THE INTERNATIONAL CONFERENCE & UTILITY EXHIBITION 2011

on Power and Energy Systems: Issues and Prospects for Asia

2ND AIT-PEA COLLABORATION

28-30 September 2011 Pattaya City, Thailand

Speakers

Plenary Speaker

Dr. Sumet Tantivejkul was born in Petchaburi Province of Thailand in 1939. He obtained his Baccalaureat Philosophic from the Academie de Montpelier, France in 1962 and quickly backed it up with Diploma in Political Science from Grenoble University, France in 1966, and a PhD also in Political Science from the Montpelier University, France in 1969. He is also holder of Certificates in Economic Planning as well as in Economic Development Institute awarded by International Publique Administration Institute, Paris (1973) and World Bank (1982), respectively.

In his official capacity, he served as the Secretary-General of the Royal Development Projects Board of the Royal Kingdom of Thailand bfrom 1993-1999. He was also the Secretary-General of the National Economic and Social Development Board from 1994-1996. He also held several key positions as President of Petchaburi Rajabhat Institute Council, Chairman of the Clean, Open and Transparent Thailand Project, Chairman of the Thai Rice Foundation, Chairman of Sirindhorn International Environment Park Foundation, and President Thammasat University Council.

Dr. Sumet Tantivejakul
Secretary-General
Chaipattana Foundation
Sri Ayuttaya Road,
Dusit, Bangkok,
Thailand

Due to his remarkable achievements he received several honors, some of them are: "Role Person of the Year 1994", Award for Oustanding Civil Affairs Adminiostrator 1995, Plaque of Honour for Excellence in Loyalty and Honesty from the Office of the Commission of Counter

Corruption in 1997. His recent awards include: Oustanding National Figure in Economic Development in 1998, Father of the Year 2008, as well as the Award for "Best Human Relationships of the Year 2010" from the Human Relation Society.

Dr. Sumet holds Honary Doctorate Degrees in Liberal Arts, Rural Planning and Development, Community Development, Agricultural Resources, Economics, Philosophy and Political Science from several universities all over Thailand. He is also highly decorated with Royal Awards, the latest of which is the Knight Grand Cross (First Class) of the Most Illustious Order of Chula Chom Klao. He is currently serving as the Secretary-General of The Chaipattana Foundation.

KEYNOTE ADDRESS 1

Prof. Saifur Rahman is the director of the Advanced Research Institute at Virginia Tech where he is the Joseph Loring Professor of electrical and computer engineering. He also directs the Center for Energy and the Global Environment at the University. He is a Fellow of the IEEE and the editor-in-chief of the IEEE Transactions on Sustainable Energy. In 2010 he is serving as the vice president for New Intiatives and Outreach for the IEEE Power & Energy Society and a member of its governing board. In 2006 he served as the vice president of the IEEE Publications Board, and a member of the IEEE Board of Directors. He is a distinguished lecturer of IEEE.

Professor Saifur Rahman
Joseph R. Loring Professor & Director
Virginia Tech Advanced Res. Inst.
Arlington, VA 22203, USA

Smart Grid as an Enabler for Distributed Generation

While central station electric power plants have long provided the bulk of electricity in all industrialized and most developing countries, the traditional need for reliability of electricity supply is now being supplemented by the need for security and environmental sustainability. As many developing countries begin to industrialize to provide jobs and better living conditions to its citizens, the requirements for reliable, secure and environmentally sustainable supply of electricity becomes paramount. While fossil fuels have been the primary sources of electricity for the last one hundred years, their cost, uneven global distribution and global warming potential are encouraging world leaders to look for alternatives in renewable solar resources, which are distributed. But distributed generation sources have their own challenges - primarily intermittency. Many believe that the smart grid – due to its inherent communication, sensing and control capabilities – will have the ability to manage the load, storage and generation assets in the power grid to enable a large scale integration of distributed generation.

A smart grid will look more like the Internet, where information about the state of the grid and its components can be exchanged quickly over long distances and diverse networks. This will allow the grid integration of sustainable energy sources, such as wind, solar, off-shore electricity, etc. for smoother system operation. But in order for this to be possible, the electric utility will have to evolve and change their ways of operation to become an intelligent provider of these services. This lecture introduces the operational characteristics of renewable energy sources, and various aspects of the smart grid - technology, standards, regulations and data security which are needed to effectively integrate these sources of electricity into the grid. This lecture also addresses the interplay among distributed generation and storage, conventional generation and demand response to provide an efficient operational strategy in the context of the smart grid.

KEYNOTE ADDRESS 2

Mr. Chen Fangzeng
Executive Vice President on Renewable Energy and Smart Grid Deployment
Shanghai Municipal Electric Power Company (SMEPC)
Shanghai, China

KEYNOTE ADDRESS 3

Prof S. N. Singh, who was born on 5th September 1966, obtained his M. Tech. and Ph. D. in Electrical Engineering from Indian Institute of Technology Kanpur, in 1989 and 1995, respectively. Presently, he is a Professor in the Department of Electrical Engineering, Indian Institute of Technology Kanpur, India. Before joining IIT Kanpur as Associate Professor, Dr Singh worked with UP State Electricity Board as Assistant Engineer from 8-8-1988 to 13-6-1996, with Rookree University (Now IIT Rookree) as Assistant Professor from 14-6-1996 to 1-1-2001 and with Asian Institute of Technology, Bangkok, Thailand as Assistant Professor from 2-1-2001 to 4-4-2003. Dr Singh received several awards including Young Engineer Award 2000 of Indian National Academy of Engineering, Khosla Research Award of IIT Roorkee, and Young Engineer Award of CBIP New Delhi (India), 1996. Prof Singh is receipt of Humboldt Fellowship of Germany (2005, 2007) and Otto-Monsted Fellowship of Denmark (2009-10).

Professor Sri Niwas Singh
Department of Electrical Engineering
Indian Institute of Technology Kanpur
Kanpur, India

His research interests include power system restructuring, FACTS, power system optimization & control, security analysis, wind power, etc. Prof Singh is a Fellow of Institution of Electronics and Telecommunication Engineers (IETE) India, a Senior Member of IEEE, USA, a Fellow of the Institution of Engineering & Technology (UK) and a Fellow of the Institution of Engineers (India).

Prof Singh has published more than 320 papers in International/national journals/conferences. He has also written two books one on Electric Power Generation, Transmission and Distribution and second is Basic Electrical Engineering, published by PHI, India.

Integrating Wind Generations to a Smart Grid Environment

Due to the increased interconnections and loading of the network with liberization and environmental pressure, the power systems have become complex and facing many challenges in their optimal, secure and efficient operation. Smart grid initiatives seem to provide remedial measured to these problems by computational intelligence, automation, advanced measurements, and application of information and communication technology (ICT). Several countries have already taken the first step in the direction of smart grid by unbundling the power system to bring competition with the introduction of renewable energy sources. Future power system structure, operation, control and management will be quite different from the existing one as it will foresee large market players with direct involvement of consumers, more renewable energy sources and trading of electricity.

Wind power generation is emerging as one of the most successful programs in renewable energy sector, and has started making meaningful contributions to the overall power requirements in India and worldwide. Harnessing wind energy for electric power generation is an important area of research due to irreversible changes in the power system structure, operation, management and ownership. Wind power integration in the existing grid is one of the major concerns in the recent years due to increased penetration level of wind power generation which will have a significant influence on the operation and control of power systems. New grid codes are being set up by several countries to specify the relevant requirements to integrate the wind power generation in the existing electric power system. The grid connection regulations are to be developed in a more consistent and internationally harmonized manner to bring the accelerated growth, maximum efficiency and to reduce the cost.

The main objective of this talk is to discuss the major challenges in integrating the wind power generation in the smart grid environment. The talk provides a platform to an in-depth discussion on the various challenges and their possible remedies in smart grid initiatives which will benefit participants from academic and R&D institutions, engineers of utilities and policy makers.

KEYNOTE ADDRESS 4

Mr. Michiaki Uriu has been serving as Executive Vice President and General Manager of Thermal Power Generation Division in Kyushu Electric Power Company, Incorporated, as well as President and Representative Director in two subsidiaries, including KYUDEN ECOSOL CO., LTD., since June 2011. He joined the Company in April 1975 and used to serve as Managing Executive Officer, Manager of New Business Development Group, Manager of Energy Market Strategy Group, Manager of Power Trading Management Group, General Manager of Environmental Affairs Department, Executive Officer, and General Manager of Corporate Planning Department. He obtained his Master's degree in Industrial Mechanical Engineering from Osaka University in March 1975.

Mr. Michiaki Uriu
Executive Vice President, and
General Manager of Thermal Power Generation Division
Kyushu Electric Power Co., Inc.
Japan

KEPCO's Efforts Towards Realization of a Low-Carbon Society

Global warming issues have been growing in importance as a problem shared by all humankind. This trend calls for emission reductions of greenhouse gases, which are considered to be the cause of global warming. Kyushu Electric Power's keynote speech at the conference is entitled "Kyushu Electric Power's Efforts towards Realization of a Low-carbon Society" and introduces our approaches to "Efficient Use of Energy," "Proactive Development and Introduction of Renewable Energy" and "Technological Development," all of which are main pillars towards the actualization of a low-carbon society. "Efficient Use of Energy" focuses on our company's enhanced efficiency of thermal power generation. "Proactive Development and Introduction of Renewable Energy" deals with our efforts towards wind and photovoltaic power, biomass and geothermal power generation, while introducing our biomass power generation project overseas and geothermal binary power generation development. Finally, "Technological Development" focuses on our small isolated island microgrid verification testing, and smart grid verification testing, as well as our Intelligent House project, which is our customer-side scheme. In this connection, the challenge we have set towards the development of lithium-ion batteries which are essential to the development of EV quick charging and regular charging infrastructure as well as carbon reduction, is also introduced.

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1. Home
2. Conference Purpose/Scope
3. Conference Topics
4. Organizing Committee
5. Tech. Program Committee
6. Intl. Advisory Committee
7. Conference Program
8. Plenary/Keynote Speakers
9. Detailed Abstracts
10. Full Papers
11. Venue
12. Field Visit Sites
13. Downloads
14. Conference Photos
15. Contact Information

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The International Conference & Utility Exhibition 2011

on Power and Energy Systems: Issues and Prospects for Asia

28-30 September 2011, Pattaya City, Thailand

E-mail: icue2011@ait.asia, Website: www.serd.ait.asia/icue2011

12 July 2011

Komkrit Prasertwong and Sirichai Dangeam
Department of Electrical Engineering
Srinakharinwirot University, Ongkharak
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Thailand

Dear Author(s),

Subject: **Status of your full paper submission to the ICUE 2011**

I am pleased to inform you that your full paper titled **"A Design and Construct an Electric Circuit to Emulate Power System Oscillation in Tie-Line Systems (ICUE-109)"** has been accepted for oral presentation in the upcoming **International Conference and Utility Exhibition 2011 on Power and Energy Systems: Issues and Prospects for Asia (ICUE 2011)**. This conference will be held during ***28-30 September 2011*** at ***Amari Orchid Pattaya Hotel, Pattaya City, Thailand.*** You will be informed of your session assignment through your registered e-mail address in due course.

For inclusion in the oral presentation schedule and conference proceeding, kindly process your copyright transfer form (see attached) and the payment of the registration fee of at least one of the authors. Kindly note that only papers with at least one registered author will be considered for inclusion in the presentations and the proceedings (note: each author is allowed to present a maximum of two (2) papers only). You may fill-up the attached registration form and submit your proof of payment to us either by email or by fax. The deadline for ***early-bird registration*** is on the **22nd of July 2011**. When sending your proof of payment please indicate your reference code (*please see above*) and its title. (Kindly ignore this registration reminder if you have already processed your registration with us.)

Also, please take this gentle reminder that your accommodation in Pattaya is not included in your registration fee. However, the ICUE 2011 organizing committee was able to arrange affordable room rates at Amari Orchid Pattaya Hotel especially offered for its participants. Please use the special hotel reservation form should you choose to stay at the Amari. Their contact details are also available in the form. Should you have any difficulty in sending the hotel reservation form, please don't hesitate to notify us so that we could help follow-up for you.

ICUE 2011 will cover academic, technical, economic, social and political dimensions of electric energy utilization and management that aims for Asian sustainable development. It is envisioned that ICUE 2011 will bring together practicing power engineers, policy makers, energy professionals, researchers and many others with interest in power and energy field, so this event is for you.

We are looking forward to seeing you at the conference.

Sincerely,

W. Ongsakul

Weerakorn Ongsakul, PhD
Conference Director
ICUE 2011

A Design and Construct an Electric Circuit to Emulate Power System Oscillation in Tie-Line Systems

K. Prasertwong, and S. Dangeam

***Abstract*--The research is to study and design an electric circuit to emulate low-frequency oscillation in power transmission lines. The simulated signal is analyzed by Prony analysis to identify frequency and damping ratio. MATLAB program and Dynamic System Identification Toolbox are used to simulate and identify the oscillation informations. The results is analyzed found that the oscillation frequency and damping ratio corresponding with designed values. Furthermore, a designed electric circuit will be used to implement low-frequency oscillation signal, which known frequency and damping ratio. These oscillation data will be used to verify correctness of the real-time algorithm to monitoring frequency and damping of power transmission lines in real-time event.**

***Index Terms*--Damping ratio, inter-area oscillation, power system oscillation, power system stability, Prony analysis.**

I. Introduction

Low frequency oscillations are generator rotor angle oscillations having a frequency between 0.1 – 2.0 Hz. The low frequency oscillations can be classified as local and inter-area mode. Typically, the frequency rang of local mode is 1 – 2 Hz and of inter-area mode is 0.1 – 1 Hz [1], [2].

Inter-area mode is more harmful than local mode. In Thailand had been installed a system called "PSGuard" to help the operator to detect and counteract power system instabilities [3]. The frequency of oscillations is identified and determined, as well as their damping. This information enables the power system operators to swiftly take well-informed decisions and counteract potential instabilities. Operators can thus avoid potential cascade tripping and system islanding.

In this work intends to construct a circuit to generate the low frequency oscillation signal to use in power oscillation monitoring system. Power oscillation monitoring is the algorithm used for the detection of power swings in a high voltage power system [3]. The algorithm is fed with selected voltage and current phasors. By processing these input phasors, it detects the various swing (power oscillation) modes. The algorithm quickly identifies the frequency and the damping of swing modes.

In this paper, we propose a circuit to create oscillation signal for developing the power oscillation monitoring algorithm to identify frequency and damping ratio in real-time.

The paper is organized as follows. In Section II is devoted to the design methodology. Section III presents simulation and experimental results. Finally in Section IV discusses some conclusions and future work.

II. Design Methodology

A circuit used to design in this paper shows as Fig. 1. After the switch S is closed, [4] the current in the circuit is given by

$$I(s) = \frac{1/L}{s^2 + \frac{R}{L}s + \frac{1}{LC}} \cdot V \quad . \tag{1}$$

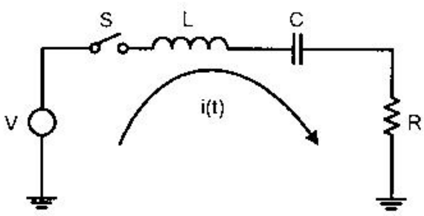

Fig. 1. R-L-C circuit.

We known that, the standard second order transfer function [5] given by

$$H(s) = \frac{\omega_n^2}{s^2 + 2\zeta\omega_n s + \omega_n^2} \ . \tag{2}$$

The relation between R-L-C values, damping ratio ζ, and undamped natural frequency ω_n given by define the denominator of (1) and (2) equal as follow

$$s^2 + \frac{R}{L}s + \frac{1}{LC} = s^2 + 2\zeta\omega_n s + \omega_n^2 \ . \tag{3}$$

Then, it gets the relation,

$$\frac{R}{L} = 2\zeta\omega_n \tag{4}$$

and

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$$\frac{1}{LC} = \omega_n^2 \tag{5}$$

Assume we want to create the oscillation signal frequency $f_d = 0.5$ Hz and the damping ratio $\zeta = 0.1$. It can be find R-L-C values as the following steps.

Step 1: Calculate the damped natural frequency ω_d

$$\omega_d = 2\pi f_d \tag{6}$$

Step 2: Calculate the undamped natural frequency ω_n

$$\omega_n = \frac{\omega_d}{\sqrt{1-\zeta^2}} \tag{7}$$

Step 3: Calculate the R-L-C values from

$$R = 2\zeta\omega_n L = \frac{2\zeta}{C\omega_n} \tag{8}$$

From (6), (7), and (8) we can calculate L and C as shown in Tables I, II, III, and IV.

TABLE I

CALCULATE L AND C WHEN DEFINE f_d , ζ AND R

f_d (Hz)	ζ	R (Ω)	L (H)	C (F)
0.1	0.01	10	795.7349	0.0032
0.1	0.1	10	79.1786	0.0317
0.1	0.3	10	25.3040	0.0911
0.1	0.5	10	13.7831	0.1378
0.5	0.01	10	159.1470	0.0006
0.5	0.1	10	15.8357	0.0063
0.5	0.3	10	5.0608	0.0182
0.5	0.5	10	2.7566	0.0276
1.0	0.01	10	79.5735	0.0003
1.0	0.1	10	7.9179	0.0032
1.0	0.3	10	2.5304	0.0091
1.0	0.5	10	1.3783	0.0138

From Table I, we see that if we want to increase the damping ratio, it should be decrease both the inductance and increase the capacitance.

TABLE II

CALCULATE L AND C WHEN DEFINE f_d , ζ AND R

f_d (Hz)	ζ	R (Ω)	L (H)	C (F)
0.1	0.01	10	795.7349	0.0032
0.5	0.01	10	159.1470	0.0006
1.0	0.01	10	79.5735	0.0003
0.1	0.1	10	79.1786	0.0317
0.5	0.1	10	15.8357	0.0063
1.0	0.1	10	7.9179	0.0032
0.1	0.3	10	25.3040	0.0911
0.5	0.3	10	5.0608	0.0182
1.0	0.3	10	2.5304	0.0091
0.1	0.5	10	13.7831	0.1378
0.5	0.5	10	2.7566	0.0276
1.0	0.5	10	1.3783	0.0138

Table II shown that, if we want to increase the oscillation frequency f_d and maintain the damping ζ , we must to decrease both inductance and capacitance.

TABLE III

CALCULATE L AND C WHEN DEFINE f_d , ζ AND R

f_d (Hz)	ζ	R (Ω)	L (H)	C (F)
0.1	0.01	5	397.8675	0.0064
0.5	0.01	5	79.5735	0.0013
1.0	0.01	5	39.7867	0.0006
0.1	0.1	5	39.5893	0.0633
0.5	0.1	5	7.9179	0.0127
1.0	0.1	5	3.9589	0.0063
0.1	0.3	5	12.6520	0.1822
0.5	0.3	5	2.5304	0.0364
1.0	0.3	5	1.2652	0.0182
0.1	0.5	5	6.8916	0.2757
0.5	0.5	5	1.3783	0.0551
1.0	0.5	5	0.6892	0.0276

Table IV shown that when R increase and we want to maintain both the frequency and damping ratio we must increase both L and C.

TABLE IV

CALCULATE L AND C VALUES WHEN DEFINE f_d , ζ AND R

f_d (Hz)	ζ	R (Ω)	L (H)	C (μF)
0.1	0.01	1000	79573	32
0.5	0.01	1000	15915	6
1.0	0.01	1000	7957	3
0.1	0.1	1000	7917	316
0.5	0.1	1000	1583	63
1.0	0.1	1000	791	31
0.1	0.3	1000	2530	910
0.5	0.3	1000	506	182
1.0	0.3	1000	253	91
0.1	0.5	1000	1378	1400
0.5	0.5	1000	275	275
1.0	0.5	1000	137	137

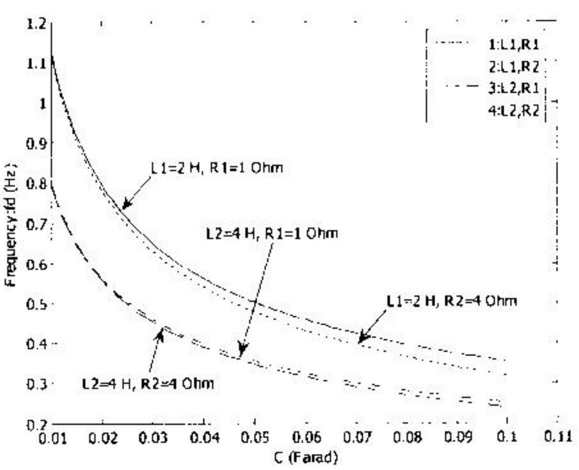

Fig. 2. The oscillation frequency versus the capacitance.

From (6), (7), and (8) we can plot relation between the frequency of oscillation, the damping ratio versus varying C, L, and R as shown in Figs. 2, 3, 4, 5, 6, and 7.

Figures 2 and 3 shown that when C increases the frequency of oscillations will decreases and the damping ratio will increases.

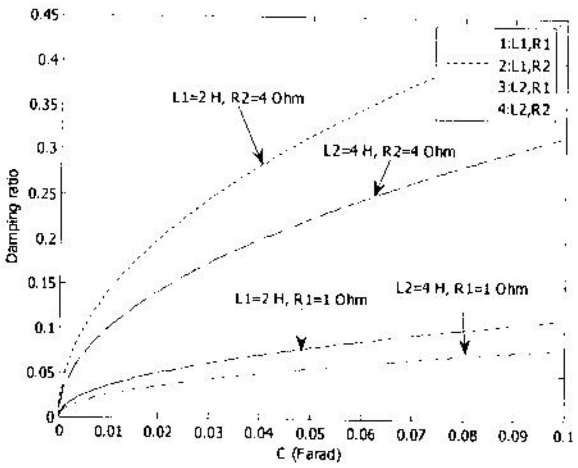

Fig. 3. The damping ratio versus the capacitance

When L increases as shown in Figs. 4 and 5, it will both decrease the frequency of oscillation and damping ratio.

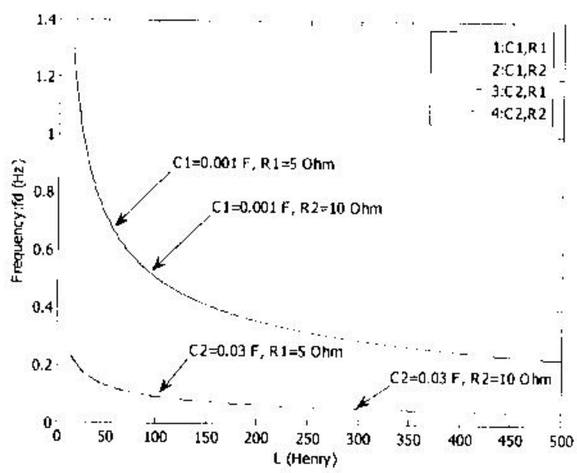

Fig. 4. The frequency versus the inductance.

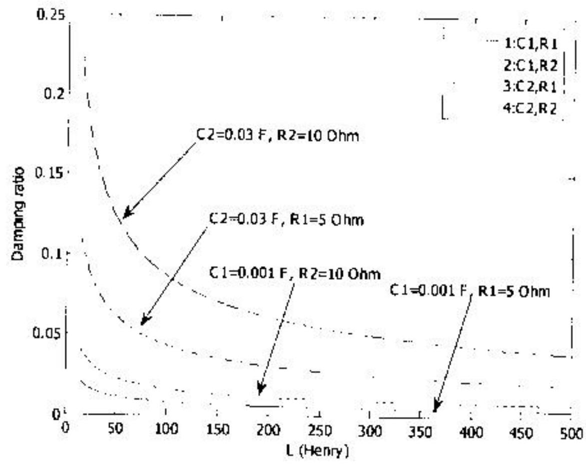

Fig. 5. The damping ratio versus the inductance.

Figures 6 and 7 shown that when R increases the frequency of oscillation will decreases and the damping ratio will increases.

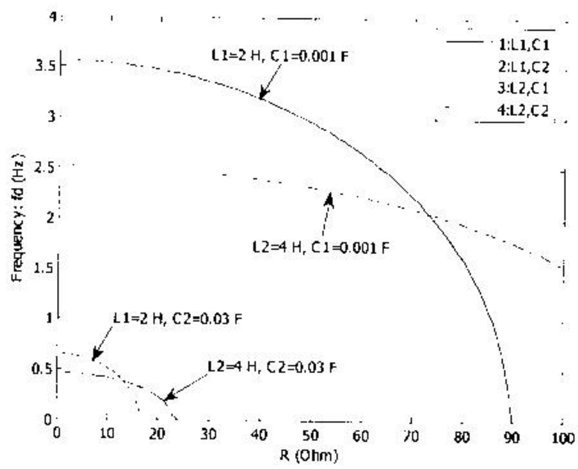

Fig. 6. The frequency versus the resistance.

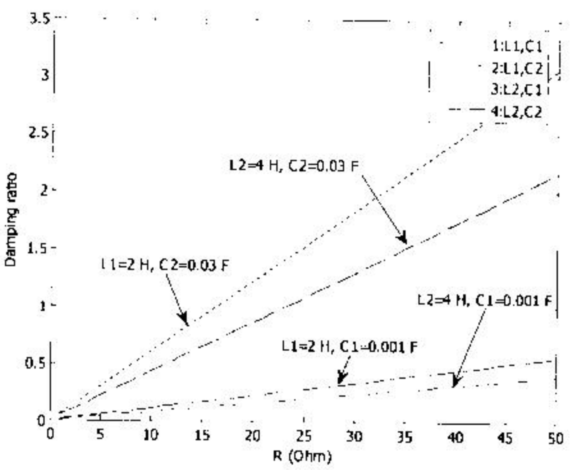

Fig. 7. The damping ratio versus the resistance

III. Simulation and Experimental Results

A. *Case I: R=1.613 kΩ, L=19.07 H, C=3.375μF, V=30 V_{dc}*

In this case, the circuit in Fig. 1, we choose R=1.613 kΩ, L=19.07 H, C=3.375 μF, and V=30 V_{dc}.

By using (1) and step function in MATLAB, the resistor voltage of the circuit can simulate and gives the result as shown in Fig. 8.

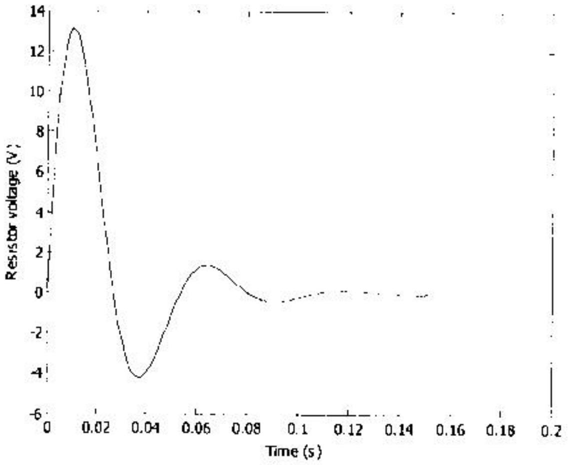

Fig. 8. Voltgae drop at resistor R

When use Ringdown analysis tools [6], [7] to identify the frequency of oscillation and damping ratio of Fig.8 found that the oscillation frequency $f_d = 18.66$ Hz and damping ratio $\zeta = 0.3392$.

From the circuit in Fig. 1, choose the parameters the same as Fig. 8 after closed switch *S* using oscilloscope measures voltage drop at resistor the result shown in Fig. 9.

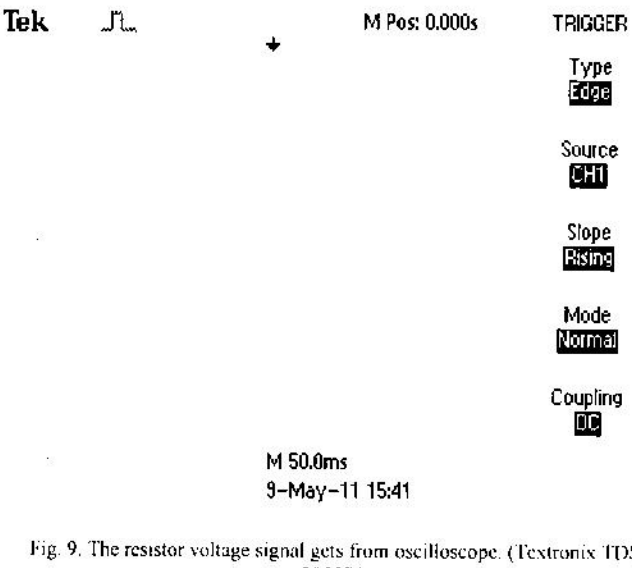

Fig. 9. The resistor voltage signal gets from oscilloscope. (Textronix TDS 2002B)

Data file obtained from oscilloscope used to identify the oscillation frequency and damping ratio by MATLAB-based Ringdown program. Figure 10 shows the oscillation signal which corresponding to Fig. 9.

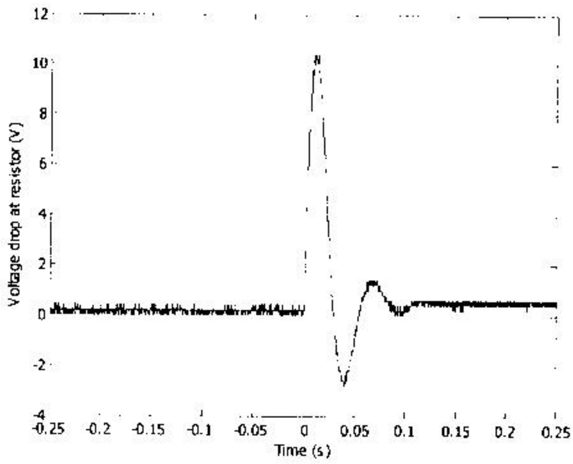

Fig. 10. Excel data file gets from oscilloscope

In Fig. 10 when we use Ringdown Tools to identify (times duration 0 – 0.1 s) the frequency of oscillation and damping ratio found that the frequency of oscillation $f_d = 17.64$ and damping ratio $\zeta = 0.3539$. It was seen that in Case I, the simulation result nearly to the experiment result.

B. *Case II: R=1.42 kΩ, L=39.1 H, C=6.1 μF, V=30 V_{dc}*

In this case, the circuit in Fig. 1, we choose R=1.42 kΩ, L=39.1 H, C=6.1 μF, and V=30 V_{dc}.

By using (1) and step function in MATLAB plotting the simulation result versus the oscilloscope result, it seen that the frequency and damping ratio quite differ. Using Ringdown tools to identify the simulation curve found that $f_d = 9.9$ Hz and $\zeta = 0.276$ but in the oscilloscope curve gets $f_d = 8.276$ Hz and $\zeta = 0.404$. It is possible that parameters of circuit not the same as the simulation values.

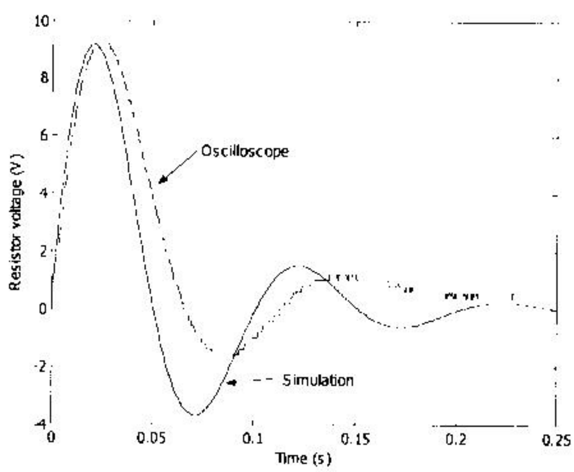

Fig. 11 Comparison between the oscilloscope and simulation result.

C. *Case III: R=245.7Ω, L=19.07 H, C=3.375 μF, V=30 V_{dc}*

In this case, we choose R=245.7 Ω, L=19.07 H, C=3.375 μF, and V=30 V_{dc}. Plotting the simulation result versus the oscilloscope result, Using Ringdown tools to identify the simulation curve found that $f_d = 19.80$ Hz and $\zeta = 0.053$ but in the oscilloscope curve gets $f_d = 122.66$ Hz and $\zeta = 0.013$. The identified result quite differ may occur from selecting range of data to identify or some mistake in Ringdown tools.

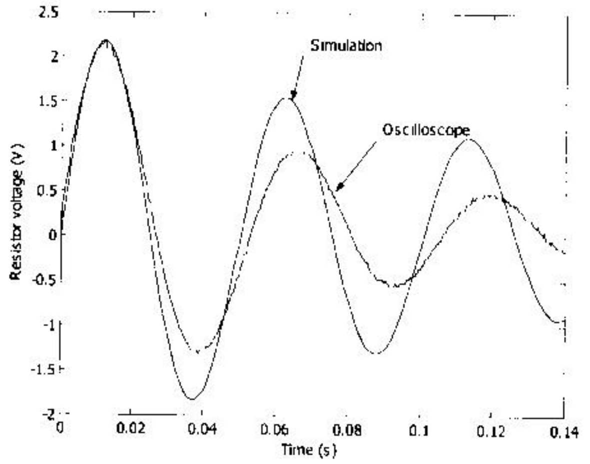

Fig. 12. Comparison between the result from simulation and oscilloscope

IV. Conclusions

This paper proposed a methodology to design the circuit to generate a signal to emulate low-frequency oscillation in transmission system. This circuit will be used for testing the algorithm which use to identify the frequency of oscillation and damping ratio.

Future work, it should be investigate the complex systems in relation of the frequency of oscillation, damping ratio, resistance, capacitance, and inductance in the transmission system. And also setting up the real-time measurement of the current and voltage and developing the algorithm for identify the frequency of oscillation and damping ratio.

The basic understanding of the frequency of oscillation and damping ratio will be benefits to controlling the damping of the power transmission system.

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VI. Biographies

Komkrit Prasertwong was born in Ayuttaya, Thailand, on May 24, 1971. He graduated B.Ind.Tech.(EE) from Vongchavalitkul University in 1993 and M.Eng. (EE) from Khonkaen University in 1998 and D.Eng form Asian Institute of Technology (AIT), Thailand

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