Hybrid PV-T Solar Collector using Amorphous Type of Solar Cells for Solar Dryer

Elieser Tarigan
Dept. of Electrical Engineering, and
PusLET
University of Surabaya

Surabaya Indonesia
elieser@staff.ubaya.ac.id

Abstract—**Solar energy that available in the form of radiation can be directly converted into heat and/or electricity using a solar device collector. Conventional solar thermal collectors generally convert sunlight into heat solely, an the other hand, a photovoltaic (PV) panels usually used solely for generating electricity. In this study, a photovoltaic solar panel is attempted to use both as solar thermal and as electricity generator at the same time so-called hybrid photovoltaic-thermal (PV-T) collector for a solar dryer system. The literature related to hybrid PV-T applications are reviewed, and a small scale solar dryer utilizing amorphous type photovoltaic-thermal (PV-T) as a collector is designed and tested. A 40 Wp amorphous solar panel is used as a solar collector and covered with double glass at the top. The output air temperature of the collector is found to vary from 35 to 50 ^{o}C during the day with the global solar irradiation of 300 – 1000 W/m^2. The output of electricity varies 4 – 25 Watt.**

Keywords—solar dryer, PV-T, solar module, solar collector

I. INTRODUCTION

For many kinds of agricultural products, the drying process is an essential process in post-harvest. The productivity and the quality of products are affected by the adequateness of the drying process. In fact, the traditional sun drying to dry agricultural products is still practiced in many places in Indonesia [1]. More appropriate ways need to be attempted to improve the quality of products as well as the hygienists' aspects. At the same time, to improve the productivity and economics of the farmers. The utilization of solar energy using solar dryers is one way for this purpose. Indonesia has advantages for its location around the equator, where solar irradiation is available abundantly throughout the year.

Solar radiation can be directly converted into heat and/or electricity using a solar device collector. Conventional solar thermal collectors generally convert sunlight into heat solely, an the other hand, a photovoltaic (PV) panels usually used solely for generating electricity. In converting solar radiation into electricity, the commercial Solar PV modules give about 17 % [2], [3] of efficiency, which means that it converts the portion of solar energy falling into the modules electricity. The higher remaining energy portion is absorbed by the cells and is converted into heat, which results in a higher temperature of cells. On the other hand, the efficiency of the PV module decreases when the cells temperature and the module increases mean less electricity generated. Higher efficiency can be produced in the form of heat by solar thermal collectors system, and however, in comparison with PV modules (in the similar area of dimension), the solar thermal collectors are commonly more expensive.

One way to increase the amount of harvested energy from solar radiation is by converting it with the combination of thermal or heat and energy electricity generation in one single collector. The system is called Hybrid photovoltaic-thermal (PV-T) collectors. The hybrid PV-T also has the advantage that the PV module gets cooled by the extraction of heat, and therefore it gives higher efficiency. The most important thing that the extracted heat can be used for other heating purposes such as air heating in a solar dryer.

The present studies are to review the development of hybrid PV-T collectors, particularly their use for solar drying. Besides, a small hybrid PV-T solar collector was designed and constructed for a solar dryer. The amorphous PV module type was chosen for it less expensive in comparison to other types of PV cells. A preliminary test was carried out for the dryer, and the results are discussed. The designed dryer in this study is expected to use for drying of herbal material, which is a part of studies in the faculty of pharmacy, University of Surabaya, Indonesia. The hybrid PV-T solar dryer is assumed a good application for such purposes as the heated air could be used directly to dry the products, while and electricity is to supply power to control airflow and temperature in the drying chamber [4].

II. METHODS

The studies in this paper are done both by literature reviews and designing, constructing, and testing a small scale PV-T solar dryer. The literature review is done to review the development of PV-T collectors and its

application in solar drying. The overall methodology is as shown in the flowchart in Fig.1.

A PV-T solar dryer based was constructed by employing an amorphous type of PV module. The PV modules acted as a solar collector, both thermal and electricity. The module consists of 40 Wp capacity, covered with double glass at the top. To minimize heat loss of the collector, at the bottom and both sides are insulated with rock wool and covered with a zink plate at the outer layer. The specification of the PV module used as a solar collector is presented in Table 1. The drying chamber was constructed separately and connected with the solar collector with a pipe through where heated air flows to the trays in the chamber. The schematic of the dryer is shown in Fig. 2. Preliminary evaluation (with no load), was conducted, and the results are discussed.

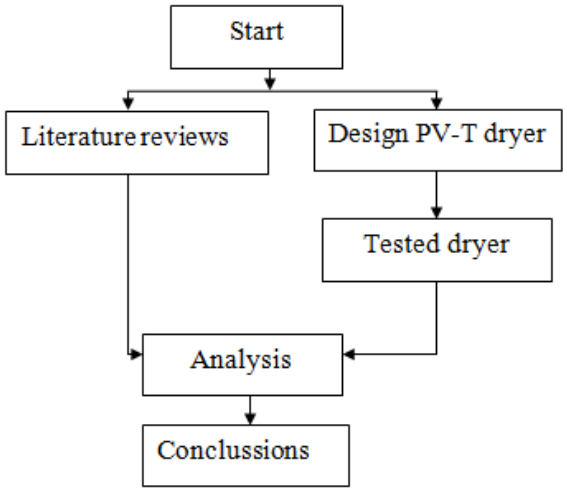

Fig.1. The overall methodology flowchart

TABEL 1. SPECIFICATION OF SOLAR PV MODULE USED

Specifications	Unit/Number/ Type
Solar Panel Type	Amorphous
Dimensions	648x1253x37 (mm)
Maximum Power	40 Watt Peak
Current at max. power	1 A
Voltage at max	46 V
Maximum System Voltage	600 V
Open Circuit Voltage	61 V
Short Circuit Current	1 A

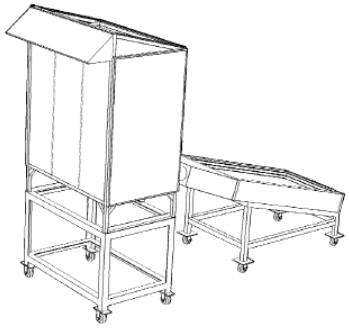

Fig 2. The schematic diagram of the dryer

III. RESULTS AND DISCUSSION

A. Solar Hybrid PV-T Collectors Review

A number of researches reported the studies on the topic of solar hybrid PV-T air collectors. The following are the selected publications that were reviewed in this section, and among them are related to the application of solar drying. Sharma et al. [5] and Sebaii & Shalaby [6] reviewed different technologies of the solar dryer. It is reported that very limited studies on the implementation of PV-T technology for solar drying.

Chow [7] and Tyagi et al. [4] reviewed the technologies development of PV-T collectors. They found that the hybrid PV collectors technologies would be a promising type of equipment in the future. Their reviews also show that extensive research on hybrid PV-T system technologies has been carried out during the last 30 years all over the world.

Hegazy [8] investigated the performance of four different models of solar PV-T collectors with a variation of air mass flow and flow ratio. The optimum flow ratio, i.e., channel depth to length, for variable mass flow operation was reported about 2.5 x 10-3. While the optimum air mass flow was found around 0.02 to 0.03 kg/s m². Bambrook et al. [9] reported that additional energy from PV would exceed the power needed by a fan with air flowrate in the range of 0.03 – 0.05 kg/s m². A study on the electrical performance of the mono-crystalline PV module under STC as a result of cooling by forced air ventilation was reported by Kim et al. [10].

Aste et al. [11] studied the performance of a hybrid PV-T collector system was by comparing the results from the real design with the theoretical model. It was found that using double glazing cover on the top of the collector resulted in higher thermal efficiency. This is due to the lower heat losses through the top side. However, due to losses by higher temperature operation, the electrical output decreased by about 16 %[12].

Tripanagnostopoulos [12] reported that the electrical efficiency of the PV module increases by about 1.6% by cooling by using it as an air collector in comparison to the normal operation. It was suggested that the surface of the air channel opposite the PV panel should be made of materials with high emissivity in order to increase the

radiation heat transfer. The possibility of increasing the heat transfer into the air was also studied. The air channel was modified to be like small fins on the surface, and placing small tubes and thin metal sheet in the air channel. These modifications resulted in the raising of the opposite air channel wall temperatures.

The air channel depth effects in the solar PV-T collectors were investigated by Farshchimonfared et al. [13] Solar PV-T collectors with different area dimensions were studied. The purposes of the studies were to identify the optimum length/width ratio of the collectors. The size of the total area corresponds to the optimum air channel was investigated. The results showed that the collector width is proportional to the air mass flow rate per unit collector area.

The effect of the airflow and heat transfer in the air gap behind PV cells was studied and reported by Persson [14]. It was reported that only a small portion of heat would be transferred from the PV modules to the air. It is estimated that the transferred heat varies from 7 - 26 %, and it depends on the air velocity. Tiwari et al. [15] investigated the performance under the no-load condition of a mixed-mode PV-T solar dryer. The generated electricity by the PV module was used to supply power for a fan in the drying system for air circulation.

B. Desain of a Small Scale PV-T Solar Dryer

A small scale solar dryer that using a hybrid PV-T solar collector was designed, constructed, and preliminarily tested. As earlier mentioned, the solar PV-T collector consists of 40 Wp amorphous type PV panels with specifications, as shown in Table 1. The diagram and component of the solar collector are shown in Fig. 3. The amorphous type of PV was chosen for its cheaper in price (even though lower efficiency). The lower efficiency PV panel would be a wider dimension than then the other types with higher efficiency for the same power capacity. On the other hand, the wider area would be an advantage for its function as a solar thermal collector.

The built solar collector is connected with a drying chamber contains drying trays. The photograph of the solar dryer is shown in Fig. 4. The connection is through the outlet air of the solar collector by using a PVC duct pipe. The drying chamber is equipped with four small DC fan installed on the top. The purpose of the fan is for air circulation. In operation, fresh air flows through the air inlet channel and gets heated in the solar collector by solar radiation. The heated air is used directly as a drying medium in the drying chamber.

The electricity generated by the PV panels is directly used to supply power for the fan. The electricity system has no battery storage. The DC fans operating speed may change over time according to the power from the PV panels. During higher solar radiation, the heat is collected would be higher as well, which means that the air temperature is also higher. At this moment, a higher speed of fans is needed, which possible by a higher electricity power from the PV. The solar panel was tested with the fixed position, i.e., solar collector facing north, following the optimum position according to the site astronomical position of Surabaya.

From the preliminary test of the solar dryer with no load, it is found that the temperature of the outlet air from the PV-T solar collector varies 35 – 50 ^{o}C corresponds to solar irradiation of varies 300 – 1000 W/m2. In parallel time, the electricity generated by the PV panel varies 4 – 25 Watt. With this output power variation, it was affecting the speed of the circulating fan. During operation, the average air temperature in the drying chamber (obtained from the solar collector), in comparison to the ambient, is shown in Fig. 5. It can be concluded that the PV-T solar collector, using an amorphous type of PV cells, works well as a solar thermal and electricity collector for the dryer.

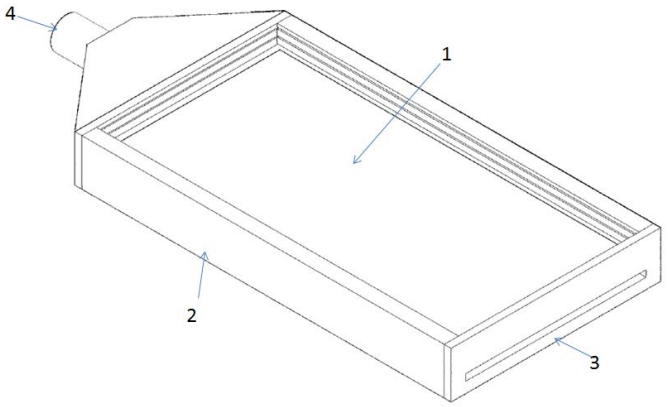

Fig. 3. Diagram of hybrid PV-T solar air collector: 1=Amorphous type of PV panels with double glass covered; 2= insulation at the left, bottom and right sides; 3 = air inlet; 4 air outlet

Fig. 4. Photograph of a small scale PV-T solar dryer

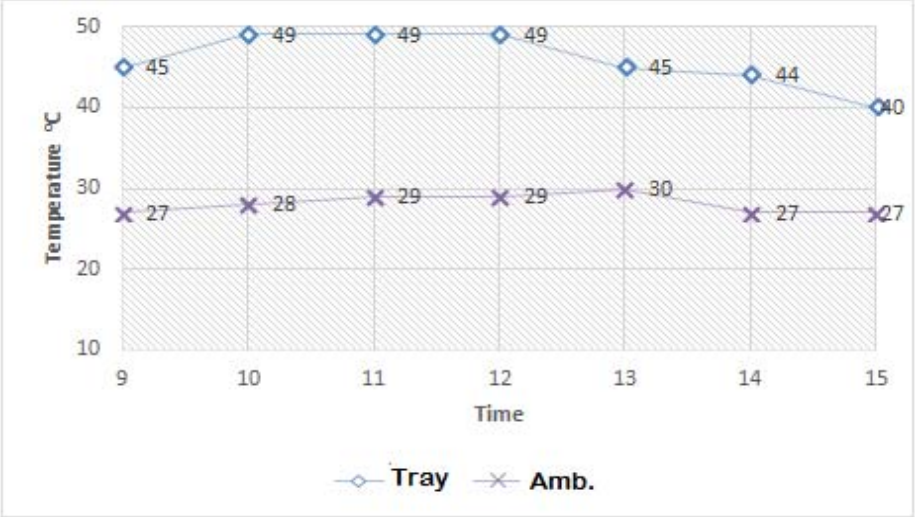

Fig. 5. Temperature in the drying chamber in comparison with ambien

IV. CONCLUSIONS

Hybrid photovoltaic-thermal (PV-T) collectors system generates heat and electricity in one single collector. This way would increase the amount of harvested energy from solar radiation. In this study, a solar dryer that using hybrid PV-T has been preliminarily tested with no load. The results show that the amorphous type of photovoltaic-thermal works well as a solar collector for a solar dryer with drying temperature around 50ºC The average electricity power generated from 40 Wp double glazed the amorphous solar panel was about 15 Watt which appropriates to supply a circulated fan for the dryer.

REFERENCES

[1] A. Fudholi *et al.*, "Solar Drying Technology in Indonesia: an Overview," *Int. J. Power Electron. Drive Syst.*, vol. 9, no. 4, p. 1804, 2018.

[2] R. Margolis and J. Zuboy, "Nontechnical Barriers to Solar Energy Use: Review of Recent Literature," *Natl. Renew. Energy Lab.*, vol. NREL/TP-52, no. September, 2006.

[3] E. D. D. Martin A. Green1, Keith Emery, Yoshihiro Hishikawa, Wilhelm Warta, "Solar cell efficiency tables," *Prog. Photovolt Res. Appl*, vol. 24, pp. 903–913, 2016.

[4] V. V Tyagi, S. C. Kaushik, and S. K. Tyagi, “Advancement in solar photovoltaic / thermal (PV / T) hybrid collector technology,” *Renew. Sustain. Energy Rev.*, vol. 16, no. 3, pp. 1383–1398, 2012.

[5] V. K. Sharma, S. Sharma, and H. P. Garg, “Mathematical modelling and experimental evaluation of a natural convection type solar cabinet dryer,” *Energy Convers. Manag.*, vol. 31, no. 1, pp. 65–73, 1991.

[6] A. A. El-Sebaii and S. M. Shalaby, “Solar drying of agricultural products: A review,” *Renew. Sustain. Energy Rev.*, vol. 16, no. 1, pp. 37–43, 2012.

[7] T. Chow, “A review on photovoltaic/thermal hybrid solar technology,” *Appl. Energy*, vol. 87, pp. 365–379, 2010.

[8] A. A. Hegazy, “Comparative study of the performances of four photovoltaic/thermal solar air collectors,” *Energy Convers. Manag.*, vol. 41, no. 8, pp. 861–881, 2000.

[9] S. M. Bambrook and A. B. Sproul, “Maximising the energy output of a PVT air system,” *Sol. Energy*, vol. 86, no. 6, pp. 1857–1871, 2012.

[10] J.-H. Kim, S.-H. Park, and J.-T. Kim, “Experimental performance of a photovoltaic-thermal air collector,” *Energy Procedia*, vol. 48, pp. 888–894, 2014.

[11] N. Aste, G. Chiesa, and F. & Verri, “Design, development and performance monitoring of a photovoltaic-thermal (PVT) air collector,” *Renew. Energy*, vol. 33, pp. 914–927, 2008.

[12] Y. Tripanagnostopoulos, “Aspects and improvements of hybrid photovoltaic/thermal solar energy systems,” *Sol. Energy*, vol. 81, no. 9, pp. 1117–1131, 2007.

[13] M. Farshchimonfared, J. I. Bilbao, and A. B. Sproul, “Channel depth, air mass flow rate and air distribution duct diameter optimization of photovoltaic thermal (PV/T) air collectors linked to residential buildings,” *Renew. Energy*, vol. 76, pp. 27–35, 2015.

[14] Thomas Persson, “Analys av luftflöde och värmetransprt i luftspalt bakom solceller,” Sweden, 1997.

[15] G. e. a. Tiwari, "Performance analysis of a conventional PV/T mixed mode dryer under no load condition," International Journal of Energy Research, pp. 919-930, 2009.

PROCEEDINGS

21st ISITIA 2020

International Seminar on Intelligent Technology and Its Applications

Humanification of Reliable Intelligent Systems

IEEE Conference Number #49792

IEEE Catalog Number : CFP20TIA-ART
ISBN : 978-1-7281-7413-6

Virtual Conference
July 22-23, 2020

ITS Institut Teknologi Sepuluh Nopember

IEEE INDONESIA SECTION

IES Indonesia Chapter

FORTEI Forum Pendidikan Tinggi Teknik Elektro Indonesia Regional VII

PROCEEDINGS

2020 International Seminar on Intelligent Technology and Its Application (ISITIA 2020)

Humanification of Reliable Intelligent Systems

22 - 23 July 2020

VIRTUAL CONFERENCE

IEEE Conference Number #49792

IEEE Catalog Number : CFP20TIA-ART
ISBN : 978-1-7281-7413-6

Organized by: Technical Co-sponsors: Supported by:

Organizing Committee

GENERAL CHAIR

Dr. Trihastuti Agustinah

VICE-CHAIR

Dr. Vita Lystianingrum B.P.

TECHNICAL PROGRAM CHAIR

Dr. Dimas Anton Asfani

PUBLICATION CHAIR

Dr. Feby Agung Pamuji

SECRETARIAT

Zulkifli Hidayat, M.Sc.

TREASURER

Dr. IGN Satriyadi Hernanda

CONTACT DETAILS:

Department of Electrical Engineering
Gedung B, C dan AJ Kampus ITS Sukolilo Surabaya, Jawa Timur, Indonesia, 60111
Phone: (+62 31) 5947302; (+62 31) 593 1237
Email: isitia@its.ac.id
Website: http://isitia.its.ac.id/

ISITIA 2020 Technical Program Committee and Reviewers

Prof. Mauridhi Purnomo, Institut Teknologi Sepuluh Nopember (Indonesia)

Prof. Gamantyo Hendrantoro, Institut Teknologi Sepuluh Nopember (Indonesia)

Prof. Haiping Du, University of Wollongong (Australia)

Prof. Natasha M. Maurits, University of Groningen (Netherlands)

Dr. Achmad Affandi, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Adhi Dharma Wibawa, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Agfianto Putra, Universitas Gadjah Mada (Indonesia)

Dr. Alvin Sahroni, Universitas Islam Indonesia Yogyakarta (Indonesia)

Dr. Andi Adriansyah, Universitas Mercu Buana (Indonesia)

Dr. Ardyono Priyadi, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Astria Nur Irfansyah, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Chastine Fatichah, Institut Teknologi Sepuluh Nopember (Indonesia)

Daniar Fahmi, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Dedet Candra Riawan, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Dhany Arifianto, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Dimas Anton Asfani, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Dimas Uman Putra, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Djoko Purwanto, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Endroyono, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Eko Setijadi, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Eko Mulyanto Yuniarno, Institut Teknologi Sepuluh Nopember (Indonesia)

Fajar Budiman, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Feby Agung Pamuji, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Handy Wicaksono, Petra Christian University (Indonesia)

Dr. Hendra Kusuma, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Heri Suryoatmojo, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. I Gusti Ngurah Satriyadi H, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. I Made Yulistya Negara, Institut Teknologi Sepuluh Nopember (Indonesia)

Indra Riyanto, Universitas Indonesia (Indonesia)

Dr. Irwan Alnarus Kautsar, Universitas Muhammadiyah Sidoarjo (Indonesia)

Dr. Irwan Purnama, Lembaga Ilmu Pengetahuan Indonesia (Indonesia)

Dr. Istas Pratomo, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Iwan Setiawan, Universitas Diponegoro (Indonesia)

Dr. Wirawan, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Joshua Abolarinwa, Federal University of Technology Minna (Nigeria)

Dr. I Ketut E. Purnama, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Khairul Anam, University of Jember (Indonesia)

Dr. Lee Yeng Seng, Universiti Malaysia Perlis (Malaysia)

Dr. Mahardhika Pratama, Nanyang Technological University (Singapore)

Mochammad Wahyudi, Universitas Gadjah Mada (Indonesia)

Dr. Mohd Ashraf Ahmad, Universiti Malaysia Pahang (Malaysia)

Dr. Muhammad Attamimi, Institut Teknologi Sepuluh Nopember (Indonesia)

Muhammad Hilman Fatoni, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Muhammad Rivai, Institut Teknologi Sepuluh Nopember (Indonesia)

Prof. Nasaruddin, Syiah Kuala University (Indonesia)

Dr. Prasetiyono Hari Mukti, Technische Universitaet Graz (Austria)

Dr. Puji Handayani, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Rachmad Setiawan, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Ratheesh Kumar Meleppat, University of California Davis (USA)

Dr. Reza Fuad Rachmadi, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Ronny Mardiyanto, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Rony Seto Wibowo, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Selo Sulistyo, Universitas Gadjah Mada (Indonesia)

Dr. Soedibyo, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Supeno Mardi Susiki Nugroho, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Tara Hamilton, Macquarie University (Australia)

Dr. Titiek Suryani, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Totok Mujiono, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Tri Arief Sardjono, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Trihastuti Agustinah, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Vita Lystianingrum, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Waskitho Wibisono, Institut Teknologi Sepuluh Nopember (Indonesia)

Dr. Wayan Ariastina, Universitas Udayana (Indonesia)

Zulkifli Hidayat, Institut Teknologi Sepuluh Nopember (Indonesia)

ISITIA 2020 General Program Schedule

Day 1, 22 July 2020

Time	Event	Venue
09:30 - 09.45	Registration	
09:45 - 10:00	Opening Ceremony: - Opening Remarks from General Chair - Official Opening by Dean of Faculty of Intelligent Electrical and Informatics Technology (ELECTICS) ITS	Webinar
10:00 - 12:00	Technical Session 1	Break-out: Bali, Jawa, Lombok, Madura
12:00 – 13:00	Break	
13:00 – 13:15	Welcome Speech from Rector of ITS Indonesia Prof. Mochamad Ashari	Webinar
13:15 – 14:00	Keynote Speech 1: Prof. Haiping Du (*University of Wollongong*) Title: Advanced Suspension Control System Design for Vehicle and Driver Ride Comfort	
14:00 - 14:45	Keynote Speech 2: Prof. Natasha M. Maurits (*University of Groningen*) Title: Finding Hidden Patterns in Data or 'How to Find the Hammer to Your Nail': A Collaboration between Human and Machine	
14:45 - 15:30	Keynote Speech 3: Dr. Ardyono Priyadi (*Institut Teknologi Sepuluh Nopember*) Title: Transient Stability Analysis for Obtaining Critical Clearing Time and Setting of Relay Protection based on Critical Trajectory and Time Domain Simulation Methods	
15:30 - 15:35	Closing Remarks by Head of Department of Electrical Engineering ITS	

Day 2, 23 July 2020

Time	Event	Venue
10:00 - 12:30	Technical Session 2	Break-out: Bali, Jawa, Lombok, Madura

Technical Session Schedule

Technical Session 1 (22 July 2020, 10:00 - 12:00)

Time*	Rooms & Track			
	Bali	**Jawa**	**Lombok**	**Madura**
	PE	RA, SI	PE	BE
10:00	B101	J101	L101	M101
10:15	B102	J102	L102	M102
10:30	B103	J103	L103	M103
10:45	B104	J104	L104	M104
11:00	B105	J105	L105	M105
11:15	B106	J106	L106	M106
11:30	B107	J107	L107	M107
11:45	B108	J108	L108	M108

Technical Session 2 (23 July 2020, 10:00 - 12:30)

Time*	Rooms & Track			
	Bali	**Jawa**	**Lombok**	**Madura**
	CE, AI, IT	CS	TN, SP	PE, HV, ED
10:00	B201	J201	L201	M201
10:15	B202	J202	L202	M202
10:30	–	J203	L203	M203
10:45	B204	J204	L204	M204
11:00	B205	J205	L205	M205
11:15	B206	J206	L206	M206
11:30	B207	J207	L207	M207
11:45	B208	J208	L208	M208
12:00	B209	J209	L209	M209
12:15	B210			M210

* Western Indonesian Time (GMT +7)

Code:

AI : AI & Machine Learning Applications
BE : Biomedical Engineering
CE : Computer Engineering
CS : Control Systems
ED : Electrical Engineering and IT Education
HV : High Voltage Engineering
IT : Information Technology
PE : Power and Energy Systems
RA : Robotics and Automation
SI : Sensors and Instrumentation
SP : Signal and Image Processing
TN : Telecommunications and Networking

Technical Session 1

Session 1 – Track: Power and Energy Systems, Bali Room

Code	#	Title	Authors
B101	1570642396	The Effect of Network Impedance and Electrode Distance to Low Voltage Series Arcing Detection	Dimas Anton Asfani; I Made Yulistya Negara; I G. N. Satriyadi; Daniar Fahmi; Awataraning Pradipta; Chairul Bahy
B102	1570640453	Standalone Single Phase DC-AC Inverter with FPGA-based Pulse Modulated Generator Unit	Muhamad Rusdi; Faizal Arya Samman; Rhiza Sadjad; A Ejah Umraeni Salam; Carmadi Machbub
B103	1570619669	Self Classification of Multifunction Relay Based on Neural Network for Industrial Scale	Rahmat Febrianto W; Margo Pujiantara; Vita Lystianingrum; Vincentius Raki Mahindara; Talitha Puspita Sari
B104	1570640211	Optimal Coordination of OCR with TCC Selection for Radial-Industrial System Using Firefly Algorithm	Punleu Chhun; Ardyono Priyadi; Margo Pujiantara; Vincentius Raki Mahindara
B105	1570641606	MPPE for Solar PV Using ANN Based on Open Circuit Voltage and Short Circuit Current	Muhammad Syafiul Umam; Muhammad Nizar Habibi; Rachma Prilian Eviningsih; Novie Ayub Windarko
B106	1570619671	Dynamic DC Optimal Power Flow Considering Losses and Different Battery Charge-Discharge Cost	Eki Rovianto; Rony Seto Wibowo; Vita Lystianingrum; Rezi Delfianti
B107	1570619675	Analysis of Fault Location on Distribution System Using Impulse Injection Learned by ANFIS	Muhammad Budi Rahayu Widodo; Adi Soeprijanto; Ontoseno Penangsang
B108	1570640837	The Coordination of Dual Setting DOCR for Ring System Using Adaptive Modified Firefly Algorithm	Kimhok Chheng; Ardyono Priyadi; Margo Pujiantara; Vincentius Raki Mahindara

Session 1 – Track: Sensors and Instrumentation & Robotics and Automation, Jawa Room

Code	#	Title	Authors
J101	1570645250	An IoT Platform for Urban Farming	Eng-Kee Tan; Yung-Wey Chong; Muhammad Niswar; Boon Yaik Ooi; Achmad Basuki
J102	1570645277	Design and Calibration of a Microfluidic Syringe System for Nanofiber Electrospinning	Rahmat Nur Fajri; Arief Sudarmaji; Mohammad Zaadit Taqwa
J103	1570643452	Monitoring of Carbon Monoxide and Sulfur Dioxide Using Electrochemical Gas Sensors Based on IoT	Muhammad Rivai; Handi Rahmannuri; Muhammad Rohfadli; Harris Pirngadi; Tasripan Tasripan
J104	1570645155	Design of Relative Permittivity Measurement Based Magneto-Electric Material using Microcontroller	Mahansa Putra; Arief Sudarmaji
J105	1570645214	Design of Sensor Node for Greenhouse Real-Time Monitoring System	Windi Puspitasari; Eko Setijadi; Achmad Affandi
J106	1570645097	Numerical Investigation of a Plasmonic Refractive Index Sensor Based on Rectangular MIM Topology	Md. Farhad Hassan; Md. Moudud Hasan; Md. Istiac Ahmed; Rakibul Hasan Sagor
J107	1570642444	Autonomous Indoor Vehicle Navigation Using Modified Steering Velocity Obstacles	Muhammad Fuad; Trihastuti Agustinah; Djoko Purwanto
J108	1570643420	LiDAR Equipped Robot Navigation on Behavior-based Formation Control for Gas Leak Localization	Muhammad Agung Nursyeha; Muhammad Rivai; Djoko Purwanto; Tukadi Tukadi

Session 1 – Track: Power and Energy Systems, Lombok Room

Code	#	Title	Authors
L101	1570644538	Impact of Auto-Reclosing on Transmission to Dynamic Response of PSS Equipped Generator in Cirebon	Eko Prasetyo; Rendie Ramadhan; Rudi Wahono
L102	1570645077	Design Li-Po Battery Charger with Buck Converter under Partially CC-CV Method	Heri Suryoatmojo
L103	1570619670	One Day Ahead Prediction of PV Power Plant for Energy Management System Using Neural Network	Khairunnisa' Binti Hanifulkhair; Ardyono Priyadi; Vita Lystianingrum; Rezi Delfianti
L104	1570645274	Optimized Modified PWM based on Differential Evolution for Reducing THD on Multilevel Inverter	Eggi Farhan Firmansyah; Ony Qudsi; Muhammad Nizar Habibi; Novie Ayub Windarko
L105	1570638240	Steady State Model of Wind Power Plant for Load Flow Study	Rudy Gianto
L106	1570644985	Numerical Simulation on Hybrid Savonius Turbine with NACA-Airfoils as H-rotor Blades	Savry Chhin; Vivien Djanali
L107	1570645204	Dynamic Economic Load Dispatch by Introducing Compressed Air Energy Storage for Solving Duck Curve	Patria Julianto; Adi Soeprijanto; Mardlijah Mardlijah
L108	1570640335	A Design of Diode-Clamped 11-Level Inverter and Its Harmonic Effect on Transformer Losses	Reynanda Bagus Widyo Astomo; Mochamad Ashari; Soedibyo Soedibyo

Session 1 – Track: Biomedical Engineering, Madura Room

Code	#	Title	Authors
M101	1570645394	Investigating EEG Pattern During Designed-Hand Movement Tasks in Stroke Patients	Made Dwi Novitasari; Adhi D Wibawa; Mauridhi Hery Purnomo; Wardah Rahmatul Islamiyah; Ali Fatoni
M102	1570642075	Effect of Image Downsizing and Color Reduction on Skin Cancer Pre-screening	Agung W. Setiawan; Amir Faisal; Nova Resfita
M103	1570645260	Bone Conduction Hearing Aid for Microtia Patient Using Open MHA Library	Annisa Riyani; Astri Handayani; Tati Mengko
M104	1570645227	Blood Pressure Measuring Device Based on Korotkoff Sound's Tapping Period and Frequency Detection	Dziban Naufal; Agung W. Setiawan; Tati Erawati Rajab
M105	1570645396	Feature Selection for EEG-Based Fatigue Analysis Using Pearson Correlation	Diah Risqiwati; Adhi D Wibawa; Evi Pane; Wardah Rahmatul Islamiyah; Agnes Estuning Tyas; Mauridhi Hery Purnomo
M106	1570633823	Cancer Imaging Using Positron Emission Tomography/Computed Tomography	Imam Kambali; Hari Suryanto
M107	1570645207	QVAT: QRS Complex Detection Based on Variance and Adaptive Threshold for Electrocardiogram Signal	Arief Kurniawan; Eko Mulyanto Yuniarno; Eko Setijadi; Mochammad Yusuf; I Ketut Eddy Purnama
M108	1570645406	The Influence of Footwear with Different Sole on the EMG Activity of Lower Limb Muscle During Walking	Ika Wulandari; Adhi Dharma Wibawa; Diah Puspito Wulandari; I Putu Alit Pawana; Sri Rahayu

Technical Session 2

Session 2 – Track: Information Technology, Computer Engineering & AI, Bali Room

Code	#	Title	Authors
B201	1570645042	Characteristics of Expertise Locator System in Academia: A Systematic Literature Review	Theresia V. Rampisela; Damayanti Elisabeth; Dana Indra Sensuse
B202	1570641817	Car Detection in Roadside Parking for Smart Parking System Based on Image Processing	Deni Kristin Manase; Zahir Zainuddin; Syafruddin Syarif; Arsan Jaya
B204	1570645117	Prediction of Dengue Fever Outbreak Based on Climate Factors Using Fuzzy-Logistic Regression	Wiwik Anggraeni; Surya Sumpeno; Eko Mulyanto Yuniarno; Reza Fuad Rachmadi; Agustinus Bimo Gumelar; Mauridhi Hery Purnomo
B205	1570645044	A Deep Auto Encoder Semi Convolution Neural Network for Yearly Rainfall Prediction	Arief Bramanto Wicaksono Putra; Rheo Malani; Bedi Suprapty; Achmad Gaffar
B206	1570645276	Transfer Learning for Recognizing Face in Disguise	Fauzan Nusyura; I Ketut Eddy Purnama; Reza Fuad Rachmadi
B207	1570619448	Markerless Motion Capture Based on Openpose Model Using Triangulation	Uti Solichah; Mauridhi Hery Purnomo; Eko Mulyanto Yuniarno
B208	1570644326	CNN Architectures Performance Evaluation for Image Classification of Mosquito in Indonesia	Brilian Putra Amiruddin; Rusdhianto Effendi Abdul Kadir
B209	1570645231	Multilayer Perceptron for Symbolic Indonesian Music Generation	Arik Kurniawati; Yoyon Suprapto; Eko Mulyanto Yuniarno
B210	1570644330	Decentralized Stock Exchange Implementation Using Ethereum	Sashank Sridhar; Siddartha Mootha; Sudha Subramanian

Session 2 – Track: Control Systems, Jawa Room

Code	#	Title	Authors
J201	1570631480	Distributed Observer Approach for Scalable Formation Control of Multi-Agent Network	Djati Wibowo Djamari; Muhamad Rausyan Fikri
J202	1570641964	Global Path Planning for USV Waypoint Guidance System Using Dynamic Programming	Nurlita Gamayanti; Rusdhianto Effendi Abdul Kadir; Abdullah Alkaff
J203	1570640931	High Gain Observer Design for DoS Attack Detection in CACC Platoon	Xiaofei Zhang; Haiping Du; Jumei Wei; Zhijuan Jia; Suimin Jia; Ge Ma
J204	1570641983	Comparison of CFAR Methods on Multiple Targets in Sea Clutter Using SPX-Radar-Simulator	Mochammad Sahal; Zaidan Adenin Said; Rifky Yulianto Putra; Rusdhianto Effendi Abdul Kadir; Adrian Aryaputra Firmansyah
J205	1570619819	Trajectory Tracking of Multi-Robot System Using A Singularity Approach	Anggitasari Putri Widanis; Trihastuti Agustinah; Ari Santoso
J206	1570628170	Implementation of Poka-Yoke System to Prevent Human Error in Material Preparation for Industry	Moch Chafidh Al Ayyubi; Haniah Mahmudah; Akuwan Saleh; Rizki Rachmadi
J207	1570640188	Pattern Forming Acceleration for Dancing UAVs Using Ant Colony Optimization	Andri Suhartono; Ronny Mardiyanto
J208	1570619692	Obstacle Avoidance with Energy Efficiency and Distance Deviation Using KNN Algorithm for Quadcopter	Irfin Sandra Asti; Trihastuti Agustinah; Ari Santoso
J209	1570642253	Application of Kalman Filter in Fine Alignment of INS Assisted by Magneto Sensors	Rusdhianto Effendi Abdul Kadir; Mochammad Sahal; Gaung Jagad; Achmad Jazidie; Zulkifli Hidayat

Session 2 – Track: Signal and Image Processing & Telecom. and Networking, Lombok Room

Code	#	Title	Authors
L201	1570645026	A Multi-Frame Blocking for Signal Segmentation in Voice Command Recognition	Achmad Gaffar; Rheo Malani; Supriadi Supriadi; Agusma Wajiansyah; Arief Putra, ABWP
L202	1570640343	FFT-based Human Detection Using 1-D Laser Range Data	Bima Sena Bayu Dewantara; Samsud Dhuha; Bayu Sandi Marta; Dadet Pramadihanto
L203	1570641768	Design of Two-Elements Subarray with Parasitic Patch for 5G Application	Ainnur Rahayu Pratiwi; Eko Setijadi; Gamantyo Hendrantoro
L204	1570642474	Wideband Vivaldi Microstrip Antenna for Rectenna Application	Kevin Nugraha Salim; Muhammad Reza Fairuzi; Maximilianus Rafael Sutoyo; Fitri Yuli Zulkifli
L205	1570641607	Radio over Fiber for Implementing Digital Television Network in Indonesia	Dian Rusdiyanto; Catur Apriono
L206	1570641984	Analysis of Affecting Technology Adoption Factors for Smart Home Services in Jabodetabek, Indonesia	Reynaldo Nathanael Gultom; Muhamad Asvial
L207	1570645113	Numerology Effect on 5G 28 GHz Communication System Performance	Ikhsan Purnomo; Achmad Muayyadi; Desti Madya Saputri
L208	1570619598	Evaluation of AIS and MAVLINK Protocol Performance	Ila Nurmawati; Achmad Affandi; Istas Pratomo
L209	1570645162	Techno-economic Analysis from Implementing SD-WAN with 4G/LTE, A Case Study in XYZ Company	Safrian Andromeda; Dadang Gunawan

Session 2 – Track: Power and Energy Systems, High Voltage Engineering & Electrical Engineering and IT Education, Madura Room

Code	#	Title	Authors
M201	1570643423	Hybrid PV-T Solar Collector Using Amorphous Type of Solar Cells for Solar Dryer	Elieser Tarigan
M202	1570619676	Energy Management Design for Industrial Demand Considering PV Power Prediction and Battery SOC	Luki Septya Mahendra; Vita Lystianingrum; Ardyono Priyadi
M203	1570645123	Real Time State of Charge Estimation for Lead Acid Battery Using Artificial Neural Network	Gilang Andaru Trinandana; Aldi Wihawan Pratama; Eka Prasetyono; Dimas Okky Anggriawan
M204	1570642313	UHF Method on PD Detection and Breakdown Characteristics of Metallic Particle in Oil Insulation	I Made Yulistya Negara; Daniar Fahmi; Dimas Anton Asfani; I Gusti Ngurah Satriyadi; Muhammad Faisal Ijlal Azmi; Raditya Premananda
M205	1570619678	Three-Phase Induction Motor Short Circuit Stator Detection Using an External Flux Sensor	Fidya Eka Prahesti; Dimas Anton Asfani; I Made Yulistya Negara; Belly Yan Dewantara
M206	1570645270	Glow-Discharge Plasma Reactor with Variation of Cathode Shapes for Water Treatment	Tria Kasnalestari; Perinov Perinov; Chairul Hudaya
M207	1570642323	Study of Ferroresonance in 150 kV High Voltage Inductive Voltage Transformer	I Gusti Ngurah Satriyadi; I Made Yulistya Negara; Dimas Anton Asfani; Daniar Fahmi; Mochamad Rizky Ramadhan; Bonifacius Kevin Yegar Sahaduta
M208	1570645023	Constant Power Generation Using Modified MPPT P&O to Overcome Overvoltage on Solar Power Plants	Reza Iskharisma Yuwanda; Eka Prasetyono; Rachma Prilian Eviningsih
M209	1570642453	Design of BLDC Motor Diagnostic Device Based on Surge Test for Phase to Ground Fault	Dimas Anton Asfani; I Made Yulistya Negara; I Gusti Ngurah Satriyadi; Dimas Tri Mulyadana; V. Ryan Wijanarko; Eduard Muljadi
M210	1570634550	Optimal PSS Design Using Particle Swarm Optimization Under Load Shedding Condition	Makmur Saini; A. M. Shiddiq Yunus; Muhammad Ruswandi Djalal

Keynote Lectures

Prof. Haiping Du

Deputy Head of School Research
Faculty of Engineering and Information Sciences
School of Electrical, Computer and Telecommunications Eng.
Advanced Manufacturing Technologies
Centre for Intelligent Mechatronics Research
hdu@uow.edu.au

Advanced Suspension Control System Design for Vehicle and Driver Ride Comfort

To reduce vibration transferred from a variety of vibration sources, such as uneven road surface and vibrating tools, to vehicle, passenger, and driver body, either vehicle or seat or both suspension system has been adopted by most vehicles. Vehicle suspension is able to provide ride comfort in addition to road holding and support of vehicle weight. Three main kinds of suspensions, namely, passive, active, and semi-active suspensions, have been proposed to deal with the conflicting requirements on ride comfort, suspension deflection limitation, and road holding capability. In particular, semi-active suspensions offer desirable performance comparable to active suspensions without requiring high power consumption and expensive hardware. Devices based on MR dampers are viable candidates for semi-active control of vehicle suspension systems. Due to the inherent nonlinear nature of MR dampers, one of the challenging aspects of utilising MR dampers to achieve high levels of performance is the development of appropriate modelling and control strategy that can take advantage of the unique characteristics of MR dampers. Vehicle seat suspension is also regarded as one of the most effective ways to reduce vibration, in particular, for heavy duty vehicles. Most of the currently available active and semi-active seat suspension control systems use linear actuators/dampers to provide the required forces to reduce vibration, however, the system structure is complex, and the cost is high. In this talk, different suspension control issues, such as parameter uncertainty, actuator time delay and saturation, and their corresponding solutions will be discussed. The modelling and control of several advanced MR damper-based vehicle suspension control systems will be presented. The active and semi-active seat suspension control systems with rotary actuators/dampers are also introduced to overcome the cost-effectiveness issues. Acceleration measurement-based friction estimation algorithm and other relevant control strategies are proposed and implemented with experimental validation.

Haiping Du received the Ph.D. degree in mechanical design and theory from Shanghai Jiao Tong University, Shanghai, China, in 2002. He was a Research Fellow with the University of Technology, Sydney, from 2005 to 2009, and was a Postdoctoral Research Associate with Imperial College London from 2004 to 2005 and the University of Hong Kong from 2002 to 2003. He is currently a Professor at the School of Electrical, Computer and Telecommunications Engineering, University of Wollongong, Wollongong, NSW, Australia. He is a Subject Editor of the Journal of Franklin Institute, an Associate Editor of IEEE Transactions on Industrial Electronics and IEEE Control Systems Society Conference, an Editorial Board Member for some international journals, such as Journal of Sound and Vibration, IMechE Journal of Systems and Control Engineering, Journal of Low Frequency Noise, Vibration and Active Control, and a Guest Editor of IET Control Theory and Application, Mechatronics, etc. His research interests include vibration control, vehicle dynamics and control systems, robust control theory and engineering applications, electric vehicles, robotics and automation, smart materials, and structures. He is a recipient of the Australian Endeavour Research Fellowship (2012)

Prof. Natasha M. Maurits

Professor of Clinical Neuroengineering, Department of Neurology,
University Medical Center Groningen, University of Groningen
the Netherlands
n.m.maurits@umcg.nl

Finding Hidden Patterns in Data or 'How to Find the Hammer to Your Nail': A Collaboration between Human and Machine

Reading the research papers of others, you may wonder which process led the authors to decide to use a particular analysis method. It could be that they are 'just' using an analysis method that is common to the field, but particularly when the method is novel to the field, it may be hard to understand how the authors thought of this new method. In this lecture I will give several examples of how this could be achieved from my own line of research in clinical neuroengineering. As an applied mathematician, I like to think of mathematics as a large toolbox, from which you 'only' need to choose the right tool(s) to tackle your problem. In real life, you would probably not use a hammer to fix a screw, but yet, in research it can be daunting to find 'the hammer to your nail'. During this lecture, I will explain how 1) to identify and 2) specify your nail so that 3) you can choose the best hammer to hit your nail. I will do this by providing examples in which data visualization and data mining, as well as data classification and prediction are used as tools. These examples will support my opinion that the best results are achieved by collaborating between human (knowledge of clinical relevance) and machine (learning algorithms).

Natasha Maurits (Applied Mathematics (MSc 1994), Biophysical Chemistry (PhD 1998)), is full professor of Clinical Neuroengineering at the department of Neurology of the University Medical Center Groningen, the Netherlands, as well as Chief Scientific Information Officer (CSIO), heading the section Information Management for Research, Education and Training of UMCG (https://www.rug.nl/staff/n.m.maurits/). She is also visiting professor at Strathclyde University in Glasgow (UK) and the University of Lincoln (UK). Her research focuses on clinical neuroengineering, in particular biomedical signal analysis, multimodal neuroimaging, high-density EEG recording, visualization of high-dimensional data and home-based diagnosis and monitoring with applications in neurology (movement disorders, neuromuscular disorders, dementia, stroke, trauma) and cognition (healthy ageing, dyslexia).

She has published more than 140 international peer-reviewed papers as well as two books (From neurology to methodology and back: an introduction to clinical neuroengineering (2012) and Math for scientists: refreshing the essentials (2017), both with Springer). Furthermore, she is a senior member of IEEE, member of the Advisory Board of the School of Mathematics of the University of Groningen (UoG), member of the Scientific Advisory Board of the Lincoln School of Mathematics and Physics (UK) and chair of the Dutch Biomedical Engineering Conference.

Within the Dutch VSNU program Digital Society, Health & Well-being, she represents the UMCG/RuG with a specific focus on topics such as Healthy Ageing, e-Health and hospital at home (H@H). From her perspective as CSIO of UMCG she is very interested in the GO FAIR initiative, personal health environments, (medical and care) data coupling and sharing and its ethical and legal implications.

Dr. Ardyono Priyadi

Deputy Education of Graduate and Profession
Department of Electrical Engineering
Faculty of Intelligent Electrical and Informatics Technology
Institut Teknologi Sepuluh Nopember
priyadi@ee.its.ac.id

Transient Stability Analysis for Obtaining Critical Clearing Time and Setting of Relay Protection based on Critical Trajectory and Time Domain Simulation Methods

The power system development causes Transient Stability Analysis (TSA) has an important role in the operation, security, reliability, and resiliency for electric power systems. There are two mains aim for TSA, i.e. obtain Critical Clearing Time (CCT) and Setting of Relay Protection. Firstly, TSA calculated CCT has been established by numerical integration of non-linear differential equations. This method is quite accurate for obtaining the CCT. This method has also ability to provide an overview of the power system stability due to transient symptoms experienced by the power system. However, time consuming of numerical integration in the calculating CCT process causes this method requires a long time in the process of iteration. It is not effective when applied to the power system transient stability analysis, because the pattern changes due to disturbances occur on a very fast. Additionally, this method cannot reach the UEP, even though it is for a single machine system. The CCT is not also directly obtained by this method. Secondly, TSA for setting of Relay Protection has done to obtain the setting of voltage drop when short circuit occur in the regular power system.

This talk is based on the obtained direct CCT by Critical Trajectory Method (A, B, C, & D Methods) and improved CCT using Super Capacitor Energy Storage (SCES). It also describes simplest way for on-line TSA by developing Wide Area Measurement (WAM) technology. Furthermore, setting of relay protection using TSA is to obtain the properly setting of export-import relays (32 PQ) when short circuit occur inside grid or infinite bus. This setting has been implemented and run well in the industrial power plant.

Ardyono Priyadi received the bachelor's degree in electrical engineering from Institut Teknologi Sepuluh Nopember (ITS), Indonesia in 1997, master and Ph.D. degree in electrical engineering from Hiroshima University, Japan in 2008 and 2011. Formerly he was Head of Electrical Engineering Department, ITS and Head of Indonesian Electrical Engineering Higher Education Forum Regional 7 (FORTEI Regional 7) East Java. Now he is the Deputy Education of Graduate and Profession in ITS. Some awards he received are Best Young Researcher ITS in 2000 and Best Accomplished Lecturer ITS in 2017. His research interest is power system transient and dynamic stability, renewable energy, smart grids, and identification of power systems.

.

21st ISITIA 2020

Humanification of Reliable Intelligent Systems

CERTIFICATE

It is hereby certified that

Elieser Tarigan

has contributed as

Presenter

in conjunction with the 2020 International Seminar on Intelligent Technology and Its Applications

22-23 July 2020
Virtual Conference

Dr. Trihastuti Agustinah
ISITIA 2020 General Chair

ITS Institut Teknologi Sepuluh Nopember
IEEE INDONESIA SECTION
ICS Indonesia Chapter
FORTEI 7 Forum Pendidikan Tinggi Teknik Elektro Indonesia Regional VII