

THE PROCEEDING

Grha ITS, December 21-22, 2010

2nd APTECS 2010

International Seminar on Applied Technology, Science, and Arts





PROCEEDING

**2nd INTERNATIONAL SEMINAR
ON APPLIED TECHNOLOGY, SCIENCE AND ARTS -
APTECS 2010**

THEME

**EMPOWERING CREATIVITY THROUGH
SCIENCE AND TECHNOLOGY TO ENHANCE
NATIONS COMPETITIVENESS**

GRAHA SEPULUH NOPEMBER, 21-22 December 2010

Organized by :

Institute of Research and Public Services (LPPM)

INSTITUT TEKNOLOGI SEPULUH NOPEMBER

2010

2nd INTERNATIONAL SEMINAR ON APPLIED TECHNOLOGY, SCIENCE, AND ARTS (APTECS 2010)

HONORARY COMMITTEE

PROF. PRIYO SUPROBO

PROF. I NYOMAN SUTANTRA

GENERAL CHAIRMAN

DR. BAMBANG SAMPURNO

TECHNICAL PROGRAM COMMITTEE

PROF. IMAM ROBANDI, PROF. PAULUS INDIYONO, PROF. GAMANTYO HENDRANTORO,
PROF. DJAUHAR MANFAAT, PROF. NOOR ENDAH MOCHTAR, PROF. TRIWULAN,
PROF. HAPPY RATNA S., PROF. R. Y. PERRY BURHAN, PROF. MAURIDHI HERY P.,
PROF. SUPRAPTO, PROF. DJATMIKO ICHSANI, PROF. I NYOMAN PUJAWAN,
PROF. ALI ALTWAY, PROF. TRIYOGI, PROF. GEDE WIBAWA,
PROF. HIYAMA TAKASHI (KUMAMOTO UN.), MARK G STEWART (UNIVERSITY OF NEW CASTLE),
PROF. WAHYUDI PRIYONO (UI), PROF. RIZAL TAMIN (ITB), PROF. JAMASRI (UGM),
DR. AGUS W., DR. K. BAHARUDIN (UTM), DR. ESSY ARIJOENI (UI), DR. TRI PADMI (ITB)

ORGANIZING COMMITTEE

DR. AULIA SITI AISJAH, PROF. DANAWATI

DR. RIA ASIH SUMITRO, DR. I MADE YULISTYA NEGARA

DR. WAHYUDI, DR. ISPURWONO,

SITI KAMILIA AZIZ, MT., AUNUR ROHIM, DEA.,

DIAH P. WULANDARI, MT., ANDJRAH HAMZAH, MSl.,

HENDRA CORDOVA, MT., DR. RER. NAT FREDY KURNIAWAN, SUYANTO, MT.

SECRETARIAT DIVISION

DR. KARTIKA NUSWANTARA, DEWI AMALIA, ST.,

IR. HERI SUDARSONO, INDAH PURWATI, SUCIPTO

OPENING SPEECH OF THE RECTOR OF ITS

Assalamu'alaikum Wr.Wb. Good Morning Ladies and Gentlemen, Let me, first, praise the Almighty God for the blessings and mercies that have made all we have today possible.

Distinguished guests, esteemed presenters and participants, I would like to extend the warmest welcome to all of you attending the 2nd *Internasional Seminar on Applied Technology, Science and Arts (APTECS)*. I would like to express my profound gratitude to Prof. KISHIDA Satoru for his willingness to join this seminar and to deliver his outstanding lecture on the Prospect of High-Tech Superconducting Oxides and their Surface Analysis Superconductivity, Surface Analysis, and Oxide as the Creative Industry for the Future. This speech would be very contributing to all attending this seminar.

Acknowledgement must also be given to all the attending plenary sessions, the Ministry of Marine Affairs and Fisheries Republic of Indonesia, Dr. Ir. H Fadel Muhammad Al-Haddar; the Chief Executive Officer, Mr. Dahlan Iskan; and Prof. Wayan Dibia who are willing to spend some of their time that I know they are quite compact in schedule. Thank you for featuring very inspiring experience and insightful notions that would be very contributing to all attending this seminar to build high comprehensive and up to date prior knowledge. Allow me to express my heartfelt gratitude to many sponsors for their generous financial support.

APTECS is an annual seminar hosted by the Institut Teknologi Sepuluh Nopember (ITS) as the forum of academic sharing focusing on various issues in science, technology and arts. As one of the reputable institutions in Indonesia, it is undeniable that active contributions of ITS would be one of the important considerations to deal with the Asean China Free Trade Agreement (ACFTA) that has been launched since the 1st January 2010. At the same time ceasing International competitions would become one of the agenda that must be done by enhancing as well as empowering the national competitiveness in all aspects including engineering, economy, social, and many others. In fact, regardless of the subsequently and surely diminished natural resources, people today need to be able to find brilliant ways to determine success in economy for the future of this beloved country, Indonesia. Dear Audience, the main point of my speech is that this country would take the global challenge only if we are able to develop dynamic cultures and traditions as a nation. And, ITS, in the Golden year anniversary, would become the leading institution to enliven the competition through the development of science, technology, and not to mention cultures and arts.

Now, dear audience, the seminar is all yours. I hope everyone will find the seminar inspiring and enriching, through presentations and discussions on empowering creativity through science and technology to enhance nation competitiveness. Finally, I wish to see you again in the coming 3rd APTECS seminar, December 2011. I wish great happiness, good health, and much success to each of you. Thank you.

Surabaya, 21 Desember 2010
Rector of ITS

Prof. Priyo Suprobo

OPENING SPEECH OF THE CHIEF OF INSTITUTE OF RESEARCH AND PUBLIC SERVICES

First of all, let us praise God whose blessings have enabled us to band together here in the 2nd International APTECS seminar that, this year, is hosted particularly to commemorate the golden year anniversary of the Institut Teknologi Sepuluh Nopember. It is a pleasure for LPPM to welcome you all the professional researchers either from abroad or all over Indonesia. This is the forum where we can meet colleagues from various specialty areas to develop knowledge, technology, and arts that would, of course, contribute to the lives of the mankind

In the attempt to foster the development of science and technology, basic and applied researches, and industrial researches as well are all the major activities need to be conducted to enhance industrial productivity and competitiveness and to advance our nations unchallenged supremacy; therefore, unless there were any publications and disseminations of research findings and discoveries, researches with high sophisticated findings and contributions would have completely no meaning.

In this global era, without ability to cope with advanced technology and to develop the creativity and innovation, industries would not be able to take part into rigorous competitions. For this reason, then APTECS raises the topic of ***“Empowering Creativity through Science and Technology to Enhance Nations Competitiveness”***.

APTECS is forwarded to be one of the forums for researchers to disseminate and further discuss the results of researches; furthermore, this forum is promoted to enrich creative and innovative ideas that would be worth considering for further researches. Intensive communication as well as discussions in APTECS would continue the process of advancing science, technology, and arts as well. Moreover, further attempt of this form is to promote the implementation of the research finding to give positive contributions for our beloved country.

All researches and their findings are aimed to keep up and further develop our noble cultural values, arts, and human civilization so that, as a member of world societies, our nation would be much dignified among other nations on earth. By hosting this seminar LPPM-ITS is not only to gain the advancement of the science and technology throughout all the findings offered in this forum but at the same time, to encourage and to enhance the arts and cultural values of this country that would fruitfully signify our existence as a nation.

This academic forum meets annually at the end of the year, and next year we would welcome you to see us again in the 3rd APTECS International Seminar that would offer more laborious topics.

On behalf of LPPM-ITS I would like to express my deepest gratitude to all presenters and participants, and I wish a productive and inspiring seminar.

Surabaya, 21 Desember 2010

Prof. Ir. I Nyoman Sutantra MSc.PhD
The Chief of LPPM-ITS

OPENING SPEECH OF THE COMMITTEE CHAIRMAN

Rector of ITS,

Dr. Ir. H. Fadel Muhammad, Minister of the Ministry of Marine Affairs and Fisheries
Ministry

Prof. KISHIDA Satoru from Tottory University Japan

Prof. Wayan Dibya from Indonesian Arts Institute, Denpasar Bali

Mr. Dahlan Iskan, the Chief Executive Officer of PLN

Distinguished Presenters, all participants, and Colleagues

Assalamualaikum, Wr. Wb.

I am both honored and delighted to welcome you here in this remarkable conference hosted by Institut Teknologi Sepuluh Nopember (ITS) Surabaya in corporation with the Research Institute and Public Services (LPPM) ITS. The conference today takes the topic of “Empowering Creativity through Science and Technology to Enhance Nations Competitiveness”.

On behalf of the committee, I would like to thank Prof. Priyo Suprobo, the Rector of ITS, whose full support has enabled all of this possible; Prof. I Nyoman Sutantra, M.Sc, PhD., the head of LPPM who has kept encouraging us in accomplishing all good preparation to welcome you here today until tomorrow; and the support of the board of committee of the golden year anniversary, whose financially support this event. Also, all the sponsors who keep rendering and make today’s conference be more easily carried out.

Ladies and Gentlemen,

The interest of the international scientific community is clear, sharing enormous inspiring notions, research findings and innovations. This Conference has attracted 150 domestic and overseas presenters, it means that within two days we will hear 150 oral presentations. The subjects range from descriptions of recent technology, science both natural and social, and arts. So, it is marvelous, isn’t it? Only in two days 150 brilliant ideas would have been disseminated and enriched our inventory of knowledge; furthermore, these 150 fresh and prolific ideas will enable this beloved country ready to face the challenge of ACFTA.

Ladies and Gentlemen,

In the middle of us, here we have four notable speakers who would overcome our desire for inputting the latest knowledge delivered in their presentations in the plenary sessions. Therefore, I would like to express my sincere gratitude and warm welcome to Prof. KISHIDA Satoru who comes far away from Tottori University, Japan; I also feel grateful for the coming of important figures: our Minister, Dr. Ir. H Fadel Muhammad Al-Haddar; Prof. Wayan Dibya from Denpasar-Bali, and Mr. Dahlan Iskan who has been so popular among us, people of Surabaya.

Ladies and gentlemen,

Today's conference is born due to a hard work of all committee and staffs who have spent their time working day by day arranging every detail of the event, so allow me to congratulate their very keen and perfect job that makes me standing up here welcoming all the distinguished guests.

Last but not least, I would like to ask you all an apology for all inconvenience that you might find prior, during, or after the conference; we are all just an ordinary man that won't be able to avoid making mistakes. Thank you and have extraordinarily inspiring seminar.

Wassalamu'alaikum Wr.Wb,

General Chairman of 2nd APTECS 2010
Dr. Bambang Sampurno

ACKNOWLEDGEMENTS

Special gratitude is extended to all of the followings:

**RECTOR OF INSTITUT TEKNOLOGI SEPULUH NOPEMBER
INSTITUTE OF RESEARCH AND PUBLIC SERVICES – ITS
THE JOURNAL OF IPTEK ITS
MINISTRY OF MARINE AFFAIR AND FISHERIES
TOTTORI UNIVERSITY, JAPAN
PERUSAHAN LISTRIK NEGARA (PLN)
PT. TELEKOMUNIKASI INDONESIA, TBK
PT. TRUBA JAYA ENGINEERING
PT. NAHARADIA PRAKASA
HOUSE OF BEAUTY CLINIQUE
ELEKTRO BUDOYO – ITS
SMKN IX SURABAYA**

for never ending supports that have made the 2nd APTECS 2010 held successfully



SCHEDULE
INTERNATIONAL SEMINAR ON APPLIED TECHNOLOGY, SCIENCE, AND ARTS
2nd APTECS 2010

Monday, 20 December 2010

Time	Activities
19.00 - 22.00	Welcome dinner for overseas participants, officially attended by the mayor, Ir. Tri Rismaharini, MT

Day I: Tuesday 21 December 2010

Time	Activities							
06.45 - 07.30	Registration							
07.30 - 07.40	Indonesian Traditional Musical Instruments- Elektro Budoyo : Ayak Talu							
07.40 - 07.50	Traditional Dancing : Jejer Gandrung Banyuwangi - SMKN 9 Surabaya							
07.50 - 08.00	Welcome to 2nd APTECS : Dr. Bambang Sampurno							
08.00 - 08.05	Ladrang APTECS : Elektro Budoyo							
08.05 - 08.15	Colossal Dancing Remo : Elektro Budoyo							
08.15 - 08.25	Speech from The Chief of Research and Public Services - ITS : Prof. I.N Sutantra							
08.25 - 08.30	Opening Term - Rector ITS : Prof. Priyo Suprobo							
11.30 - 12.30	Theme I : The prospect of High - Superconducting Oxides and Their Surface Analysis Superconductivity, Surface Analysis, and Oxide and The Creative for The Future: by Prof. KISHIDA Satoru – Tottori University, Japan							
	Theme II : Central Roles of The Electricity to Enhance the Quality of Nation Competitiveness: by Mr. Dahlan Iskan – PLN Moderator: Prof. Imam Robandi							
	Break for Lunch and Pray							
	A	B	C	D	E	F	G	
12.30 - 12.47	Eng-21	Art-1	Eng-65	Eng-87	Sci-1	Eng-51	Eng-105	
12.47 - 13.04	Eng-22	Art-2	Eng-66	Eng-88	Sci-2	Eng-52	Eng-106	
13.04 - 13.21	Eng-23	Art-3	Eng-67	Eng-89	Sci-3	Eng-53	Eng-107	
13.21 - 13.38	Eng-24	Art-4	Eng-68	Eng-90	Sci-4	Eng-54	Eng-108	
13.38 - 13.55	Eng-25	Art-5	Eng-69	Eng-91	Sci-5	Eng-55	Eng-109	
13.55 - 14.12	Eng-26	Art-6	Eng-70	Eng-92	Eng-117	Eng-56	Eng-110	
14.12 - 14.31	Eng-27	Gen-1	Eng-71	Eng-93	Eng-118	Eng-57	Eng-111	
14.31 - 14.48	Eng-28	Gen-2	Eng-72	Eng-94	Eng-119	Eng-58	Eng-112	
14.48 - 15.05	Eng-29	Gen-3	Eng-73	Eng-95	Eng-120	Eng-59	Eng-113	
15.05 - 15.30	Break							
15.30 - 15.47	Eng-30	Gen-6	Eng-74	Eng-96	Gen-9	Eng-60	Eng-114	
15.47 - 16.04	Eng-31	Gen-7	Eng-75	Eng-97	Gen-4	Eng-61	Eng-115	
16.04 - 16.21	Eng-32	Gen-8	Eng-76	Eng-98	Gen-5	Eng-62	Eng-116	

NOTE : **A : Room Argopuro 1** **E : Room Semeru 1**
 B : Room Argopuro 2 **F : Room Semeru 2**
 C : Room Kawi **G : Room Utama**
 D : Room Lawu

Day II: Wednesday, 22 December 2010

Time	Activities						
06.45 - 08.00	Registration						
08.00 - 08.10	Indonesian Traditional Musical Instrument- Elektro Budoyo : Ojo dipleroki & Kelinciku Ucul						
08.10 - 08.20	Traditional Dancing Pendet - TPKH ITS						
08.20 - 08.30	Indonesian Traditional Musical Instrument - Elektro Budoyo : Ketawang						
08.30 - 10.30	Keynote Speaker III and IV Panel : Theme III: Resilience of National Arts and Culture to Enhance Nation Competitiveness: By Prof. Wayan Dibia – Indonesian Arts Institute, Bali Theme IV : Empowering Marine Resources to Enhance Nation Competitiveness: Dr. Ir. H Fadel Muhammad Al-Haddar – Ministry of Marine Affairs and Fisheries Moderator: Prof. I Ketut Aria Pria Utama						
	A	B	C	D	E	F	G
10.30 - 10.47	Eng-1	Eng-9	Eng-17	Eng-46	Eng-39	Eng-78	Eng-33
10.47 - 11.04	Eng-2	Eng-10	Eng-18	Eng-47	Eng-40	Eng-79	Eng-34
11.04 - 11.21	Eng-3	Eng-11	Eng-19	Eng-48	Eng-41	Eng-80	Eng-50
11.21 - 11.38	Eng-4	Eng-12	Eng-20	Eng-49	Eng-63	Eng-81	Eng-100
11.38 - 11.55	Eng-5	Eng-13	Eng-42	Eng-35	Eng-64	Eng-82	Eng-101
11.55 - 12.12	Eng-6	Eng-14	Eng-43	Eng-36	Eng-85	Eng-83	Eng-102
12.12 - 12.39	Eng-7	Eng-15	Eng-44	Eng-37	Eng-86	Eng-84	Eng-103
12.39-12.58	Eng-8	Eng-16	Eng-45	Eng-38	Eng-77	Eng-99	Eng-104
12.58 - 13.45	Break for Lunch and pray						
13.45- 14.00	Closing Ceremony and Awarding Certificate						
14.00 - 14.30	Preparation for City Tour (Cancelled)						
14.30 - 17.30	City Tour (Cancelled)						
17.00 - ...	See you on 3rd APTECS						

NOTE : **A : Room Argopuro 1** **E : Room Semeru 1**
 B : Room Argopuro 2 **F : Room Semeru 2**
 C : Room Kawi **G : Room Utama**
 D : Room Lawu

Moderator Day I

A	Room : Argopuro 1	A: Prof. Ir. Noor Endah Mochtar, M.Sc., Ph.D.
B	Room : Argopuro II	B: Prof. Ir. Happy Ratna Sumartinah, M.Sc., Ph.D.
C	Room : Kawi	C: Prof. Dr. Ir. Mauridhi Hery Purnomo, M.Eng.
D	Room : Lawu	D: Prof. Ir. Gamantyo Hendrantonno, M.Eng., Ph.D.
E	Room : Semeru 1	E: Prof. Dr. R. Y. Perry Burhan, M.Sc.
F	Room : Semeru 2	F: Prof. Dr. Ir. Suprpto, M.Sc.
G	Room : Utama	G: Dr. Maria Anityasari, ST., ME.

Moderator Day II

A	Room : Argopuro 1	A: Dr. rer.nat Fredy Kurniawan, MSi
B	Room : Argopuro II	BDr. Ir. A. A. Masroeri, M.Eng.
C	Room : Kawi	C: Prof. Ir. Sutardi, M.Eng., Ph.D.
D	Room : Lawu	D: Prof. Ir. Djauhar Manfaat, M.Sc., Ph.D.
E	Room : Semeru 1	E: Prof. Dr. Ir. Adi Soeprijanto, M.T.
F	Room : Semeru 2	F: Prof. Dr. Ir. Dra. Danawati Hari Prajitno, SE, M.Pd.
G	Room : Utama	G: Dr. Ir. Ria Asih Soemitro, M.Eng., DEA.

Rules of Paper Presentation

1. The allotted time for presentation and question-answer session is 15 minutes for each presenter
2. To keep prompt presentation, bell would ring three times to remind the presenter's available time for presentation. It rings every eight minutes of the allotted time, ten minutes, and the last 15 minutes.
3. It is mandatory that the presenter promptly uses the time allotted.
4. The timekeeper would also strictly watch the time allotted to each presenter.

List of Abstracts:

Effect of Ethanol-Indonesian Regular Unleaded Gasoline Blends and Ignition Timing on Engine Performance of Fuel Injected SI Engine ATOK SETIYAWAN, BAMBANG SUGIARTO, AND YULIANTO S. NUGROHO	Eng -1	1
A Stair Climbing Wheelchair Based on Customer Needs I MADE LONDEN BATAN, SUNARDI TJANDRA, ALFIAN HUDAN NUZULA, AND GHOFFAR F.S.	Eng-2	1
Simulation of Close Loop Distributorless Digital Ignition Multipurpose with Matlab Software SYAMSUL HADI, BAMBANG SAMPURNO, AND LIZA RUSDIYANA	Eng-3	2
Fuzzy Control System of CVT with Two Actuator Fork Screw to Increase Vehicle Acceleration BAMBANG SAMPURNO AND WIDJOKONGKO HANANTO	Eng-4	2
A Study on the Use of Kinetic Energy Recovery System Technology for Motorcycle to Enhance Acceleration DIAH WULANDARI, BAMBANG SAMPURNO, AND I NYOMAN SUTANTRA	Eng-5	3
A Comparative Study on Shielded Metal Arc Welding in Sea Water, Fresh Water and Air ATRIA PRADITYANA	Eng-6	3
Phase Transformation of CuZn Alloys Produced by Mechanical Alloying with Milling Time and Zn Volume Fraction Variation WIDYASTUTI, RAHMATILLAH ISRA', AND NURUL TAUFIQURRAHMAN	Eng-7	4
Initiation and Propagation of Crack in Nylon-6 Disk Under Impact SUTIKNO	Eng-8	4
Models of Queuing Simulation for Slag Transportation MUHAMMAD RUSMAN AND SUTIKNO	Eng-9	5
Output Power Measurement of the Developed Knee Flexion Angular Driven by Human Energy Harvester HARUS LG AND UMARUDIN	Eng-10	5
Electromagnetic Vibration Energy Harvester for Harvesting Vibration Energy of the KRI KKP-811's Engine HARUS LG AND RAHMAT SUSANTO	Eng-11	6
The Effect of Welding Parameters on the Configuration of Arc and Its Prediction by Artificial Neural Network ABDULLAH SHAHAB, I. B. RU ADHI ATMA WIGUNA, AND MUHAMMAD FADLY ABBAS	Eng-12	6
Designing a Portable Semi Automatic Dryer Machine for Rattan Art Home Industry AGUNG PRIJO BUDIJONO	Eng-13	7

Planning and Developing Hot Press Machine Using Pneumatic System Relay Based Control SAMPURNO	Eng-14	7
On the Vibration Profile of a V-Belt Transmission System in the Presence of a Lump BAMBANG DARYANTO W. , AND HERY ARTADY	Eng-15	8
The Influence of the Coil Length and the Number of Wire Turns on the Voltage Generated by a Vibration Energy Harvesting Mechanism WIWIEK HENDROWATI, BAMBANG DARYANTO W., AND HARUS L. GUNTUR	Eng-16	8
Empowering a Collective Techno-Force: Transforming an Engineer's Force into a Collective Techno-Force by Strengthening Techno-Team Work (An Interplay of Constructionism Perspective and Social Dimension of Organization) ADI SURYANI	Eng-17	9
Analysis on Modeling of DC Motor and Its Driving System Using with Matlab for Wheeled Mobile Robot MIRZA GHULAM INDRALAKSANA, AND HENDRO NURHADI	Eng-18	9
Concept of Rejuvenation Pure Asbuton Bitumen in Accordance with the Specifications of Petroleum Asphalt used is a Pavement Material FILIA RAKHMAH AND INDRASURYA B. MOCHTAR	Eng-19	10
Hydrometeorological Data Collection and Processing NOORDIAH HELDA	Eng-20	10
Experimental Study on Internal RH of BFS Mortars at Early Age JANUARTI JAYA EKAPUTRI	Eng-21	11
The Implementation of Probabilistic Scheduling (Case Study : Development Project of FSAINTEK UNAIR Building) FARIDA RAHMAWATI	Eng-22	11
Dry Joint Connection on Precast Column FATHMAH MAHMUD	Eng-23	12
Modal Parameter Extraction of a Seismically-Excited Multi-Story Building from Its Measured Response AGUNG BUDIPRIYANTO	Eng-24	12
Vulnerability Index Estimation for Building and Ground Using Microtremor TRIWULAN, WIDYA UTAMA, DWA DESA WARNANA, AND SUNGKONO	Eng-25	13

Prediction of Strength of 28-day-age-concrete with Fly Ash Based on Early Age Concrete Data Using Maturity Method IFTA MINKA, PUJO AJI, AND TRIWULAN	Eng-26	13
Prediction of Strength of 28 day-age-concrete Based on Early Age Concrete Data Using Maturity Method TEGAR JUANG PAMBUDI, TRIWULAN, AND PUJO AJI	Eng-27	14
Finite Element Modeling of Concrete-Steel Bond of Reinforced Concrete Structure DATA IRANATA	Eng-28	14
Compressive Strength and Microstructure Properties of Polymeric Concrete Incorporating Pulverized Fuel Ash (PFA) and Microwave Incinerated Rice Husk Ash (MIRHA) M.F. NURUDDIN AND M.S. DARMAWAN	Eng-29	15
Application of Probabilistic Scheduling Method on UNAIR FSAINTEK Building Project FARIDA RAHMAWATI AND WINDIARTO ABISETYO	Eng-30	15
Fabrication of Simple House Walls by Using Recycled Plastic Materials MUNARUS SULUCH AND HARUN ALRASYID	Eng-31	16
Load Distribution and Deflection Prediction of Pile Groups for Lateral Load DEWI AMALIA, SUWIGNYO, AND ANANTA SIGIT SIDHARTA	Eng-32	16
PDT Model for NSVM CHRISTIONO UTOMO	Eng-33	17
Micro Earthquake Monitoring to Detect the Distribution of Fluid Injection in Kamojang Geothermal Field ANIK HILYAH	Eng-34	17
Shear Strength Predictions of Steel Reinforced Concrete Beam-Column Joints Using Superposition and Strut-and-Tie Methods BUDI SUSWANTO AND HIDAYAT SOEGIHARDJO	Eng-35	18
The Impacts of Gypsum Board to the Post-fire Steel Profile HIDAYAT SOEGIHARDJO AND TEGUH ESA WIBAWA	Eng-36	18
Experimental Investigation of Hydraulic Jump on Conventional and Stepped Spillway EDIJATNO, NADJADJI ANWAR, AND VERY DERMAWAN	Eng-37	19

Creativeness of Sustainable Development Aspects on Spatial Arrangement Strategies and the Reformation of Public Transportation Systems within the Agglomeration Areas of Mebidangro to Anticipate the Operational of Medan Baru Internasional Airport at Kualanamu FILIYANTI TETA ATETA BANGUN	Eng-38	19
Optimization Process of Extraction of Paclitaxel and 10-Deacetylbaaccatin III from <i>Taxus Wallichiana Zucc</i> Using Supercritical CO₂ NGUYEN QUANG DUY, PHAN DINH TUAN, AND LE THI KIM PHUNG	Eng-39	20
Nonlinear pH Control (Adaptive Self-Tuning PID) Based on Reaction Invariant HENDRA CORDOVA AND ALI MASDUKI	Eng-40	20
A Study on the Effects of Rice Husk Ash on Strontium Waste Cementation SUSETYO HARIO PUTERO AND KUSNANTO	Eng-41	21
Neural Networks Based Predictive PID Controller for Nonlinear System BAMBANG L. WIDIJANTORO, HENI DWI PUTRI, AND BAMBANG PRIHANDOKO	Eng-42	21
Temperature Sensor Model Based on Thermo-Optics Effect in Fractal Fiber Bragg Grating M. RAMDLAN KIROM	Eng-43	22
M and C Sea Transportation as Solution for Increasing Safety at Sea AULIA S. AISJAH, AA MASROERI, EKO BUDI J., WASIS D. ARYAWAN, AND FITRI ADI I	Eng-44	22
A Design of Multivariable Optimal Control Linear Quadratic Gaussian (LQG) in FPB 38 Ship for Improving Turning Capability AULIA SITI AISJAH, A. A. MASROERI, AND DINAYATI RODLIYAH	Eng-45	23
Cold Chain System (Future Research Prespective) GRASIANO WARAKANO LAILOSSA, KETUT BUDA ARTANA, AND A.A.B.DINARIYANA	Eng-46	23
The Concept of Wireless Optical Communication System to Transmit the Fringe Pattern of a Sagnac Interferometer SAYUTI SYAMSUAR	Eng-47	24
Designing Automatic Backwash in Sand Filter Tank at Ipa 1 PDAM Gresik TOTOK SOEHARTANTO, RONNY DWI NORIYATI, AND NUR RAHMAH AWALIYAH	Eng-48	24
Biokinetic Study on α-Amylase Hydrolysis of Sorghum Starch to Readily Fermentable Sugar for Bioethanol SOEPRIJANTO, TRI WIDJAJA, ARINO ANZIP, AND SUHARMADI	Eng-49	25

Prediction of CO₂ Gas Solubility in Aqueous Solution of Potassium Carbonate and MDEA Using Electrolyte UNIQUAC SAIDAH ALTWAY, KUSENDRA DWI MARHETHA, KUSWANDI, AND WINARSIH	Eng-50	25
Alkaline Pretreatment on Hydrolysis of Grain Sorghum Bioconversion to Ethanol by Simultaneous Saccharification and Fermentation YUNI PARAMITHA SARI, DINI ANGGRIANI, AND NONOT SOEWARNO	Eng-51	26
Producing Sulfur Coated Urea by Fluid Bed Wet Coating Method: Drying Kinetics and Product Quality SUHERMAN, WIDAYAT, AND M. DJAENI	Eng-52	26
Process Improvement of Coco-Biodiesel Production through Three Stages Esterification Processes HADIYANTO, ANDRI CAHYO KUMORO, BAMBANG HELIYANTO, AND WIDAYAT	Eng-53	27
Fabrication of Microstructure Gold Electrode HIKMAT, FREDY KURNIAWAN, AND SUPRAPTO	Eng-54	27
Solvent Selection for Microwave Assisted Extraction of Dioscorin from <i>Dioscorea Hispida</i> Dennst Flour INDAH HARTATI AND ANDRI CAHYO KUMORO	Eng-55	28
Regulation of PDF 1.2 Expression by Defence and Abiotic Stress Signalling Pathways BADRUZSAUFARI, PAUL R. EBERT, AND DON MACLEAN	Eng-56	28
Case Study of Heat Transfer and Cracker Diffusivity Coefficient Characteristics to Design Exhaust Gas Heat Dryer AGUNG PRIJO BUDIJO, ALI KHOMSAH, AND AGUS BUDIANTO	Eng-57	29
Modification of HZSM-5 Base Catalysts for Producing Biofuels from Palm Oil AGUS BUDIANTO, KUSNO BUDHIKARJONO, ACHMAD ROESYADI, NURJANNAH, AND DANAWATI HARI PARJITNO	Eng-58	29
Carbon Dioxide Absorption into Promoted Aqueous Potassium Carbonate L. PUDJIASTUTI, E.A.SAPUTRA, A.ALTWAY, SUSIANTO, KUSWANDI, AND NONOT SUWARNO	Eng-59	30
Effects of Time and Solvent/Feed Ratio on the Extraction of Mannan from Aloe Vera Leaf Pulp ANDRI CAHYO KUMORO AND DIAH SUSETYO RETNOWATI	Eng-60	30
Anti-Sway Control for Haptic Crane for Application of Material Handling by Using Active Force Control (AFC) DIDIK SETYO P., ENDAH S. NINGRUM, ALI HUSEIN ALASIRY, AND MOH. NASYIR T.	Eng-61	31

Optimal Performance Design of Wind-Diesel Hybrid Power System (WDHPS) with Superconducting Magnetic Energy Storage (SMES) by Using Imperialist Competitive Algorithm (ICA) RADIKA HENDRI WIJAYA, MOCHAMAD AVID FASSAMSI, AND IMAM ROBANDI	Eng-62	31
Optimal Design of PID Power System Stabilizer (PSS) Using Ant Colony Optimization (ACO) MIFTAKHUR ROZIQ M.D, AS'ADI, TAMAJI, AND IMAM ROBANDI	Eng-63	32
Optimization of Capacitive Energy Storage (CES) for Improved Transient Stability on Single Machine Infinite Bus (SMIB) Using Differential Evolution Algorithm WENDY KURNIAWAN KAUTSAR, A. M., BENIE ZAKARIYA, AS'ADI, ALI MUSYAFI, AND IMAM ROBANDI	Eng-64	32
Application of Modified Backpropagation Neural Networks-based Economic Dispatch AKBAR SWANDARU, M. YUSUF WIBISONO, M. RIDHA FAUZ, AND IMAM ROBANDI	Eng-65	33
Generation Scheduling for Optimal Economic Dispatch Using Clonal Selection Algorithm (CSA) YUNITIKA TRISIANA, MUHAMMAD RIDHA FAUZI, TAMAJI, AND IMAM ROBANDI	Eng-66	33
Design of Power System Stabilizer (PSS)-based on Adaptive Neural Networks and PI Controller Using Particle Swarm Optimization (PSO) M. YUSUF WIBISONO, AS'ADI, FACHRUDDIN, AND IMAM ROBANDI	Eng-67	34
Application of Imperialist Competitive Algorithm for Optimal Capacitive Energy Storage in Electric Power System GUMILANG WICAKSONO, M. AVID FASSAMSI, AND IMAM ROBANDI	Eng-68	34
An Analog Prototype Model of STATCOM in Analysis and Design SOEDIBYO, IMAM ROBANDI, NI KETUT ARYANI, AND AS'ADI	Eng-69	35
Application of Differential Evolution for Load Frequency Control Optimization on Two Area Power System FACHRUDDIN A, MIFTAKHUR ROZIQ M.D., MUHAMMAD RIDHA FAUZI, TAMAJI, AND IMAM ROBANDI	Eng-70	35
Optimal Performance of Wind-Diesel Hybrid Power System (WDHPS) on Isolated Area with Superconducting Magnetic Energy Storage (SMES) Using Particles Swarm Optimization (PSO) A. M. BENIE ZAKARIYA I, STEPHAN, FACHRUDIN, AND IMAM ROBANDI	Eng-71	36
Optimal Coordination of Superconducting Magnetic Energy Storage (SMES) and Power System Stabilizer (PSS) on Power System Using Differential Evolution Algorithm MUH. MAHFUD ROSYIDI, A. M. BENIE ZAKARIYA, ALI MUSYAFI, AND IMAM ROBANDI	Eng-72	36
Optimal Design of PID Power System Stabilizers (PSS) Using Imperialist Competitive Algorithm (ICA) SUGENG LAKSONO, MOCHAMAD AVID FASSAMS, AS'ADI, ALI, AND IMAM ROBANDI	Eng-73	37

Optimization Solutions of Economic Dispatch in Power System Using Bacterial Foraging Algorithm MUHAMMAD RIDHA FAUZI, ALI MUSYAFA, AND IMAM ROBANDI	Eng-74	37
Tuning of Automatic Voltage Regulator (AVR) System and Power System Stabilizer (PSS) Using Imperialist Competitive Algorithm (ICA) MUHAMMAD TAUFIQ RAMADHAN, MUHAMAD OTONG, TAMAJI, AND IMAM ROBANDI	Eng-75	38
Design of Power System Stabilizer (PSS) Using Imperialist Competitive Algorithm (ICA) in Multimachine Power System AS'ADI, ADI PRAMUKA, ERPHAN SAHIRI, AND IMAM ROBANDI	Eng-76	38
State Feedback Controller Design of Power System Stabilizer (PSS) by Using Fuzzy Model TAMAJI AND IMAM ROBANDI	Eng-77	39
Design of Optimal Dual Input Power System Stabilizers (DIPSS) and Capacitive Energy Storage (CES) Using Particle Swarm Optimization (PSO) FAIQ ULFI, TAMAJI, AND IMAM ROBANDI	Eng-78	39
Optimal Tuning of PID Controller for Load Frequency Control (LFC) Using Ant Colony Optimization (ACO) M. FAISHAL A, MIFTAKHUR ROZIQ M.D, MUHAMMAD RIDHA FAUZI, TAMAJI, AND IMAM ROBANDI	Eng-79	40
Tuning of Power System Stabilizer (PSS) on Single Machine Infinite Bus (SMIB) Using Particle Swarm Optimization (PSO) ZAINAL ABIDIN, MUHAMMAD OTONG, TAMAJI, AND IMAM ROBANDI	Eng-80	40
Model and Simulation of Vehicle Lateral Stability Control FACHRUDIN, IMAM ROBANDI, AND I NYOMAN SUTANTRA	Eng-81	41
Application of Modified Neural Network- based Economic Dispatch in Java-Bali Interconnection System AMIR AMRUDDIN, M. YUSUF WIBISONO, AS'ADI, AND IMAM ROBANDI	Eng-82	41
Power Quality Improvement in AC/DC Three Phase Semiconverter with Third Harmonic Injection Using PI Controller PRIMA DEWI PERMATASARI, YAHYA CHUSNA ARIF, AS'ADI, AND IMAM ROBANDI	Eng-83	42
Design of Imperialist Competitive Algorithm for Optimal Coordination Superconducting Magnetic Energy Storage (SMES) and Power System Stabilizer (PSS) MOCHAMAD AVID FASSAMSI, AS'ADI, FACHRUDIN, AND IMAM ROBANDI	Eng-84	42
Effects of Fuel Reprocessing Flow Rate on Passive Compact Molten Salt Reactor (PCMSR) Fuel Composition at Sustainable Phase ANDANG WIDI HARTO	Eng-85	43

Design of Automatic License Plate Identification System for e-Commerce Solutions to Parking Space Optimization W. TRI HARTONO AND ARMEIN Z. R. LANGI	Eng-86	43
Power Supply Planning Study on Electric Train Island North Java Tracking R. AHMAD CHOLILURRAHMAN AND ANTON ANDRI HARTANTO	Eng-87	44
A Fuzzy Logic Controller for Stability Voltage and Maximum Energy Extraction for Fixed Speed Wind Power Generation Systems RONY H. R. FOR A, KETUT BUDA ARTANA, AND MASROERI	Eng-88	44
Analysis of Medical Images Segmented Using Optimized Fuzzy Logic Methods INDAH SOESANTI, ADHI SUSANTO, THOMAS SRI WIDODO, AND MAESADJI TJOKRONEGORO	Eng-89	45
Noisy MRI Medical Images Segmentation Using a FCM Algorithm that Incorporates Spatial Information into the Membership Function INDAH SOESANTI, ADHI SUSANTO, THOMAS SRI WIDODO, AND MAESADJI TJOKRONEGORO	Eng-90	45
Fault Distance Estimation of Two-Terminal Transmission Lines RAMADONI SYAHPUTRA	Eng-91	46
Designing Control Device for Closing and Opening the Door Using TV Remote MARVIN CHANDRA WIJAYA AND SEMUIL TJIHARJADI	Eng-92	46
Design of Generator DC Barium Ferrite Permanent Type Axial Magnetic Flux (AFM) for Wind Power Electricity Application Utilizes Finite Element Method Magnetics (FEMM) Software DYAH SAWITRI AND RUDYANA KRISTYANTO	Eng-93	47
Utilization of Water Disposal Results Condensation of Condenser Geothermal Power Plant as a Micro-Hydro Powerplant R. AHMAD CHOLILURRAHMAN	Eng-94	47
Dielectric Dissipation Factor Comparison Between Mineral Oil and Synthetic Ester Oil During Aging Process ENDAH YULIASTUTI	Eng-95	48
Designing Traction Control System of Front Wheel Drive Vehicle with Mpc Controller MOH SYARIFUDDIEN ZUHRIE	Eng-96	48
Designing Video Conference Application for Distance Learning MINGSEP, LUKITO E. NUGROHO, JAZY E. ISTIYANTO, AND RISANURI HIDAYAT	Eng-97	49
Segregation Mechanism Observations on Al₂O₃ Particles in Al/Al₂O₃ MMCs MOCHAMAD Z, WIDYASTUTI, AND MOCHTAR K.	Eng-98	49

The Concept of Wireless Optical Communication System to Transmit the Fringe Pattern of a Sagnac Interferometer JOHN MCLACHLAN-KARR	Eng-99	50
Maintenance Scheduling for Main Engine Support Systems Using System Dynamics Modeling RUBBY PRASETYA, I PUTU ANDHI INDIRA KUSUMA, AAB. DINARIYANA D.P., LAHAR BALIWANGI, AND KETUT BUDA ARTANA	Eng-100	50
Maturity Measurement Model for ERP Higher Education Implementation to Improve Costumer Orientation and Service through Education and Training Human Resource Related It Using Cobit 4.1 and Weighted Fishbone Diagram RAHIMI FITRI AND RIYANARTO SARNO	Eng-101	51
Maritim Weather Forecast Using Fuzzy Logic for Shipping Feasibility at Tanjung Perak Port Surabaya SYAMSUL ARIFIN, AULIA SITI AISJAH, BAMBANG LELONO W., AND PRITA MEILANITASARI	Eng-102	51
Implementation of RFID Technology in Inventory Control RINDRA YUSIANTO AND WISNU ADI PRASETYANTO	Eng-103	52
Customer Protection in Reuse Strategy – An Analysis from Warranty Perspective MARIA ANITYASARI	Eng-104	52
Ergonomic Design on Mobile and Portable Fish Smoking Tool to Improve Fish Processing for Improving SME Competitiveness EKO NURMIANTO, NUGROHO PRIYO NEGORO, AND RETNANI RAHMIATI	Eng-105	53
Risk Based Design for LNG Receiving Terminal in Benoa Bay-Bali RENDY MAULANA B, KETUT BUDA ARTANA, AND A.A.B. DINARIYANA	Eng-106	53
Mathematical Modeling of Batch Distillation with a Middle Vessel Under Total Reflux Policy A. HISYAM, R. MOHD YUNUS, B. ABDUL AZIZ, AND CHIN SIM YEE	Eng-107	54
Mapping of Potential Renewable Energy Sources as an Alternatives Energy Ready to be Exploited in Province of East Nusa Tenggara AGUSTHINUS S. SAMPEALLO	Eng-108	54
Propagating Gravity Current in a Uniform Channel as a Laboratory Model for Salt Intrusion TJIPTO PRASTOWO	Eng-109	55
Effects of Mechanical Milling on Hydriding-dehydriding Properties of Mg-23.5Ni Eutectic Alloy SUTARSIS AND S.L-LEE	Eng-110	55

Residual Stress on Thermal Spray Material at High Temperature Resistant Ceramic Metal Super Alloy H. PURWANINGSIH, R. FAJARIN, H. TANADI, AND SULISTIJO	Eng-111	56
Experimental Study of Alternative Materials Composite for Helmet ATRIA PRADITYANA	Eng-112	56
An Investigation into the Resistance Characteristics of Geometrically Similar Models and with Special Attention to Model with Bulbous Bow I K A P UTAMA AND A JAMALUDDIN	Eng-113	57
Design of Product Service System Online Self-Assessment for Higher Education Institution Students R. W. TRI HARTONO AND TATA SUPRIYADI	Gen-1	57
Improving Business Competitiveness through Innovation: A Comparative Study among China, India and Indonesia SARI LESTARI ZAINAL RIDHO AND MARIESKA LUPIKAWATY	Gen-2	58
The Role of University in Improving the Quality of Human Resources ROHANI JAHJA WIDODO	Gen-3	58
Acceptance of Web Surfers to Internet Content Filters: A Gender Perspective BAROROH LESTARI	Gen-4	59
Design of Higher Education Learning Management System Interoperability YENI ANISTYASARI AND RIYANARTO SARNO	Gen-5	59
Effect of Information Technology Maturity Model Process by Using Domain Information Technology Acquisition and Implementation in Higher Education ALEXANDER SETIAWAN	Gen-6	60
"Personal Mobile Learning" Distance Learning Device Using DVB Technology KUMARA SADANA PUTRA, S.Ds,	Gen-7	60
E-Learning Distributed System Development for Rural Education SEMUIL TIJHARJADI AND MARVIN CHANDRA WIJAYA	Gen-8	61
Sand and Shell Crafts Bussiness Group Development in Paiton District, Probolinggo Regency EKO NURMIANTO, NUGROHO PRIYO NEGORO, AND WALUYOHADI	Gen-9	61
Lighting Analysis for Design Interior Car Body of First Class Train New Generation PT. INKA BAMBANG TRISTIYONO	Art-1	62

Enhancement of New Batik Design for Teenagers Segment RAHMATSYAM LAKORO, BAROTO TAVIP INDROJARWO, SABAR, AND SAYATMAN	Art-2	62
Development of New Batik Design for Contemporary Segment BAROTO TAVIP INDROJARWO, SABAR, RAHMATSYAM LAKORO, AND SAYATMAN	Art-3	63
Consumer Preferences of New Batik Design for Children, Teenagers and Contemporary Segments by Perceptual Mapping SABAR, BAROTO TAVIP INDROJARWO, RAHMATSYAM LAKORO, AND SAYATMAN	Art-4	64
Exploration of New Batik Design for Children Segment SAYATMAN, BAROTO TAVIP INDROJARWO, SABAR, AND RAHMATSYAM LAKORO	Art-5	65
Eco-Tech in Architecture Case: Architecture by Jean Nouvel and YB Mangunwijaya MURNI RACHMAWATI	Art-6	65
Potency of <i>Pemphis Acidula</i> as a Handicraft Material Decreasing Its Population LISTIANI, TUTIK NURHIDAYATI, AND DIAN SAPTARINI	Sci-1	66
Antibacterial Effect of Casein and Casein Hydrolysisate on <i>Enterobacter Sakazakii</i> FATMA ZUHROTUN NISA, DYAH INTAN PUSPITASARI, AND NURROKHMAN	Sci-2	66
Mathematics Mobile Learning Application (MMLA) for System of Linear Equation with Two Variables: An Alternative Instructional Media EVANGELISTA LUS WINDYANA PALUPI AND SITTI MAESURI PATAHUDDIN	Sci-3	67
Advantages of Algae <i>Spirogyra</i> as the Raw Material of Bioethanol with the Addition of α-Amilase Enzyme SULFAHRI, SITI MUSHLIHAH, EKO SUNARTO, AND RENIA SETYO UTAMI	Sci-4	67
Bioclimatic Concept Approach in Sustainable Architecture Context for Improving Indoor Thermal Comfort on Warm Humid Tropic HoUsing Estate IMA DEFIANA	Sci-5	68
Classification of Particles with Sub-Micron in Size by Using the Electrically Enhancement Hydro-Cyclone Separator ROMANUS KRISANTUS TUE NENU, HIDEYO YOSHIDA, SUGENG WINARDI, AND M. RACHIMOELLAH	Eng-114	68
Artificial Intelligence Development Based Adaptive Neuro Fuzzy Inference System for Lung Cancer Diagnosis SYAMSUL ARIFIN, ANDI RAHMADIASAH, AND SYLVIA AYU PRADANAWATI	Eng-115	69
Robot Soccer System Based on Virtual Force Field Method Approach RIZKY YUNIAR HAKKUN, ENDAH SURYAWATI NINGRUM, AND SETIAWARDHANA	Eng-116	69

Structural Behaviour of Submerged Floating Tunnels Under Environmental Loadings	Eng-117	70
ENDAH WAHYUNI, I GUSTI PUTU RAKA, BUDI SUSWANTO, DJOKO PRIYO UTOMO, AND MULYO HARRIS PRADONO		
Slenderness Study of Square Reinforcement Concrete Columns with Software MS Visual Basic 6.0	Eng-118	70
IMAN WIMBADI, TAVIO, AND PAULUS WINOTO		
Implementation of Virtual Force Field Method for Movements Control Autonomous Mobile Robot in Soccer Robot Applications	Eng-119	71
ALI HUSEIN ALASIRY, ENDAH SURYAWATI NINGRUM, AND BAYU PRASETYO		
An Image Processing System For Visual Servoing of Soccer Robot	Eng-120	71
ENDAH SURYAWATI NINGRUM, RIZKY YUNJAR HAKKUN, ALI HUSEIN ALASIRY, AND RODIK WAHYU INDRAWA		

State Feedback Controller Design of Power System Stabilizer (PSS) by using Fuzzy Model

TAMAJI¹ AND IMAM ROBANDI¹

¹Department of Electrical Engineering,
 Faculty of Industrial Technology, Institut Teknologi Sepuluh Nopember, Surabaya, 60111, Indonesia
 email: tamajikayadi@yahoo.com

Abstract— Power system stabilizer (PSS) is used to damp the mechanic electro oscillation that is the disturbance of PSS. Some methods of PSS control design are adaptive control, robust control. The other side of fuzzy logic is also influence by the performance increasing of PSS. The stability analysis and performance gain can be obtained by using the Linear Matrix Inequality (LMI). In this paper, we study how to build the Takagi-Sugeno fuzzy model, determine the LMI condition such that system stable, design state feedback controller and also simulate the performance of PSS. Here, we make program by using Matlab software.

Keywords—LMI, Takagi-Sugeno fuzzy model, state feedback

I. INTRODUCTION

In power system generation, power system stabilizer (PSS) is use to damp the mechanic electro oscillation. This oscillation is a disturbance of system. Some disturbances are due to continuing variation of power, changing the set point and others. Some methods of PSS design controller are direct feedback linearization (Tamaji, 2009; Yadaiah & Ramana, 2006), adaptive control and robust control beside that fuzzy logic is influence to increase the performance of PSS. The stability analysis and performance gain of fuzzy model control system can be obtained by Linear Matrix Inequality (LMI) (Tanaka & Wang, 2001 in Soliman, 2009).

In this paper, we design the state feedback controller of single machine infinite bus (SMIB). The mathematical model of SIMB system is non linear system (Soliman, 2009; Yadaiah & Ramana, 2006). To design the controller of this PSS, at the first time, we change the mathematical model of SIMB into fuzzy model T-S, after that we define the fuzzy state feedback controller, we determine the LMI condition such that the system is stable, determine the feedback gain and finally we make simulation to analyze the performance of PSS.

II. SMIB FUZZY MODEL

Single machine infinite bus is a simple model of power system. This system consist of single power which connect with two line parallel transmission respect to large networking and approximate by infinite bus. This system is showed in Figure 1.

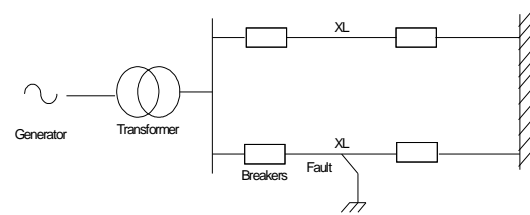


Figure 1. SMIB power system

The generating power system is a non linear system (Soliman, 2009; Tamaji, 2009) as follows:

$$\begin{aligned} \dot{\delta} &= \omega_0 - \omega \\ \dot{\omega} &= (T_m - E'_q I_q - (x_q - x'_d) I_d I_q) / M \\ \dot{E}'_q &= (-E'_q - (x_q - x'_d) I_d + E'_{fd}) / T_{d0} \\ \dot{E}'_{fd} &= \frac{K_E}{T_E} (V_{ref} - V_T + u_{pss}) - \frac{1}{T_E} E'_{fd} \end{aligned} \quad (1)$$

The state variable $\delta, \omega, E'_q, E'_{fd}$ is angle, angular velocity, induced EMF proportional to field current and generator field voltages, respectively. From Yadaiah & Ramana, 2006, we know that

$$P_e = \frac{E'_q V_s}{x_{de}} \text{Sin} \delta; \quad (2)$$

$$Q = \frac{E'_q V_s}{x_{de}} \text{Cos} \delta - \frac{V_s^2}{x_{da}}; \quad (3)$$

$$V_T = \sqrt{V_d^2 + V_q^2};$$

$$V_d = -X_e I_q + V_s \text{Sin} \delta \quad (4)$$

$$V_q = X_e I_d + V_s \text{Cos} \delta \quad (5)$$

Such that by substituting equation (2) and (3) into equation (4) and (5) we obtain

$$V_d = -X_e I_q + \frac{P_e x'_{d\epsilon}}{E_q}; V_q = X_e I_d + \left(Q + \frac{V_s^2}{x'_{d\alpha}} \right) \frac{x'_{d\epsilon}}{E_q};$$

or
$$I_q = \frac{P_e x'_{d\epsilon}}{E_q X_e} - \frac{V_d}{X_e},$$

There are some methods to design the controller of non linear system such that adaptive controller, robust control, linear direct feedback and by building the fuzzy model T-S. In this paper we use the building the fuzzy model T-S to design controller. At first the system in equation (1) we arrange into state space system

$$\begin{bmatrix} \dot{\delta} \\ \dot{\omega} \\ \dot{E}'_q \\ \dot{E}'_{fd} \end{bmatrix} = \begin{bmatrix} \frac{\omega_0}{\delta} & -1 & 0 & 0 \\ 0 & S_1 & \frac{P_e x'_{d\epsilon}}{E'_q X_e M} - \frac{V_d}{X_e M} & 0 \\ 0 & 0 & -S_2 & \frac{1}{T'_0} \\ 0 & 0 & S_3 & -\frac{1}{T_E} \end{bmatrix} \begin{bmatrix} \delta \\ \omega \\ E'_q \\ E'_{fd} \end{bmatrix} \quad (6)$$

$$+ \begin{bmatrix} 0 \\ 0 \\ 0 \\ \frac{K_E}{T_E} \end{bmatrix} u_{pss}$$

where

$$S_1 = \frac{(T_m - (x_q - x'_d)I_d I_q)}{M \omega}; S_2 = \frac{-(x_q - x'_d)I_d}{T'_0 E_q};$$

$$S_3 = \frac{K_E}{T_E E_q} (V_{ref} - V_T)$$

In this problem we define the fuzzy variable are P, Q, X_e , where

$$P \in [P^- \quad P^+]; P \in [Q^- \quad Q^+]; P \in [X_e^- \quad X_e^+];$$

such that we can derive the fuzzy rules as follows:

Rule Model 1

IFP(t)..is..P⁻ ..AND...Q(t)..is..Q⁻ AND
 ...X_e(t)..is..X_e⁻ THEN $\dot{x}(t) = A_1 x(t) + B u(t)$
 $y(t) = C x(t)$

Rule Model 2

IFP(t)..is..P⁻ ..AND...Q(t)..is..Q⁻ AND...X_e(t)..is..X_e⁺
 THEN $\dot{x}(t) = A_2 x(t) + B u(t)$
 $y(t) = C x(t)$

.....

Rule Model 8

IFP(t)..is..P⁺ ..AND...Q(t)..is..Q⁺ AND...X_e(t)..is..X_e⁺
 THEN $\dot{x}(t) = A_8 x(t) + B u(t)$
 $y(t) = C x(t)$

Define the member functions of P are

$$L_1 = \frac{P - P^-}{P^+ - P^-}; L_2 = \frac{P^+ - P}{P^+ - P^-},$$

the member functions of Q are

$$M_1 = \frac{Q - Q^-}{Q^+ - Q^-}; M_2 = \frac{Q^+ - Q}{Q^+ - Q^-},$$

and the member functions of X_e are

$$N_1 = \frac{X_e - X_e^-}{X_e^+ - X_e^-}; N_2 = \frac{X_e^+ - X_e}{X_e^+ - X_e^-},$$

Suppose

$$h_1 = L_1 M_1 N_1; h_2 = L_1 M_1 N_2; h_3 = L_1 M_2 N_1; h_4 = L_1 M_2 N_2$$

and

$$h_5 = L_2 M_1 N_1; h_6 = L_2 M_1 N_2; h_7 = L_2 M_2 N_1; h_8 = L_2 M_2 N_2$$

If we define

$$\alpha_i = \frac{h_i}{\sum_{j=1}^8 h_j}; i = 1, 2, \dots, 8 \quad (7)$$

Then the state space system in equation (6) can be written as model fuzzy

$$\dot{x} = \sum_{i=1}^8 \alpha_i A_i x + B u \quad (8)$$

and the output

$$y = C x \quad (9)$$

After we build the state space fuzzy model, we design the state feedback controller based on equation (8) and it call Parallel Distributed Compensation (PDC).

III. DESIGN CONTROLLER FUZZY MODEL OF SMIB

Parallel Distributed Compensation-PDC is a fuzzy design controller of fuzzy model Takagi-Sugeno (Fuzzy Model T-S). There are some designs controller such as state feedback controller $u = -F x$, and output feedback controller $u = F y$, where y is output such as equation (9). In this paper we design the controller by using the state feedback controller. State feedback fuzzy controller is constructed by PDC is

$$u(t) = -\sum_{i=1}^8 \alpha_i F_i x(t) \quad (10)$$

We substitute equation (10) into equation (8), we obtain

$$\dot{x} = \sum_{i=1}^8 \alpha_i A_i x - B \sum_{i=1}^8 \alpha_i F_i x$$

Or we can write as

$$\dot{x} = \sum_{i=1}^8 \alpha_i (A_i - BF_i) x \quad (11)$$

The design controller is to determine the matrix F_i such that the system in equation (11) is stable. One of methods to analyze the stability of system is by determining the eigen value of $\sum_{i=1}^8 \alpha_i (A_i + BF_i)$ and the

other is by defining the Lyapunov function. The system is stable if the real part of eigen value is negative or lay on the left half plane of complex space. The stability analyze by Lyapunov method is define the Lyapunov function

$$V(t) = x^T Q x \geq 0; Q \text{ positive definite} \quad (12)$$

System (11) is stable if we can find positive definite matrix Q which satisfy equation (12) and

$$\dot{V}(t) = \dot{x}^T Q x + x^T Q \dot{x} \quad (13)$$

is negative definite.

Substitute equation (11) into equation (13) we get

$$\dot{V}(t) = \dot{x}^T Q x + x^T Q \dot{x}$$

$$\dot{V}(t) = \left(\sum_{i=1}^8 \alpha_i (A_i - BF_i) x \right)^T Q x + x^T Q \left(\sum_{i=1}^8 \alpha_i (A_i - BF_i) x \right)$$

$$\dot{V}(t) = x^T \left(\sum_{i=1}^8 \alpha_i (A_i - BF_i) \right)^T Q x + x^T Q \left(\sum_{i=1}^8 \alpha_i (A_i - BF_i) \right) x$$

$$\dot{V}(t) = x^T \left[\left(\sum_{i=1}^8 \alpha_i (A_i - BF_i) \right)^T Q + Q \left(\sum_{i=1}^8 \alpha_i (A_i - BF_i) \right) \right] x$$

So $\dot{V}(t)$ is negative if

$$\left[\left(\sum_{i=1}^8 \alpha_i (A_i - BF_i) \right)^T Q + Q \left(\sum_{i=1}^8 \alpha_i (A_i - BF_i) \right) \right]$$

negative definite, or

$$\left[\left(\sum_{i=1}^8 \alpha_i (A_i - BF_i) \right)^T Q + Q \left(\sum_{i=1}^8 \alpha_i (A_i - BF_i) \right) \right] < 0 \quad (14)$$

Inequality (13) is called linear matrix inequality (LMI). So, in the Lyapunov method is we must determine matrix $F_i, i=1,2,\dots,8$ such that there is matrix positive definite Q which satisfy equation (14) (We solve the inequality (14)).

At this moment, we use the eigen value method to determine matrix $F_i, i=1,2,\dots,8$.

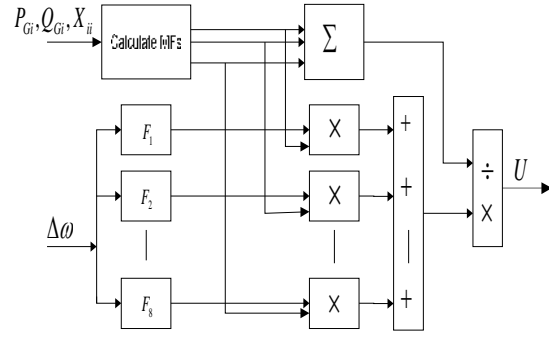


Figure 2. Schematic diagram for the proposed stabilizer on Gen # i

IV. SIMULATION AND RESULT

We take the parameter value as follows: [Soliman, 2009]

$$x_d = 1.8; x'_d = 0.3; x_q = 1.7; M = 13; T_{d0} = 8;$$

$$\omega_0 = 377; K_E = 200; T_E = 0.001; V_s = 1$$

with fuzzy parameter

$$(P, Q, X_e)$$

$$P \in [0.4 \ 1]; Q \in [-0.2 \ 0.5]; X_e \in [0.2 \ 0.4]$$

We make computer program for simulation by Matlab software. We use Matlab function "pole placement method" (place) to determine the feedback gain matrix $F_i, i=1,2,\dots,8$. We desire the pole or eigen value of matrix

$$\sum_{i=1}^8 \alpha_i (A_i - BF_i) \text{ is } [-1 \ -2 \ -3 \ -5].$$

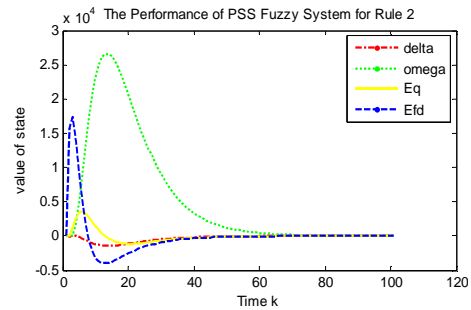


Figure 3. The Performance of PSS for rule 2, pole [-1 -2 -3 -5]

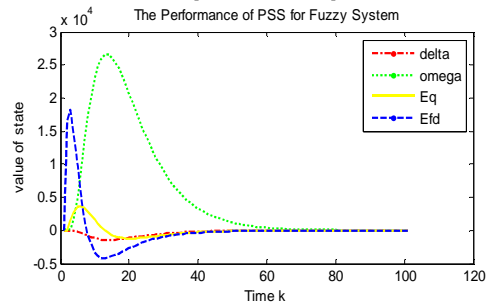


Figure 4. The Performance of PSS for Fuzzy System Pole [-1 -2 -3 -5]

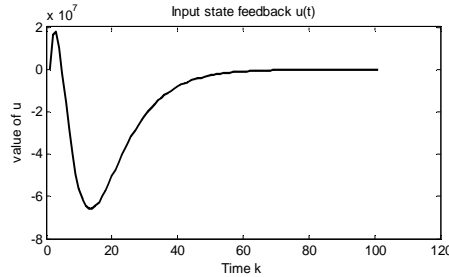


Figure 5. State Feedback Controller, Pole
 $[-1 \ -2 \ -3 \ -5]$

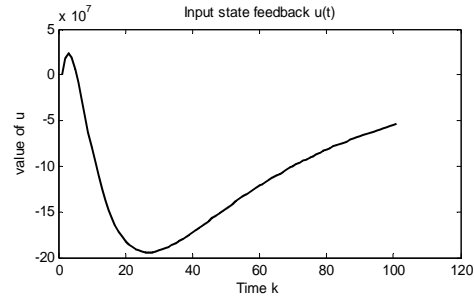


Figure 8. State Feedback Controller, Pole
 $[-1 \ -0.2 \ -3 \ -5]$

From simulation we know that feedback gain for each rule F_i can be obtained by using pole placement technique, such as figure 3 and the all state variables converge to zero after 60 time step. Figure 4 shows that the performance of fuzzy system and the all variables also go to zero after 60 time step. The state feedback controller $u(t) = -\sum_{i=1}^8 B\alpha_i x_i(t)$ is showed figure 5, after time set 60 the state feedback converge to zero.

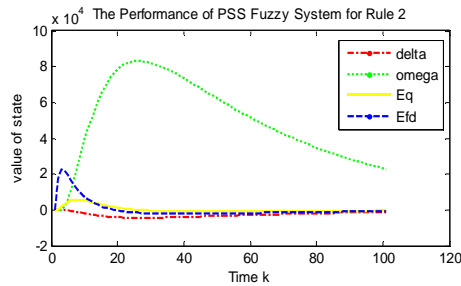


Figure 6. The Performance of PSS for rule 2, Pole
 $[-1 \ -0.2 \ -3 \ -5]$

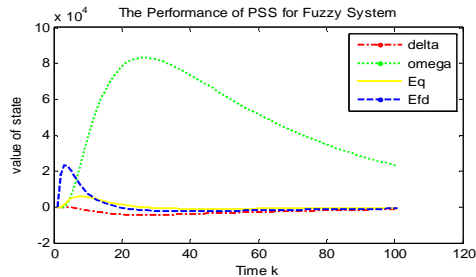


Figure 7. The Performance of PSS Fuzzy system, Pole
 $[-1 \ -0.2 \ -3 \ -5]$

The performance of PSS depends on pole which is taken. Figure (6) and (7) show the performance of PSS and state feedback controller if we take pole $[-1 \ -0.2 \ -3 \ -5]$. Because the second pole (eigen value) is -0.2 then the state variable ω (the second state variable) need more time to converge to zero. Figure (8) show that the state feedback controller is not yet converge to zero after time 100.

V. CONCLUSION

Based on the discussion above and the simulation result, we conclude that

1. The fuzzy model system can be used to design the non linear PSS system
2. It is necessary to change the non linear system into the fuzzy state space system.
3. The state variable and the state feedback controller will converge to zero at the same time.
4. The speed of convergence of system depend on the choosing pole or eigen value

VI. FURTHER RESEARCH

The research will continue with solving the LMI to determine the feedback gain $F_i, i = 1, 2, \dots, 8$. Beside that we can design the output feedback controller for fuzzy system of PSS either for SMIB or Multi-machine power system.

VII. REFERENCES

- [1] Soliman, M, Elshafei, Bendary, F. and Mansour, W, 2009, LMI static Output Feedback design of fuzzy power system stabilizers, Expert systems with Application 36 pp. 6817-6825, Elsevier
- [2] Tamaji, Musyafa A, Darma A and Robandi I, 2009, Controller Design SMIB by Direct Feedback linearization, presented in Conference APTECS 2009, ITS, Surabaya, Indonesia
- [3] Yadaiah, N, Ramana, N.Y., 2006, Linearization of Multi machine Power System: modeling and Control