Positive Cloud to Ground Flashes Observed in Indonesia," *Atmosphere*, vol. 8, no. 1, Art. no. 1, Jan. 2017, doi: 10.3390/atmos8010004.
- [25] Z. A. Baharudin, N. A. Ahmad, M. Fernando, V. Cooray, and J. S. Mäkelä, "Comparative study on preliminary breakdown pulse trains observed in Johor, Malaysia and Florida, USA," *Atmospheric Research*, vol. 117, pp. 111–121, Nov. 2012, doi: 10.1016/j.atmosres.2012.01.012.