





Chief Guest

Prof. Bhaskar Ramamurthy

(IIT Madras)

Talk

AI in Engineering

Prof. A. Jhunjhunwala

Department of Electrical Engineering,
IIT Madras













ऑडिटोरियम
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MEETING HALL →







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AUDITORIUM →
भोजनालय
DINING HALL →

BPIP-1

Power electronic converters for Grid
Interface of solar power generation

Dr. BHIM SINGH

Prof. & Head

FNAE, FNA, FNASc, FASc, FTWAS, FIEEE, FIET, FIETE, FIE (I), C. ENGR

Department of Electrical Engineering

Indian Institute of Technology Delhi

New Delhi-110016-India







**NATIONAL CONFERENCE ON
RECENT TRENDS IN POWER ENGINEERING**
(for Research Scholars)

Date: 29-30 December 2015

Venue: IC & SR Auditorium



Chief Guest

Prof. Bhaskar Ramamurthi

(Director, IIT Madras)

&

Plenary Talk on

"Enabling India with Electricity"
by



Prof. Ashok Jhunjhunwala
Department of Electrical Engineering,
IIT Madras



A Generalized Framework to Diagnose Displacements in Transformer Winding



Prof. L. Satish

HV Lab, Dept. of Electrical Engineering
Indian Institute of Science, Bangalore
homepage: hve.iisc.ernet.in/~satish

Credits: Mr. Pritam Mukherjee, Ph.D. scholar

National Power Engineering Research Scholars' Meet, IIT-M, 29-30 Dec, 2015



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Prof. Ashok Jhunjharia
Department of Electrical Engineering
IIT Madras

ABB and Solar Impulse
An innovation and technology alliance for a better world

ABB and Solar Impulse share a common vision of reducing resource consumption and increasing the use of renewable energy.

ABB and Solar Impulse are passionate partners of knowledge technology for a better world.

First across-the-world flight powered by the sun

Three ABB engineers were onboard in the cockpit, conducting technical inspection and operations



Venue: IC & SR Auditorium

Chief Guest

Prof. Bha...urthi

(D)

"Enabling

ty"





Chief Guest

Bhaskar Ram

Director, IT

&

TV



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(Director, IIT Madras)



**Multilevel inverters with
reduced DC link power
supplies for IM drives**

K. Gopakumar
Professor , DESE (formerly CEDT)
Department of Electronic systems Engineering
Indian Institute of Science
Bangalore



SR Auditorium



Ch... t

Prof. Bhaskar Ramamurthi

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ENERGY AUDIT

&

ITS RELEVENCE TO INDIA

- A CAPSULIZATION

ATHUMADHAVAN

Institute of Energy Studies, Anna University, Chennai.

28.03.2016





**NATIONAL CONFERENCE ON
RECENT TRENDS IN POWER ENGINEERING**
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Chief Guest
Prof. Bhaskar Ramamurthi

(Director, Anna Institute of Technology and Research)

Plan for "Green
Electricity"

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OVERVIEW

An Overview

- What is Green Energy?
 - Energy that can be extracted, generated, and/or consumed without any significant negative impact to the environment.
 - lower waste output relative to energy sources.
 - eg. solar, wind, geothermal and hydro energy.
- Why use Green Energy in Data Communication?
 - rapid surge in both subscribers and digital data content.
 - produce a lot of stress in wireless infrastructures.
 - use of more power due to Power Amplifiers (PA's) in Radio Base Stations (RBS's).
 - account for large emission of Green House Gases (GHG's).
- Present talk deals with use of alternative green energy sources for powering a Telecom tower for future Data Communication as well as to reduce the GHG's emission.

ANNA INSTITUTE OF TECHNOLOGY AND RESEARCH
2







National Conference on Recent Trends in Power Engineering
 Indian Institute of Technology Madras, Chennai 600 036, India.
 29-30 December 2015

Closed Loop Control Analysis of Half Bridge LLC Resonant Converter based Battery Charger

Sumanta Kumar Show
 Research Scholar, NITK Surathkal, India

P. Parthiban
 Assistant Professor, NITK Surathkal, India



Introduction

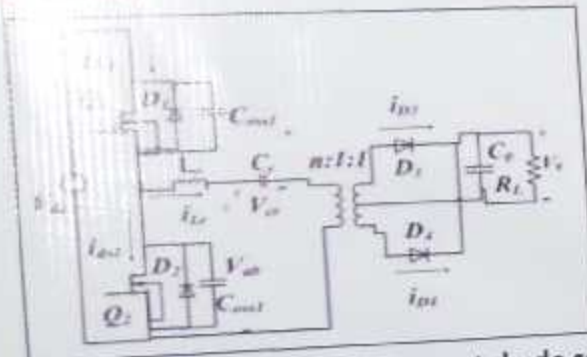


Fig. 1 Circuit diagram of LLC resonant dc-dc converter.

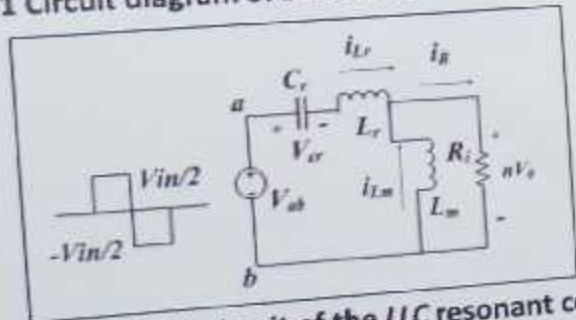


Fig. 2 Equivalent circuit of the LLC resonant converter.

Circuit Description

An LLC resonant Half-Bridge (HB) dc-dc converter consists of an LLC resonant inverter, a current-driven transformer with a center tapped rectifier.

Controller Parameters : $K_p = 0.0154$, $K_i = 10$.

Half-Bridge LLC converter Specifications

Electrical Specifications

Input Voltage (V_{in})	(380 – 420) V
Output Voltage (V_o)	(28 - 72) V
Output Current (I_o)	(16 - 25) A
Maximum Power (P_o)	1.8kW
Main Resonant Frequency (f_H)	200 kHz
Secondary Resonant Frequency (f_r)	85.287 kHz
Switching Frequency	(94.6 – 226.6) kHz

Component Parameters

Resonant Inductor (L_r)	1.855 μ H
Magnetizing Inductor (L_m)	8.356 μ H
Resonant Capacitor (C_r)	34.2 μ F
Transformer Turns Ratio	9:1:1

Results & Discussion

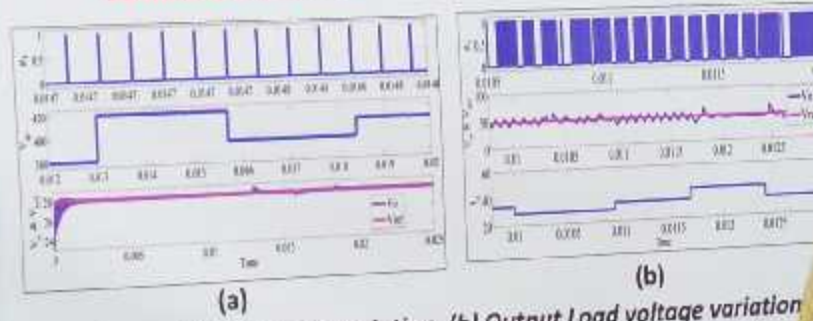


Fig. 3 (a) Input Line voltage variation, (b) Output Load voltage variation

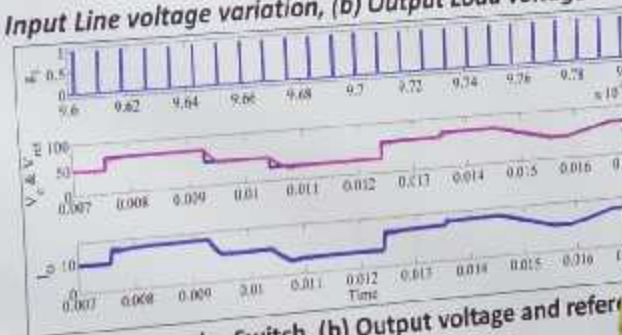


Fig. 4 (a) Gate pulses to the Switch, (b) Output voltage and reference voltage, (c) Output Load current.

Conclusions

Simulation analysis of a LLC resonant Half-Bridge (HB) dc-dc converter control is presented with R-Load. Results shows the performance of the Controller for adjustment of output voltage for line, load and reference.

HVE018

Calculation of Corona Generated Ionic Currents of Unipolar HVDC Transmission Lines Using New Computational Method

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INTRODUCTION

The electric field environment of HVDC transmission lines is different from that existing HVAC transmission lines. In DC transmission, these space charges fill the inter electrode region, contrary to that in AC transmission where the space charge created by corona is contained in the vicinity of the conductors because of the periodic reversal of the applied voltage. Hence it may be possible to predict the AC corona losses based on corona cage models. Whereas, in case of HVDC lines it is not possible to predict the DC corona losses using cage models. However, evaluation of alternate line design based on entirely experimental means proved costly and time consuming. On account of this fact, computational analysis based on experimental findings can provide a significant support for evaluation of alternate line designs.

In this context, the authors have made an attempt to develop the computational method using physical model of corona phenomenon around the line conductor with considering impacts of atmospheric parameters such as temperature and pressure.



Electric Field Environment of Unipolar HVDC Lines

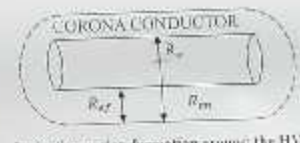
METHOD OF CALCULATION:

The major equations used to estimate the parameters of electric field environment of unipolar HVDC lines are ion current equation and Poisson's equation and the governing equations of ion current and Poisson's equations are given below:

$$J = qnE$$

$$\nabla \cdot n = (\rho/\epsilon) + E$$

Where n is space charge affected electric field, E is space charge free electric field, J is ionic current density, ρ is ion space charge density and q is mobility of ions. The average mobility of ions considered is $1.5 \text{ m}^2/\text{s}$.



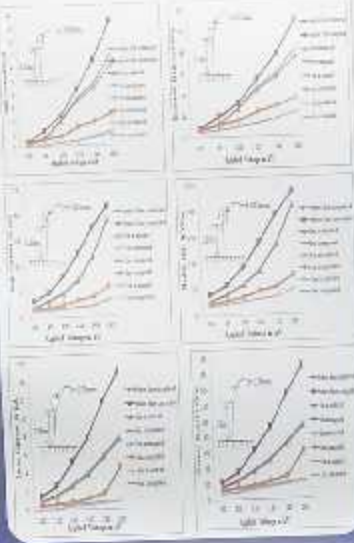
Ionization region formation around the HVDC line conductor

From the equations related to parameters of electric field environment of HVDC lines, it is very clear that the ion space charge density at ground level is dependent on ionization of air molecules in the ionization region. Therefore, the computational procedure to estimate the ion space charge density at ground level shall take into account the ionization of air molecules from the ionization region. The resultant magnitude of space charge density is calculated using modeling of physics of corona generation is given by

$$\rho = k - A \cdot D \cdot C \cdot m^2$$

Where $k = Z \cdot \nu \cdot E_0 \cdot n_0$ ion concentration

RESULTS



CONCLUSIONS

1. The proposed computational results are closely matching with experimental results, irrespective of height and diameter of the line conductor.
2. The variation of both ionic current and electric field distribution of unipolar HVDC transmission lines at ground level are found to be non-linear in nature for both experimental and computational results.
3. Experimental results of both ionic current and electric field are varies inversely relation with the height and diameter of conductor.
4. The proposed computational method predicts and calculates the parameters of electric field environment of HVDC transmission lines at different atmospheric temperature and pressure conditions.
5. The computational method, considering impact of atmospheric temperature, pressure can provide significant results in analyzing the electric field environment of unipolar HVDC transmission lines for different line conductor configurations with good computational accuracy.





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 Indian Institute of Technology Madras, Chennai 600 036, India.
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Dynamic Operation and Control Schemes for
 Hybrid Static Synchronous Series Compensation

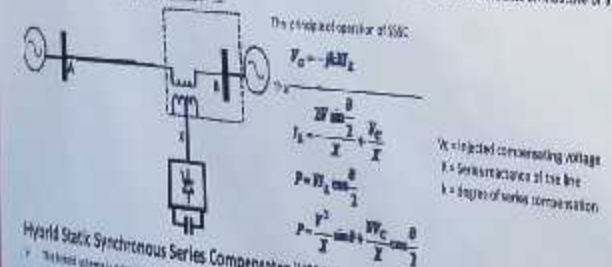
Raju J VIT University, Vellore, India Kowsalya M VIT University, Vellore, India Arunachalam M Rajarajeswari College of Engineering, Bangalore, India

Introduction:

- The need arises in the demand of electrical energy due to the industrial development, compelled the power system engineers to provide mechanical and electrical power.
- With increasing in the power demand, the load constraints a voltage stability problem which presently is solved by incorporating the high power synchronous series compensation to solve the voltage stability problem.
- Hybrid Static Synchronous Series Compensation (HSSSC) is presented in this paper to improve the problems associated with the voltage stability and loadability of the system.
- The power transfer with little loss on low line impedance of the voltage drop (i.e., line reactance) and the line current can be controlled with the help of HSSSC.
- The main function of HSSSC is to provide series compensation through HSSSC such that the virtual line reactance modifies and helps in reducing the voltage drop and increasing the power flow along with improvement in the voltage at load bus.

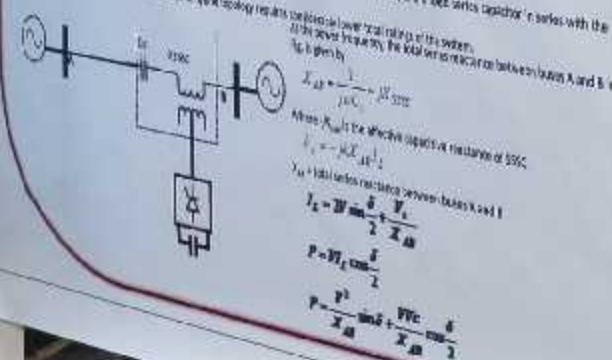
Static Synchronous Series Compensator (SSSC):

- The basic building block of the SSSC is shown in Fig. 1. A series capacitor which is connected in series with the transmission line by a coupling transformer.
- A small part of the injected voltage with a phase shift from the reference voltage is a quadrature with the line current resolves an inductive or a capacitive reactance series with the transmission line.



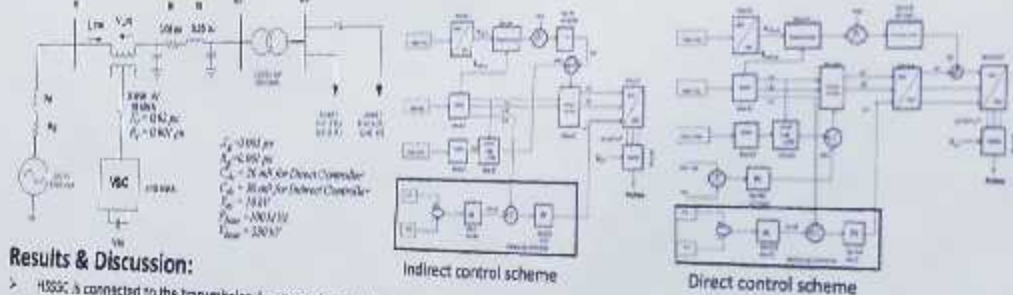
Hybrid Static Synchronous Series Compensator (HSSSC):

- The hybrid scheme is a combination of Static Synchronous Series Compensator (SSSC) and a fixed series capacitor in series with the transmission line.
- Since the series capacitor is fully utilized, the hybrid topology requires a lower rating of the system.



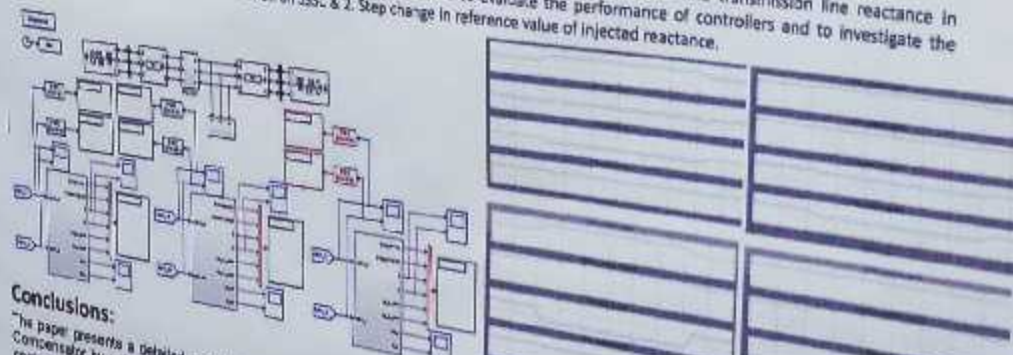
Methodology:

- Modeling and simulation of Neutral Point Clamped (NPC) Voltage Source Converter (VSC) based Hybrid Static Synchronous Series Capacitive Compensator (HSSSC) with direct and indirect control schemes is presented.
- The effectiveness of the schemes is to analyzing the performance characteristics of HSSSC evaluating using the MATLAB/SIMULINK.



Results & Discussion:

- HSSSC is connected to the transmission line through a coupling transformer in series with the line. Reactive load is connected after the Bus 3 with step down transformer.
- Now the HSSSC is injecting a generated 15MVA, 36kV power in series with the line. All the values are measured in per unit system with 230kV Base voltage and 100MVA base power with the line.
- Reactive load is connected after the bus 4 with step down transformer. Now the HSSSC is injecting a generated ± 15 MVA, 36kV power in series with the line. All the values are measured in per unit system with 230kV Base voltage and 100MVA base power.
- To evaluate the performance of NPC VSC based HSSSC control in transmission line simulation is done by using MATLAB/SIMULINK. The Radial system utilizes a small HSSSC, rated at 5.0kV and ± 15 MVA, for injecting voltage into the system.
- Both Direct and Indirect controllers are used and compared in this section. The controllers compensate transmission line reactance in capacitive mode of operation. The following two tests were conducted to evaluate the performance of controllers and to investigate the system behavior: 1. Impact of load variation on SSSC & 2. Step change in reference value of injected reactance.



Conclusions:

The paper presents a detailed model of a Neutral Point Clamped Voltage Source Converter based Hybrid Static Synchronous Series Compensator by using the Matlab/Simulink simulation package. The performance of HSSSC Simulink based model with two types of controllers, Indirect and direct type have been presented in this paper. The behavior with the two controllers has been compared. The HSSSC is designed to control the impedance characteristics of a transmission line. A 3-level NPC VSC has been used for converter as it is considered suitable for a high voltage application. The two tests were conducted to evaluate the performance of controllers one is impact of load variation on HSSSC and another one the step change in reference value of injected reactance. Based on two tests the NPC VSC based HSSSC system behavior was investigated. These tests are compared simultaneously for the Direct and Indirect type of controllers.

National Conference on Recent Trends in Power Engineering
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29-30 December 2015

Electric and Magnetic field Simulation of Polymer Nano-composites for Electromagnetic Shielding Effectiveness

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Introduction

- Electric and Magnetic Interference are the serious problems faced by modern electronic systems.
- Electromagnetic compatibility is accomplished by electronic components and filters in by shielding.
- Performance of polymer composite with respect to the EM Shielding is becoming popular and is investigated in this study.
- Polymer composite used in this study is High Density Polyethylene (HDPE) and fillers used are Multi-walled Carbon nanotube (MWCNT) and nano Nickel.
- Filler percentage of the nano composite is varied and change in electric field distribution in static and time variant conditions and Magnetic fields are simulated and analyzed.
- Properties of pure polymer and nano Filler additives are compared to check the changes in the behaviour of composite from insulating to conductive property.
- Simulation studies have been carried out and discussed using COMSOL Multiphysics.

Methods

1. Basic Equations for Electric Field Simulations

Electric Field Simulations are based on the following equations:

$$\nabla \cdot D = \rho$$

$$E = -\nabla V$$

$$D = \epsilon_0 \epsilon_r E$$

Where D = electric Field Displacement
 ρ = Charge density
 E = Electric Field

- Electric Field displacement is a function of the permittivity of material and electric field produced at a given input voltage.
- Charge density is calculated by divergence of electric field displacement.

2. Electric Field Modelling



- Simple model using FEM is shown in Fig.1 for simulation of Electric field using two parallel plate electrodes.
- The nano composite material developed is placed between the two conducting copper plate electrodes.
- Copper plate is shown in blue colour and has potential of about 10 V and Copper plate in red colour is the ground (V=0).

3. Basic Equations for Magnetic Field

Magnetic Field Simulations are based on the following equations:

$$\nabla \cdot B = 0$$

$$B = \mu_0 \mu_r H$$

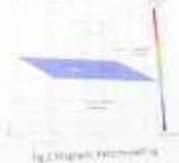
Where B = Total Magnetic field
 H = magnetic field strength

- Total Magnetic field calculation is related to permeability of material and magnetic field strength.
- Divergence of magnetic field is zero as magnetic monopoles do not exist in space.

4. Magnetic Field Modelling

- A permanent magnet model is used for simulation of Magnetic field.
- Nano composite material developed is placed below a permanent magnet which is to be evaluated.

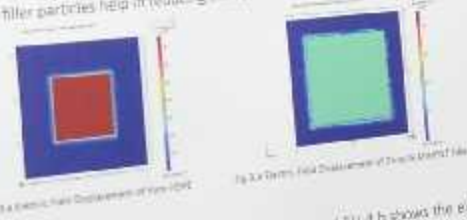
- With the help of Permanent magnet, magnetic field is generated.
- Effect of the magnetic field on pure polymer and polymer nano-composites are compared.



Results

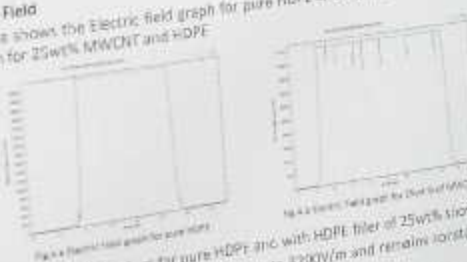
1. Electric Field Displacement

- Figure 3.a and 3.b show the comparison of electric field displacement between pure HDPE and 25 Wt% MWCNT and HDPE composite.
- The electric field displacement values for pure HDPE gives $70 \times 10^{-9} \text{ C/m}^2$ and with 25% MWCNT HDPE filler is $110 \times 10^{-8} \text{ C/m}^2$ at locations closer to the electrode.
- Away from the electrode, the electric field effect is negligible in both cases which shows that the filler particles help in reducing the resistivity of the material.



2. Electric Field

- Fig. 4.a shows the Electric field graph for pure HDPE and Fig. 4.b shows the electric field graph for 25Wt% MWCNT and HDPE.



- Electric field (V/m) values for pure HDPE are up to 3200V/m and remain constant across the pure HDPE sheet.
- For HDPE with 25Wt% of MWCNT there is rise in value up to 5000V/m and then drop down to 4000V/m.
- Due to the filler addition variation in electric field is observed.
- In case of HDPE with 25Wt% of composite, there is presence of more free electrons. This helps the charges to flow and make the nano composite material more conducting.

3. Polarization

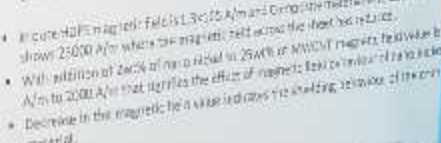
- Polarization obtained in the material for pure HDPE is shown in Fig.5.a and polarization for HDPE with 25Wt% MWCNT is as shown in Fig.5.b.
- Polarization in pure HDPE is $45 \times 10^{-9} \text{ C/m}^2$ along the sheet.

- Polarization in HDPE with 25Wt% MWCNT varies from $1.94 \times 10^{-8} \text{ C/m}^2$ to 11.014 C/m^2 along the sheet, which shows the value of polarization is increased with respect to displacement in less as compared to that of pure HDPE, which is a desired.



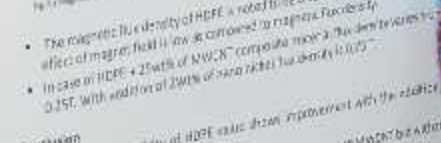
4. Magnetic Field

- In case HDPE magnetic field is $3.3 \times 10^{-4} \text{ A/m}$ and composite material with 25% MWCNT shows 2500 A/m where the magnetic field across the sheet has reduced.
- With addition of 25wt% of nano nickel in 25wt% of MWCNT magnetic field value is A/m to 2000 A/m that verifies the effect of magnetic field reduction in a field.
- Decrease in the magnetic field value reduces the shielding, reduction of the nano material.



5. Magnetic flux density

- The magnetic flux density of HDPE is about 0.02 T/m which is reduced with the effect of magnetic field in as compared to magnetic flux density.
- In case of HDPE + 25wt% of MWCNT composite material the flux density is about 0.03 T/m with addition of 25wt% of nano nickel the density is 0.05 T/m.



Conclusion

- Electrical conductivity of HDPE is increased with the addition of MWCNT.
- Magnetic property is not showing if carbon nanotubes are added to HDPE.
- If nano nickel, magnetic properties shows good improvement.
- The good electric and magnetic properties, the carbon nanotubes and nano nickel MWCNT + 25wt% nano nickel. Colating composition has not to improve the shielding effectiveness behaviour.

HVE017


National Conference on Recent Trends in Power Engineering
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 29-30 December 2015

Evaluation of High Voltage Rotating Machine Stator Insulation System Using Diagnostic Tests
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 ***Joint Director and HOD, Diagnostic Cables & Capacitors Division, Central Power Research Institute, Bangalore.

Introduction

- Unplanned failure of equipment used in electric power stations is a major concern for the utility industry.
- Majority of the machine failure are the result of insulation breakdown.
- The insulation system of machine is subjected to thermal, electrical, mechanical and chemical stresses.
- In general, the insulation system of any power equipment is designed to have a life span of 20-30 years.
- To assess the condition of insulation system, diagnostic tests are carried out.
- Diagnostic tests provide useful information on level of degradation of insulation system.
- Necessary action can be taken based on the analysis of diagnostic test results to avoid unexpected failure of machines.

Diagnostic Tests

- Insulation resistance test
- Polarization index test
- Dielectric loss test
- Partial discharge test
- Tan delta test
- PD detection test
- PD detection test
- PD detection test

INSULATION RESISTANCE & POLARIZATION INDEX TEST

Insulation resistance (IR) test is a measure of the ability of the insulation system to resist the flow of current. It is a measure of the quality of the insulation system. The test is carried out by applying a DC voltage across the insulation system and measuring the current. The polarization index (PI) is the ratio of the IR at 10 minutes to the IR at 1 minute. A PI value of 2 or more is considered good.

Diagnostic Tests continued

B. TAN DELTA MEASUREMENT TEST

- Tan delta is known as dissipation factor is a measure of dielectric loss.
- Usually the winding insulation is supposed to act as a pure capacitor.
- If greater there is a loss of energy in the form of heat when excited by AC voltage.
- The winding insulation can be approximated as a capacitor in parallel with a resistor.



- Tan delta test is the average measurement of tan delta value at two voltage levels, normally 20% of line-to-line voltage and line-to-ground voltage.
- It is an indirect indication of partial discharge occurring in high voltage stator insulation system.

$$\tan \delta = \frac{I \sin \delta}{I \cos \delta} = \frac{I \sin \delta}{I \cos \delta}$$

- The minimum value of PI for class F insulation is 2. If IR value is more than 2.0 then PI is not significant.
- The maximum permissible value of Tan Delta for a class F insulation is 3%.
- The maximum permissible limit of AT is 1%.

C. PARTIAL DISCHARGE TEST

- Partial discharge is a localized electrical discharge that only partially bridges the insulation between conductors and which can, or cannot, occur adjacent to a conductor.
- Partial discharge creates a PD pulse which are sensed by using difference PD's and are processed by PD detection system.
- The trend in PD magnitude over time is the most effective way of monitoring the discharge activity.

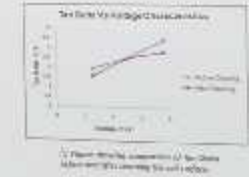
Results & Discussion

- The insulation system considered here is a class F insulation stator coil of rated voltage 6.6 kV.
- IR and PI test and Tan Delta test were conducted on the coil.
- The IR/PI test was conducted using a megohmmeter of Megger make - S1 5010.
- The tan Delta test was performed using Haefely Midas 288x instrument.
- Before conducting the test, the coil was found to be contaminated.
- The tests were performed and after the completion of tests, the coil was cleaned using a solvent.
- To check the improvement in results the tests were repeated.



Parameter	Before Cleaning	After Cleaning
IR (MΩ)	100	1000
PI	1.5	2.5
Tan Delta (%)	4.5	2.5

Parameter	Before Cleaning	After Cleaning
IR (MΩ)	100	1000
PI	1.5	2.5
Tan Delta (%)	4.5	2.5



Conclusions

- The results obtained from the experiment indicate good correlation with insulation condition.
- Hence diagnostic tests are very good tool for monitoring the condition of rotating machines insulation system.
- These tests should be conducted in regular basis in order to trend the test data.

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Unscheduled Interchange Price Based Load Frequency Control suitable for a
two area Competitive Electricity Market

Bhavani M
Assistant professor
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Associate Professor
Thiagarajar College of Engineering, Madurai
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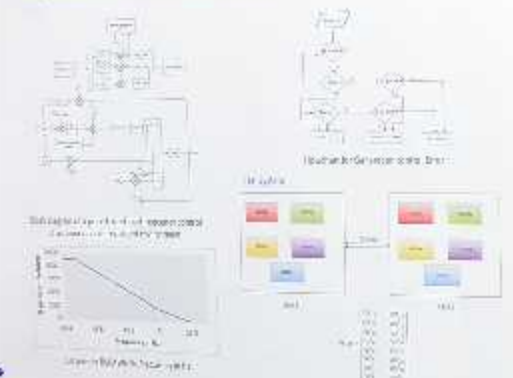
Durga R
PG scholar- Power System Engineering
Thiagarajar college of Engineering, Madurai
TN, India

Introduction

$ABT = EC + UIC$

- UIC based on the fluctuating frequency and at the same time, load shedding trading for system control.
- The automatic loads of a two area system frequency control is employed in a two area system.

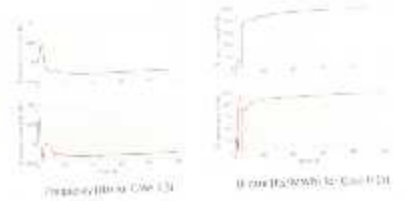
Implementation of proposed work



Results & Discussion

Bilateral Contract

Case	Δf_1	Δf_2	ΔP_{12}	ΔP_{21}	ΔP_{1L}	ΔP_{2L}
1	0.001	0.001	0.001	0.001	0.001	0.001
2	0.002	0.002	0.002	0.002	0.002	0.002
3	0.003	0.003	0.003	0.003	0.003	0.003
4	0.004	0.004	0.004	0.004	0.004	0.004
5	0.005	0.005	0.005	0.005	0.005	0.005



Case	Δf_1	Δf_2	ΔP_{12}	ΔP_{21}	ΔP_{1L}	ΔP_{2L}
1	0.001	0.001	0.001	0.001	0.001	0.001
2	0.002	0.002	0.002	0.002	0.002	0.002
3	0.003	0.003	0.003	0.003	0.003	0.003
4	0.004	0.004	0.004	0.004	0.004	0.004
5	0.005	0.005	0.005	0.005	0.005	0.005

Conclusions of our research

- Analysis has been carried out for a two-area electricity market, with U-price based load frequency control.
- The proposed U-price signal aids the frequency control within 10s.
- GENCOs earn profit by appropriately responding to the U-price signal. Moreover, captive power producers may get an opportunity to serve the change in demand.






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Analysis of Optimal Operation of Electric Arc Furnace for Various Combinations of Transformer-Reactor Taps to Enhance the Arc Stability

R.V. S.E.Shraavan and C.Vyjayanthi
 National Institute of Technology Goa, India

Power System Feeding EAF



Why to Analyze Arc Furnace?

- Heavy duty industrial loads
- Large power requirements
- Their efficient operation is extremely important

Operational Challenges

- Arc instability leading to jagged operation
- Refractory Wear and Electrode regulation
- Power quality issues


Stages of Operation

- Boring
- Melting
- Refining


Key Aspects of Furnace Operation

- Each stage operates at different EAF Transformer Taps
- Stage-wise different arc stability properties.
- Melting phase consumes large Power
- Important to operate with minimum energy consumption and enhanced stability
- Requirement of optimal transformer-reactor tap combination to enhance arc stability
- Commercial viability - Max. No. of Melts
- Efficiency
- Technical viability - energy efficiency

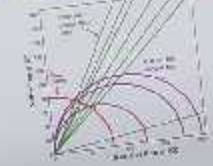
Effect of Series Reactor



Transformer-Reactor Combinations



Circle Diagram to Assess Furnace Operation



The Circle diagram consists

- ✓ P-Q loci at various operating loads
- ✓ Fixed Power factor lines
- ✓ Max. Apparent power curve of EAF transformer
- ✓ Projection of operated P and Q onto circle diagram.

Results

Melting Stage 1
 Tap 4 operation at 538V without series reactor

Melting Stage 2
 Tap 8 operation at 442V without series reactor

Tap 1 operation at 561V with 0.8 ohm series reactor

Tap 7 operation at 465V with 0.2 ohm series reactor

Tap 2 operation at 500V

Comparison of arc stability diagrams for various transformer-reactor combinations.

- Optimal arc stability diagrams for various transformer-reactor combinations.
- Thereby combination

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Steady-State DC Conductivity of Low Density Polyethylene with Deep Chemical Impurity

A.K Upadhyay, C.C. Reddy
 Department of Electrical Engineering, IIT Roorkee



Introduction

- Possible Deep Chemical Impurities

CHEMICAL STRUCTURE	NAME	TRAP DEPTH (eV)
	3-Decalone <chem>C12H18O</chem>	0.45
	4,6-Decene <chem>C12H22</chem>	0.45
	1-Decalene <chem>C10H18</chem>	0.45

- Because of the large value of potential traps there is a deep electric potential well near the conduction band of n-alkane.
- The electric charge carriers, such as electrons and holes can be captured by these deep electric potential well.
- Potential Distribution of Chemical Defect

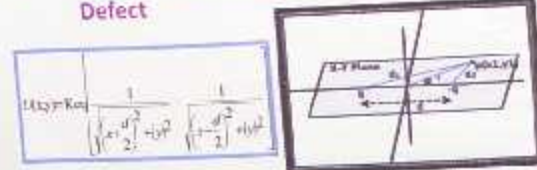


Fig. 1 Separating Chemical Impurity as a Dipole in X, Y Plane

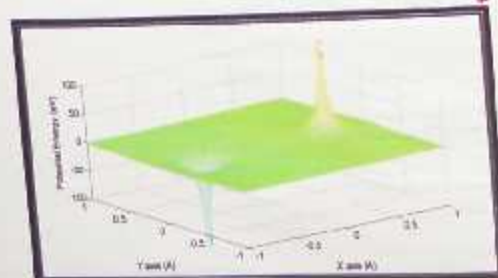
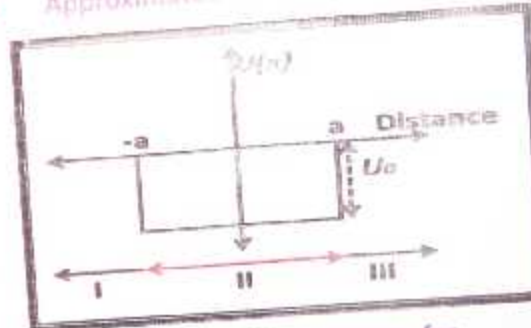


Fig. 2 Potential Energy Distribution in X, Y Plane

Results & Discussion

- Approximated as a Square Well



- Solution of Potential Energy for Possible Energy State

Time Independent Schrodinger Equation

$$-\frac{\hbar^2}{2m} \nabla^2 \psi(x, y, z) + U(x, y, z) \psi = E \psi(x, y, z)$$

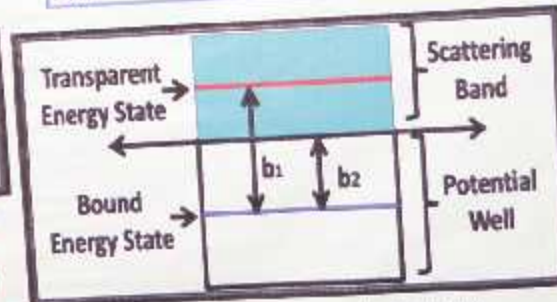


Fig. 3 Possible Energy State and Scattering Band

Conclusion

Mobility of free charge carriers is no longer independent from deep chemical impurities meanwhile it has decreased value due to presence of these impurities. Hence it plays an important role in calculation of conductivity of LDPE.



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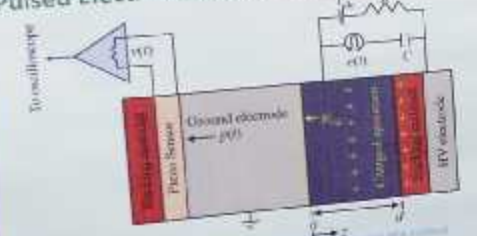
De-convolution For Spiky Charge Signal

Ashish Gupta, C. C. Reddy
Department of Electrical Engineering, IIT Ropar, Punjab

Introduction

Pulsed Electro-Acoustic (PEA) method is one of the most popular technique used for space charge measurement in dielectric material. However, the signal obtained from PEA method required some signal processing technique like de-convolution. In this work, authors examined applicability of sparse de-convolution on space charge signal obtained from pulsed electro-acoustic method.

Pulsed Electro-acoustic Method



Induced voltage signal $v(t)$ is
$$v(t) = h(t) * p(t) \quad (1)$$

Sparse De-convolution

minimizing cost function given by,
$$F(p) = \arg \min \left[\frac{1}{2} \|v - H p\|_2^2 + \lambda \|p\|_1 \right] \quad (2)$$

Majorization-Minimization

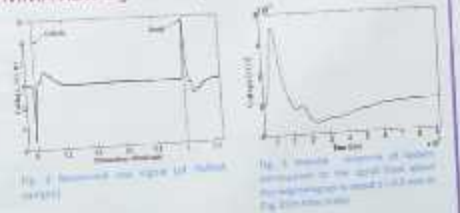
The majorization function $G_1(p)$ may be taken as
$$G_1(p) \geq F(p) \quad \forall p \quad G_1(p_0) = F(p_0)$$

The majorization function $G_2(p)$ may be taken as
$$G_2(p) = \frac{1}{2} \|v - H p\|_2^2 + \frac{\lambda}{2} p^2 \quad (3)$$

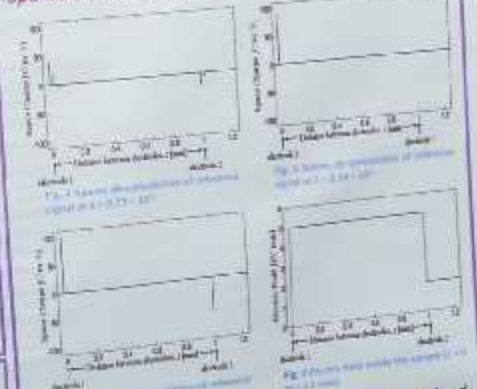
The solution can be written explicitly as
$$p_{opt} = \left(\frac{1}{\lambda} - \frac{1}{\lambda} B^T (2\lambda A + B R_0 B^T) B A^{-1} v \right) \quad (4)$$

Results & Discussion

PMMA Raw signal & Impulse response



Sparse De-convolution



- When λ is low ($= 0.77 \times 10^{-6}$), the de-convolved signal, Fig. 4, has noise in output signal.
- When λ is high ($= 3.34 \times 10^{-6}$), the de-convolved signal, Fig. 5, one of the space charge signal peaks is also suppressed.
- when λ ($= 1.77 \times 10^{-6}$) yields smooth electric field distribution inside the sample as show in Fig. 7.

Conclusions

- The noise reduction in sparse de-convolution seems to be perfect for spiky signals. However, for smooth charge profiles sparse de-convolution may not be a suitable choice.





HVE009

SP 6

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Effect of Profiles on Pollution Performance of HVAC Cap & Pin Porcelain Insulators

N Vasudev¹ K N Ravi² K A Venkatesh³
¹Central Power Research Institute, Bangalore ²Sapthagiri Engineering College, Bangalore ³Presidency University, Bangalore

Introduction

The profile of the insulator plays a significant role in the pollution performance of insulators. Based on the recommendation of Central Electricity Authority (CEA) report-2008, fabricating of insulators with reference to Indian Transmission System is being carried out by PCCIL/CPRI.

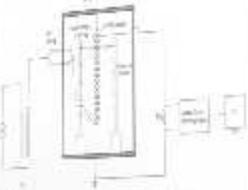
In this research work, 13 different profiles of cap and pin insulator is analyzed for their maximum withstand salinity (MWS) characteristics for 400 kV system voltage using salt fog method.

The testing procedure and fabrication salinity characteristics meet the requirement set by IS: 63607.


Statistical analysis is carried to find the influence of Applied Specific Clearance (ASCC), Diameter, Bush Spacing, Clearance Factor and Shrinkage between sheds.

A regression equation is proposed for estimating the maximum withstand salinity of the insulator from its profile parameters.


Schematic Representation of Experimental Setup



Insulator Samples Considered for Analysis



WWS Characteristics Vs Profile of Cap & Pin Insulator Strings



Calculus Based Derivation for Least Squares Formulas

The sum of the squared residuals is given by

$$\sum_{i=1}^n (y_i - \hat{y}_i)^2$$

Substituting

$$\hat{y}_i = b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5$$

By taking partial derivatives with respect to $b_0, b_1, b_2, b_3, b_4, b_5$

$$\begin{cases} \sum_{i=1}^n y_i - \sum_{i=1}^n (b_0 + b_1x_1 + b_2x_2 + b_3x_3 + b_4x_4 + b_5x_5) = 0 \\ \sum_{i=1}^n x_1(y_i - b_0 - b_1x_1 - b_2x_2 - b_3x_3 - b_4x_4 - b_5x_5) = 0 \\ \sum_{i=1}^n x_2(y_i - b_0 - b_1x_1 - b_2x_2 - b_3x_3 - b_4x_4 - b_5x_5) = 0 \\ \sum_{i=1}^n x_3(y_i - b_0 - b_1x_1 - b_2x_2 - b_3x_3 - b_4x_4 - b_5x_5) = 0 \\ \sum_{i=1}^n x_4(y_i - b_0 - b_1x_1 - b_2x_2 - b_3x_3 - b_4x_4 - b_5x_5) = 0 \\ \sum_{i=1}^n x_5(y_i - b_0 - b_1x_1 - b_2x_2 - b_3x_3 - b_4x_4 - b_5x_5) = 0 \end{cases}$$

Multiple Regression Equation is

$$\hat{y}_i = 1.21 + 1.11x_1 - 0.12x_2 + 0.70x_3 - 2.07x_4 - 1.02x_5$$

Mean Square Error (MSE) of the arrived Regression Equation (Samples 1-11) is

MSE = 0.005185

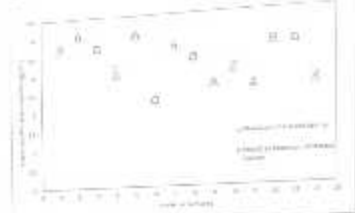
The coefficient of determination (R^2) is

0.9839

MSE when checked again new samples (12-14) is

MSE = 0.005767

Prediction of Maximum Withstand Salinity Characteristics of Insulators



Conclusions

1. A critical study has been carried out to evaluate the pollution performance of different profiles of insulators with respect to maximum withstand salinity characteristics.
2. Statistical model has been developed to determine the maximum withstand salinity of the insulators in terms of its profile parameters.
3. The co-efficient of determination (R^2) and Mean Square Error (MSE) of the predicted MWS value comes in good agreement with the experimental investigations.
4. For the first time, validity of the model has been verified by checking against the new profiles.



HVE005

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Effect of Profiles on Pollution Performance of HVAC Cap & Pin Porcelain Insulators

N Vasudev¹ K N Ravi² K A Venkatesh³
¹Central Power Research Institute, Bangalore ²Sapthagiri Engineering College, Bangalore ³Presidency University, Bangalore

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A regression equation is proposed for estimating the maximum withstand salinity of the insulator from its profile parameters.

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By taking partial derivatives with respect to $b_0, b_1, b_2, b_3, b_4, b_5$

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$$\hat{y}_i = 1.21 + 1.11x_1 - 0.12x_2 + 0.70x_3 - 2.07x_4 - 1.02x_5$$

Mean Square Error (MSE) of the arrived Regression Equation (Samples 1-11) is

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The coefficient of determination (R^2) is

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Prediction of Maximum Withstand Salinity Characteristics of Insulators



Conclusions

1. A critical study has been carried out to evaluate the pollution performance of different profiles of insulators with respect to maximum withstand salinity characteristics.
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4. For the first time, validity of the model has been verified by checking against the new profiles.



National Conference on Recent Trends in Power Engineering Indian Institute of Technology Madras, Chennai 600 036, India. 29-30 December 2015



A study on copper corrosion and its effect on dielectric properties of paper oil insulation of transformers using simulation and laboratory experiments

S. Daisy Flora and J. Sundara Rajan
Central Power Research Institute, Bangalore – 560080.

1. Introduction

- Paper of insulation in transformer is severely affected by copper corrosion.
- Electrochemical phenomenon due to reactive sulphur oxides present in oil.
- Corrosive sulphur compounds react with copper conductor to form copper sulphide (Cu₂S).
- Cu₂S is initially formed in the conductor surface and then migrates towards different layers of papers.
- Dielectric properties of paper insulation are affected by Cu₂S due to its semi-conducting nature.
- The parameters of importance in this phenomenon are:
 - ✓ nature of reacting sulphur species in oil
 - ✓ surface condition of copper conductors
 - ✓ moisture
 - ✓ temperature
 - ✓ time of exposure
- Cu₂S exhibits semi-conductivity in the temperature range of 300 K to 383 K and is conductive above 383 K.
- In this study, the effect of both temperature and copper sulphide contamination on the following dielectric parameters of paper of insulation is explained:
 - ✓ Electric stress
 - ✓ Tan δ
 - ✓ ε' and ε''
 - ✓ Polarization Index
 - ✓ Insulation Resistance

2. Simulation study - FEM Model

In this study, simulations were carried out on a pigtail sample configuration (Fig. 1(a) and 1(b)).



- In the proposed 3-D model, paper and Cu₂S are considered as two different layers.
 - Electric stress enhancement on the clear paper layer due to Cu₂S migration into each paper layer is computed.
 - Simulations were carried out by representing the clear impregnated paper layer by its permittivity of 3.72 and the layer of Cu₂S by its permittivity of 40.
 - The conductivity of Cu₂S layer is considered to be 35 (Ω⁻¹ m⁻¹) and 1x10¹⁵ (Ω⁻¹ m⁻¹) in order to represent the metallic and semi-conducting behaviour of Cu₂S respectively.
 - Boundary conditions: +5V Volt at the top electrode (HV) and -5V Volt at the bottom electrode (LV).
- The electric stress across the Cu₂S contaminated paper layers and clear paper layers for different values of conductivity are furnished in Table 1.

Table 1. Comparison of electric stress at top electrode and clear paper for different conductivity values.

Conductivity of Cu ₂ S (Ω ⁻¹ m ⁻¹)	Maximum Electric Stress (kV/cm)			
	Clear Paper	Composite Dielectric	Clear Paper	Composite Dielectric
1	0.00	0.00	0.00	0.00
2	0.00	0.00	0.00	0.00
3	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00
5	0.00	0.00	0.00	0.00
6	0.00	0.00	0.00	0.00
7	0.00	0.00	0.00	0.00
8	0.00	0.00	0.00	0.00
9	0.00	0.00	0.00	0.00
10	0.00	0.00	0.00	0.00

The variation of maximum electric stress (kV/cm) across clear paper layer for progressive migration of Cu₂S for different conductivity values is shown in Fig. 1.

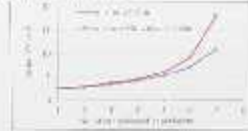


Fig. 1. Variation of maximum electric stress across clear paper layer for progressive migration of Cu₂S for different conductivity values.

3. Experimental Study

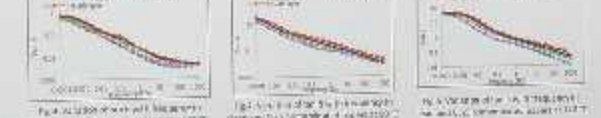
The dielectric measurements were carried out on laboratory model transformer winding (Fig. 1(a)). The paper layers on the high voltage (HV) conductor are initially contaminated by Cu₂S and low voltage (LV) conductor consisted of only clear paper layers.

3.1. FDS Measurements

The FDS measurements were carried out at 200 V AC over a frequency range of 1 kHz down to 0.1 Hz.

Effect of Cu₂S on tan δ

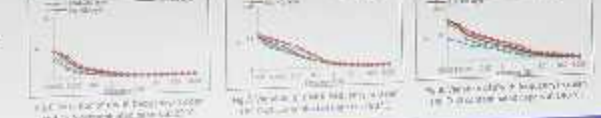
The variation of tan δ with frequency in clear and Cu₂S contaminated paper at 25 °C, 50 °C and 140 °C are shown in Fig. 3, 4 and 5.



The results of variation of tan δ at 25 °C, 50 °C and 140 °C are constant and are responsive to the changes that occur in paper of insulation due to the migration of Cu₂S through the paper layers.

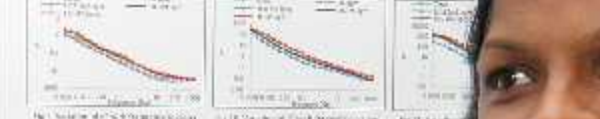
Effect of Cu₂S on ε'

The variation of ε' with frequency in clear and Cu₂S contaminated paper at 25 °C, 50 °C and 140 °C are shown in Fig. 6, 7 and 8.



Effect of Cu₂S on ε''

The variation of ε'' with frequency in clear and Cu₂S contaminated paper at 25 °C, 50 °C and 140 °C are shown in Fig. 9, 10 and 11.



The values of tan δ, ε' and ε'' show a variation in magnitude due to the contamination of paper insulation.

3.2. Polarization Index (PI)

The values of polarization index at 25 °C, 50 °C and 140 °C for clear and contaminated paper layers are furnished in Table 2.

No. of Cu ₂ S Contaminated Paper Layers	PI at 25 °C	PI at 50 °C	PI at 140 °C
0	2.00	2.00	2.00
1	2.00	2.00	2.00
2	2.00	2.00	2.00
3	2.00	2.00	2.00
4	2.00	2.00	2.00

It is also noted that the Polarization Index (PI) and number of paper layers contaminated were constant.

3.3. Insulation Resistance

The variation of insulation resistance in clear and contaminated paper samples at 25 °C, 50 °C and 140 °C are shown in Fig. 12, 13 and 14.



There is a reduction in the insulation resistance of paper layers contaminated.

4. Conclusion

- The effect of Cu₂S migration on electric stress distribution across insulation is studied.
- The values of tan δ, ε' and ε'' show a variation in magnitude due to the migration of Cu₂S through the paper layers.
- Polarization Index (PI) is constant for clear and contaminated paper layers.
- There are no characteristic changes in insulation resistance due to the migration of Cu₂S through the paper layers.
- Using FDS and PDI, the effect of Cu₂S on insulation resistance is studied. It is observed that the insulation resistance of contaminated paper is constant but the further migration of Cu₂S through the paper layers is to be studied in future.

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NATIONAL CONFERENCE ON RECENT TRENDS IN POWER ENGINEERING
Indian Institute of Technology Madras, Chennai 600 036, India
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ANALYSIS OF PARTICLE MOVEMENT AND PARTIAL DISCHARGE IN THE WINDING OF POWER TRANSFORMER USING CFD

N.Vasanthi Gowri¹ P.Srikanth¹ V.Shashank¹ G.Sankeerth¹ M.Ramalinga Raju²

1. CBIT, Hyderabad India 2. JNUT, Kakinada, India

I. POWER TRANSFORMER:

- An important apparatus in electrical substation
- Electric field analysis is the most important design variable

II. PARTIAL DISCHARGE:

Electrical discharge that occurs across a limited area of the insulation, usually by conducting electrical charges across a bridging the gap, between two conductive surfaces, represents a partial discharge system

Under normal working conditions, the high-voltage insulation where the insulating condition deteriorated with age, or has been degraded prematurely by electrical over-stressing, or due to improper

DISCHARGE IN TRANSFORMER OIL:

Reasons for the partial discharge in a transformer is **FREE METALLIC PARTICLE CONTAMINATIONS BY TRANSFORMER**



Power transformer flow in partial discharge. **FLUID MECHANICS** critical analysis and algorithms to solve at involve fluid flows

Geometry of the problem

Time occupied by the fluid into may be transient or non-uniform

3D modeling

Site of injection + radiation + species

Boundary conditions

Initial conditions, fluid behavior

Boundary conditions of the problem

Which the equations are solved or transient



Visualization of fluid flow

III. SIMULATION METHOD PROPOSED:



- HV winding of a 300 MVA, 220 KV/132KV/13KV transformer
- 220 KV/132/11 KV auto transformer is considered
- Transformer has a center entry type of winding as shown
- Only half of the HV coil is examined
- The gap between the immediate press board cylinder and coil is 8 mm and the half height of the coil is 957 mm
- Particle is located at any point in the base

IV. CFD ANALYSIS OF THE TRANSFORMER:

- Two dimensional model of a HV winding of the considered transformer is obtained by ANSYS software.
- ANSYS FLUENT is used to model a flow pattern of transformer oil. Oil flow is considered in correlation with the outside flow, as the design part includes the inlet and exit way of an oil flow
- To obtain the oil flow pattern, the HV winding part is divided into 5651 fine slots. A copper particle of spherical shape with 0.5 mm is also allowed to move along with the transformer with the oil velocity of 0.5 m/sec.

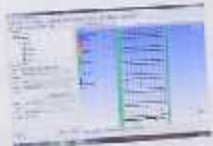


Fig. 4. Simulated oil flow streamlines at HV winding side of a transformer

V. COLLISION OF PARTICLE WITH TRANSFORMER WINDING:

- A simulation comprising the individual insulated conductors inside the disc would require a large computational effort
- The area of particle under collision with the winding is divided into number of elements by finite element tool.
- FEM finds the axis of area of contact with the boundary.



Fig. 5. Model of Finite Elements of colliding area of the particle

- The particle first collides with the disc number 53 and the corresponding disc voltage is 81.466 kV.
- As the particle touches the winding, electric stress is imposed on the particle.

VI. ELECTRIC FIELD ANALYSIS:

- ANSYS classic makes use of Finite Element Method (FEM) to obtain a structural analysis.
- The area of particle under collision with the winding is divided into number of elements by finite element tool.
- FEM finds the axis of area of contact with the boundary.
- Electrostatic energy in a bounded volume can be given by $2W = \int_V \epsilon E^2 dv$ - (1)

For a two dimensional analysis along with the axis x and y with m nodes and a number of elements can be written as,

$$2W = \int_V \left(\frac{\epsilon}{2} \left(\frac{\partial V}{\partial x} \right)^2 + \left(\frac{\partial V}{\partial y} \right)^2 \right) dv$$

The electric energy inside an element is,

$$2W^e = \int_V \left(\frac{\epsilon}{2} \left(\frac{\partial V}{\partial x} \right)^2 + \left(\frac{\partial V}{\partial y} \right)^2 \right) dv$$

Total energy available in the contact area is given by,

$$2W = W^1 + W^2 + \dots + W^m$$

The shape function of a considered 2D geometry is,

$$V^e = \sum_{i=1}^m N_i V_i$$

The total node potential is given by,

$$V = \sum_{i=1}^m N_i V_i$$

VII. COLLISION OF PARTICLE WITH OTHER TRANSFORMER WINDING DISCS:

- With further iterations it is found that apart from disc 53 the spherical particle also collides with discs 52 and 51
- The voltages corresponding to disc 52 and 51 are 82.34 and 83.218 kV respectively. The particle collides with disc 52 and 51 are shown in Fig. 6 and Fig. 7 respectively.

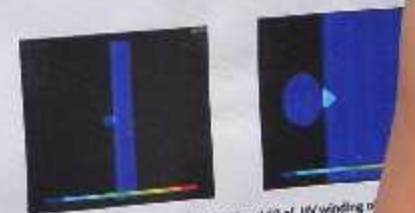


Fig. 6. Particle colliding with disc 52 and 51 of HV winding

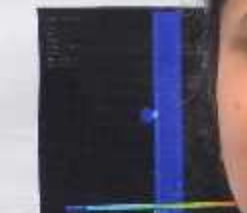


Fig. 7. Particle colliding with disc 53 of HV winding of a transformer

VIII. RESULTS:



FREQUENCY RESPONSE AND COHERENCE FUNCTION ANALYSIS FOR DETECTION OF A SINGLE TURN FAULT IN THE LINE END COIL OF 11 KV MOTOR

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Sridhar

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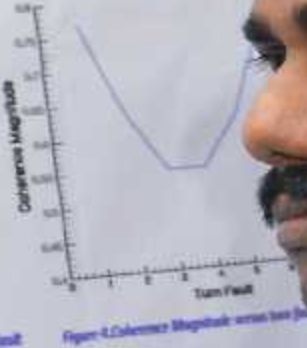
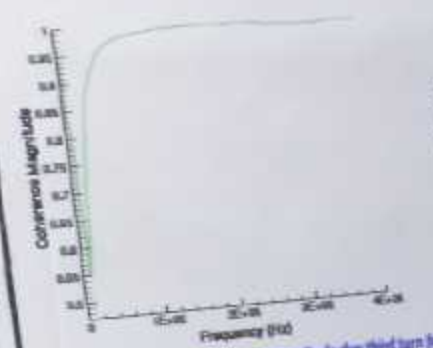
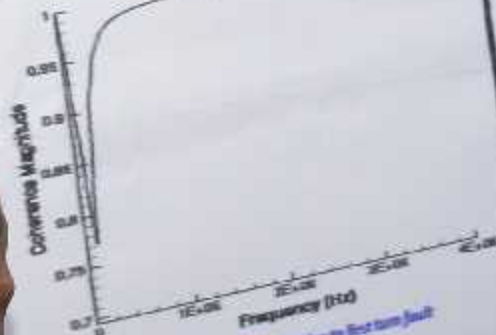
JNT University, Hy

Introduction

Power motors are reported to have failed more frequently in industries. The main reason attributed to the failure is due to fast surge voltage generated during circuit breaker switching operations. There is no published work related to transient voltage surge in the turns of line end coil due to incidence of surge. A new method is yet proposed for location of turn failures due to surge voltage in the high voltage motors.



Based on comparison of frequency response and coherence function between two frequency responses, a method is suggested to determine the failure of a specific turn.



Coherence magnitude for turn fault

Turns Faults	Frequency	Coherence Magnitude
1	50 Hz	0.7716
2	100 Hz	0.6324
3	150 Hz	
4	200 Hz	
5	250 Hz	
6	300 Hz	
7	350 Hz	

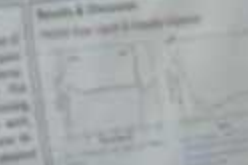
The results related to different turn faults appear in coherence magnitude with frequency. From the above table, it is observed that coherence magnitude is higher for middle level turns.

Conclusion

- The work presented in this paper shows the function behavior of turn failure.
- The variation of coherence magnitude is observed.
- It is concluded that motor condition can be detected by this method.

Recent Trends in Power Engineering
 Institute of Technology Madras, Chennai 600 036, India
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De-convolution For Spiky Charge Signal
 Author: Sajid, S. S. Reddy
 Department of Electrical Engineering, IIT Madras



Results & Discussion
 The de-convolution results are shown in the figure. The original signal is shown in red and the de-convoluted signal is shown in blue. The de-convoluted signal is much smoother than the original signal.

PED025

National Conference on Recent Trends in Power Engineering
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Study, Design and Performance Analysis of 2,3 & 4
Phase Interleaved Boost Converters in Renewable
Energy Source Application

ABISHRI.P
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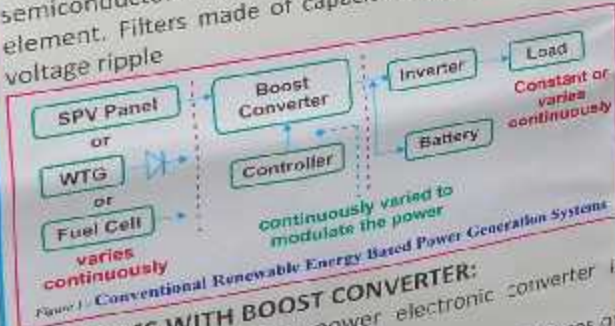
INTRODUCTION :

A suitable power conditioner is very much needed for the Renewable Energy Sources (RES), such as Solar Photovoltaic (SPV) panel, Wind Turbine Generator (WTG) and fuel cell to connect it to the load because of its non-linear current Vs voltage (I-V) characteristics, due to lower output voltage of the sources and its dependency on the sporadically varying natural phenomena. The DC-DC converter along with suitable controllers is generally used in the renewable energy sources, to maintain a constant voltage at the input of the inverter for a stable output (load) voltage, and to handle power flow control based on load requirement. The larger ripples in RES sources such as SPV panel, fuel cell etc., A detailed investigation on 2 phase, 3 phase and 4 phase interleaved boost converter is carried out with SPV, wind turbine generator, Fuel cell and battery and parameters like input current ripple, output voltage ripple and the power handling capability is analyzed. It is observed that the output voltage ripple is minimized at the points where the input current ripple is minimized. It is observed that the 4 phase IBC offers better input current and output voltage ripple reduction than the 2 and 3-phase IBC.

METHODOLOGY:

BOOST CONVERTER:

A boost converter is a DC-to-DC power converter with an output voltage greater than its input voltage. It is a class of SMPS containing at least two semiconductors and at least one energy storage element. Filters made of capacitors are reduce output voltage ripple



PROBLEMS WITH BOOST CONVERTER:

- ◆ The power level of a power electronic converter is limited due to several factors.
- ◆ An increase in current causes an increase in stresses on switching devices and The boost inductor should be increased to avoid saturation and overheating problems.

INTERLEAVED BOOST CONVERTER(IBC):

- ◆ Hence, for an efficient power generation and to protect the life time of the RE resources, a power conditioner that simultaneously applies voltage and power flow control along with negligible voltage and current ripple is very much necessary.
- ◆ To develop an efficient multi-phase DC-DC converters as the basic converter unit of the RES based power generation systems to increase the power processing capability with reduced ripple content and to improve the reliability.



Figure 2: 2-Phase Interleaved Boost Converter (IBC)

ADVANTAGES OF IBC:

- ◆ Increase the power processing capability
- ◆ Reduced electromagnetic emission
- ◆ Fault tolerance
- ◆ Reduced conduction losses (I²R)
- ◆ Improve the reliability of the power electronic system
- ◆ Ripple cancellation in both the input and output waveforms

RESULT:

Analysis of 2, 3 & 4 Phase are tabulated below:

Source	2 Phase	3 Phase	4 Phase
Input Current (I)	0.08 Amperes	0.05 Amperes	0.02 Amperes
Output Voltage (V)	0.86 Volts	0.82 Volts	0.53 Volts

As Seen in the both Cases the 4 phase IBC offers better Input Current and Output Voltage Ripple Reduction than the 2 Phase and 3 Phase Interleaved Boost Converter (IBC). Hence 4 Phase Interleaved Boost Converter (IBC) is proposed as the Basic Converter Unit of High Power Supply.

HVE010

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Partial Discharge Characteristics of Synthetic Ester-Pressboard Insulation System: Effect of Conducting Particle

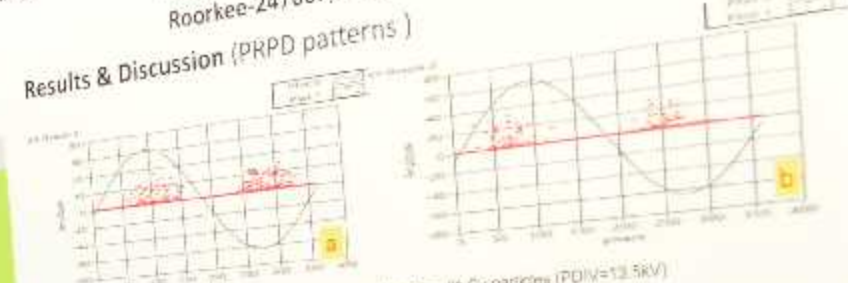
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Department of Electrical Engineering,
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Introduction (Research Area- High Voltage Engineering)

Properties	Pressboard	Transformer Oil
Degr.	Cellulose of high-strength	Paraffinic, naphthalene
Manufacture	Impregnated cellulose	Extracts from petroleum
Usage	Insulation and mechanical support	Insulation well as cooling

- Partial discharge (PD) - electrical discharge partially bridges the insulation.
- PD is sign of insulation degradation and root cause of breakdown.
- In order to understand PD, artificial defects were added (i.e. conducting particles-Cu).



- Figure 2. PRPD patterns of pressboard sample with Cu particles (PDIV=13.5kV)
- (a) at centre of electrodes. (b) near by earth electrode
 - Two samples- 1. Cu particles at centre of electrodes. 2. Cu particle at near by earth electrode.
 - Measured value. PRPD pattern (Phase resolved partial discharge pattern)

Conclusions

- To check the suitability of synthetic ester for transformer insulation the PD experiment of Synthetic ester-pressboard with Cu particles has been carried out.
- As per the above PD patterns, Cu particles at the centre of the electrodes is having more repetitive pulses than Cu particles at nearby earth electrode.
- This PD patterns are used for condition monitoring of large transformers.

Reference

Sarathi, R., I.P. Merin Sheema, J. Sundarajan, M.G. Daikas, "Influence of harmonic ac voltage on surface discharge formation in transformer insulation", IEEE Trans. on DEI, vol. 21, No.5, pp. 2183-92, 2014.



HVE010

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Results & Discussion (PRPD patterns)

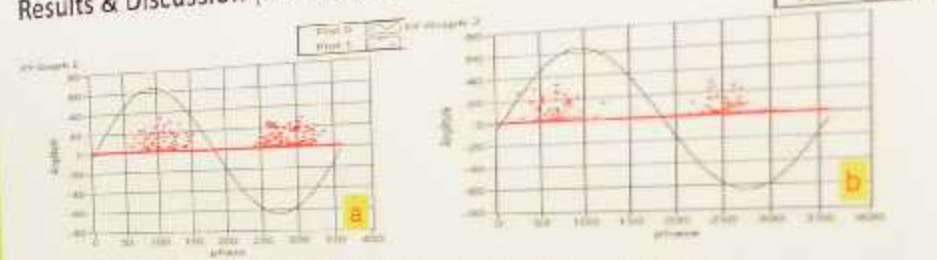


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a) at centre of electrodes. b) near by earth electrode

- Two samples- 1. Cu particles at centre of electrodes 2. Cu particle at near by earth electrode
- Measured value- PRPD pattern (Phase resolved partial discharge pattern)

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Properties	Pressboard	Transformer Oil
Origin	Cellulose of highest quality	Paraffinic, naphthalene
Manufacture	Unbleached sulfate Cellulose	extracts from petroleum
Usage	Insulation and mechanical Support	Insulation well as cooling

- Partial discharge (PD)- electrical discharge, partially bridges the insulation.
- PD- sign of insulation degradation and root cause of breakdown.
- In order to understand, PD- artificial defects, were added (i.e. conducting particles-Cu).

Experimental work (two parts)



Figure 1: a) Schematic of test cell, b) photo of experimental setup



Optimal Siting and Sizing of DG for Loss Minimization and Voltage Stability Improvement in Distribution System

J. Senthil Kumar¹, M. Aravindhan², S. Charles Raja³, P. Venkatesh⁴
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 Department of Electrical and Electronics Engineering, Thiagarajar College of Engineering, Madurai, Tamil Nadu, India

Objective

- Identifying the optimal DG location by Voltage Stability Index (VSI).
- Optimal Sizing of DG to minimize power loss.
- Power loss and Voltage Stability Margin (VSM) to be analyzed for 12 and 59 bus RDS system.

Problem Formulation

DG Placement Voltage Stability Index (VSI)

$$VSI = \frac{4X_k^2 \cdot P_k^2}{V_k^2 (Q_k + Q_c)} \dots (1)$$

DG Sizing Minimize $P_{loss} = \sum I_k^2 R_k \dots (2)$

Power – conservation limit $P_{in} = P_D + P_L - P_{DG} \dots (3)$

Voltage Stability Margin (VSM)

$$VSM(V) = V(V) - 4(P(V)X_k - Q(V)R_k) - 4V(V)^2(P(V)R_k + Q(V)X_k) \dots (4)$$

Where,

R=Resistance of branch k, P=Real power load(kW), Q=Reactive power load(kW), NL=Total number of branches, P_L=Total Power loss(kW), I=Current flowing in branch k, P_{SS}=Power from substation(kW), P_D=Total power demand(kW), P_{DG}=Power injected by DG(kVA)

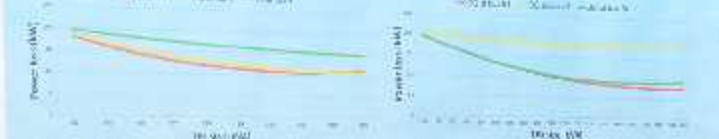
Proposed Method



Results and Discussions

- CASE 1: Placing random DG in top three sensitivity buses.
- CASE 2: Optimal setting of DG size using PSO.
- CASE 3: Increasing load power demand for future expansion
- CASE 4: Integrating DG capable of injecting both real and reactive power

Case 1: Placing random DG in top three sensitivity buses



Case 2: Optimal setting of DG size using PSO

	Without DG	12 Bus RDS	59 Bus RDS	Without DG	12 Bus RDS	59 Bus RDS
DG Size (kVA)		11.848.15	11.848.15		11.848.15	11.848.15
Substation Real Power (kW)	475.04	500.78	500.78	475.04	500.78	500.78
Substation Reactive Power (kVar)	440.00	490.71	490.71	440.00	490.71	490.71
Total Real Power loss (kW)	263.72	10.71	10.71	263.72	10.71	10.71
Total Reactive Power loss (kVar)	8.227	1.177	1.177	8.227	1.177	1.177
Minimum Voltage @ Bus	0.942081	0.942081	0.942081	0.942081	0.942081	0.942081
Minimum VSM @ Bus	0.716172	0.942081	0.942081	0.716172	0.942081	0.942081

Case 3: Increasing load power demand for future expansion

	12 Bus RDS	59 Bus RDS	12 Bus RDS	59 Bus RDS
DG Size (kVA)	11.848.15	11.848.15	11.848.15	11.848.15
Total Real Power loss (kW)	10.71	10.71	10.71	10.71
Total Reactive Power loss (kVar)	1.177	1.177	1.177	1.177
Minimum VSM @ Bus	0.942081	0.942081	0.942081	0.942081

Case 4: Integrating DG capable of injecting both real and reactive power

	Without DG	12 Bus RDS	59 Bus RDS
DG Real power injection (kW)		11.848.15	11.848.15
DG Reactive power injection (kVar)		11.848.15	11.848.15
Substation Real Power (kW)	475.04	500.78	500.78
Substation Reactive Power (kVar)	440.00	490.71	490.71
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Total Reactive Power loss (kVar)	8.227	1.177	1.177
Minimum VSM @ Bus	0.716172	0.942081	0.942081

Conclusion

- This research work provides a methodology for optimal siting and sizing of DG in radial distribution system using VSI and PSO.
- The proposed work can be extended for future load growth types of DG.

Corresponding author: J Senthil Kumar



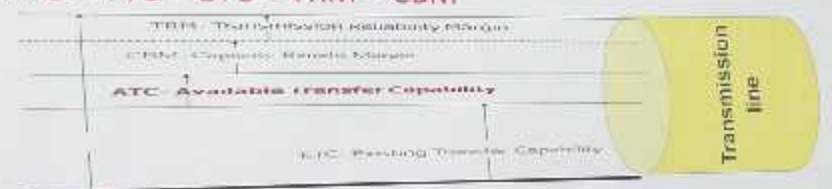
ATC Enhancement by Incorporating FACTS Devices for Deregulating Scenario in Present Power Market

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 K. Bavithra
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Definition

ATC is a measure of the Transfer Capability remaining in the transmission network for further commercial activity over and above already committed uses

$$ATC = TTC - ETC - TRM - CBM$$



Objective

Maximize ATC $MAX \{ATC_{max}^{FACTS}\}$

Limits for ATC determination

- Bus Voltage limits ($V_{min} \leq V_i \leq V_{max}$)
- Line Thermal limits ($P_{ij} < P_{ij}^{max}$)
- Reactive power limits ($Q_{min}^{max} < Q_{ij} < Q_{max}^{min}$)

ATC Determination

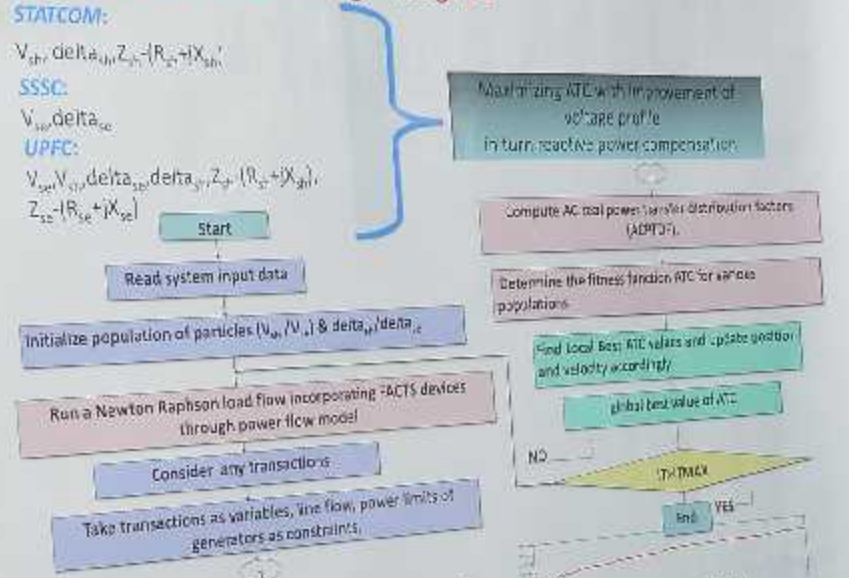
- AC-PTDF of line $i-j$ is given by, $ACPTDF_{i,j} = \frac{\Delta P_{ij}}{P_m}$
- Power transfer in the line $i-j$ due to transaction $m-n$ is given by, $T_{i,j} = \alpha \cdot \frac{P_m - P_n}{P_m}$
- ATC for transaction $m-n$ is found by, $ATC_{m-n} = \min \{T_{i,j}\}, i, j \in N$

Incorporating FACTS devices - power flow

STATCOM(Shunt), SSSC(Series), UPFC(Combine)
 The change in angle and voltage is determined by change in jacobian elements.

$$\begin{bmatrix} \Delta \delta^{FACTS} \\ \Delta V^{FACTS} \end{bmatrix} = \begin{bmatrix} J_1^{FACTS} & J_2^{FACTS} \\ J_3^{FACTS} & J_4^{FACTS} \end{bmatrix}^{-1} \begin{bmatrix} \Delta P \\ \Delta Q \end{bmatrix}$$

Optimizing variables and target using PSO



Conclusions

- FACTS can enhance ATC (UPFC > SSSC > STATCOM)
- Improvement in transmission system assets that replaces a tedious job of erecting new transmission facility which is extravagant.



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Optimal Siting and Sizing of DG for Loss Minimization and Voltage Stability Improvement in Distribution System

J. Senthil Kumar¹, M. Aravindhan², S. Charles Raja³, P. Venkatesh⁴
¹Research Scholar, ²PG Scholar, ³Assistant Professor, ⁴Associate Professor

Department of Electrical and Electronics Engineering, Thiagarajar College of Engineering, Madurai, Tamil Nadu, India

- Objective**
- Identifying the optimal DG location by Voltage Stability Index (VSI).
 - Optimal Sizing of DG to minimize power loss.
 - Power loss and Voltage Stability Margin (VSM) to be analyzed for 12 and 69 bus RDS system.

Problem Formulation

DG Placement Voltage Stability Index (VSI)

$$VSI_k = \frac{4X_k}{P_k} \left(\frac{P_k}{Q_k} + Q_k \right) \dots(1)$$

DG Sizing $Minimize(X_k) = \sum_{k=1}^{NL} P_k R_k \dots(2)$

Power - conservation limit $P_{in} = P_D + P_L - P_{DG} \dots(3)$

Voltage Stability Margin (VSM)

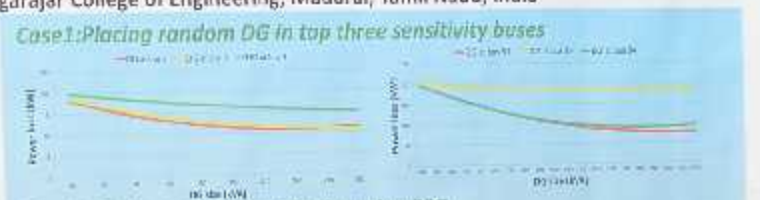
$$VSM_k = |P_k|^{-1} [4(P_k)X_k - Q_k(R_k)^2 - 4(P_k)^2(P_k)R_k + Q_k^2 X_k] \dots(4)$$

Where,
 R=Resistance of branch k, P=Real power load(kW), Q=Reactive power load(kW), NL=Total number of branches, P_L=Total Power loss(kW), I=Current flowing in branch k, P_{sc}=Power from substation(kW), P_{in}=Total power demand(kW), P_{DG}=Power injected by DG(kVA)



Results and Discussions

CASE 1: Placing random DG in top three sensitivity buses.
 CASE 2: Optimal setting of DG size using PSO.
 CASE 3: Increasing load power demand for future expansion
 CASE 4: Integrating DG capable of injecting both real and reactive power



Case 2: Optimal setting of DG size using PSO

Without DG	12 Bus RDS	69 Bus RDS
Substation Power (kW)	208.91	208.91
Substation Reactive Power (kVAR)	103.21	103.21
Total Real Power (kW)	212.64	212.64
Total Reactive Power (kVAR)	103.21	103.21
Total Power Loss (kW)	12.27	12.27
Minimum Voltage (V)	230.00	230.00
Minimum VSM (%)	0.7882	0.7882

CASE 3: Increasing load power demand for future expansion

Without DG	12 Bus RDS	69 Bus RDS
Substation Power (kW)	212.64	212.64
Substation Reactive Power (kVAR)	103.21	103.21
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Minimum Voltage (V)	230.00	230.00
Minimum VSM (%)	0.7882	0.7882

Conclusion

- This research work provides a methodology for optimal placement and sizing of DG in radial distribution system using VSI and PSO technique.
- The proposed work can be extended for future load growth and different types of DG.

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National Conference on Recent Trends in Power Engineering
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Design and Analysis of Tilt Integral Derivative Controller for Automatic Generation Control in Deregulated Environment

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 Veer Surendra Sai University of Technology, Burla, Odisha, India

Abstract: In this present work, a novel Differential Evolution (DE) algorithm optimized Tilt-Integral-Derivative (TID) controller is proposed for Automatic Generation Control (AGC) of multi area multi source power system under deregulated environment. The gains of the TID controller are optimized employing DE optimization technique using Integral of Time multiplied by Absolute value of Error (ITAE) criterion. Further, to improve the dynamic performance of the system Static Synchronous Series Compensator (SSSC) is placed in the tie-line and the performance of proposed approach has been investigated in all possible of power transactions taking place under deregulated environment.

Introduction

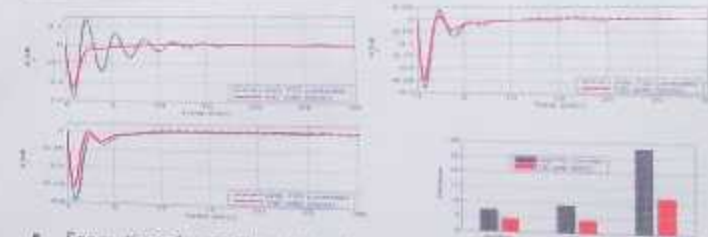
- The changes in the load affect the deviation of frequencies of all the areas and also in the tie-line powers.
- The problem of controlling the real power output of generating units in response to changes in system frequency and tie-line power interchange within specified limits is known as Automatic Generation Control (AGC).

Methodology



Results & Discussion

Scenario	SLP in arm-1	SLP in arm-2
Power based	2%	0%
Biateral based	2%	2%
Contract violation	10%	2%



- From the above Figs. It is observed that, the dynamic responses of the SSSC incorporated system are better in terms of settling time, peak over shoots and ITAE objective function.

Conclusions

- A new TID controller for AGC problem under deregulation is designed and implemented.
- Important physical constraints such as boiler dynamics, governor dead band, generation rate constraints and time delay are included in the system model.
- The dynamic performance improvement with SSSC is performed.



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Optimal Placement and Sizing of Combined DG and Capacitor For Minimization Of Power Loss & THD in Distorted Distribution Systems

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Introduction

Distributed generation (DG) in power systems may lead to several advantages such as reducing power losses and improving voltage profiles. The presence of distributed generation (DG) in power systems may lead to several advantages such as reducing power losses and improving voltage profiles. Nowadays maximum power DGs are present in the systems which include power quality problems such as harmonics, while placing DG harmonics should be considered. The additional objective of THD minimization also considered. This work presents a new combined technique for minimizing the power loss and THD in distribution system by optimal DG installation together with capacitor placement by using Genetic Algorithm.

Objective

- Optimal placement & sizing of DGs & capacitor to minimize total power loss and THD
- To improve the voltage profile.

Problem Formulation

Minimization of power loss (F₁)
 $F_1 = \sum_{i=1}^n P_{loss}$
 Minimization of THD (F₂)
 $F_2 = \sum_{i=1}^n THD$

Operational Constraints

Bus voltage limit
 $V_{min} \leq |V_i| \leq V_{max}$

THD voltage limit
 $THD_i \leq THD_{lim}$

The DG capacities
 $P_{DG} \leq P_{DGmax}$

Fitness function, $F = F_1 + F_2$

Implementation Of Proposed Work



Test system



Fig.69 bus radial distribution system

System data

- The test system for the case study is a 12.66 kV radial distribution with the total load of 3.8 MW and 2.69 MVar.
- The minimum and maximum voltage limits are set at 0.95 p.u and 1.05 p.u.
- The occurrence of the harmonics in the system is due to non linear loads which are located at four buses 19, 30, 38 and 57 in 69 bus distribution system.

methodology

- Case1: DG capable of injecting real power only
- Case2: DG capable of injecting both P&Q
- Case3: Both DG (injecting both P&Q) and capacitor

Results & Discussion

Case	Bus no	Size	P-loss (Kw)	Q-loss (Kvar)	THD (%)
Base case analysis	(1) DG capable of injecting real power only	19: 845.2kw	343.4	24.11	17.85
	(2) only DG like uniformed	21: 1106.9kw	193.3	51.04	3.598
	(3) DG capable of injecting both P&Q	61: 796.95kw	64.00	62.16	1.356
Case1: DG capable of injecting P&Q	(1) DG	58: 775kw, 531.2kvar	40.75	10.086	1.039
	(2) DG and capacitor	21: DG: 506.36kw, 361.74kvar Cap: 140.87kvar	38.326	19.589	1.345
	(3) DG and capacitor	51: DG: 845.23kw, 307.24kvar Cap: 209.35kvar	14.126	15.85	1.225



Conclusion

- A suitable problem formulation to place DGs and capacitor in a distorted distribution systems and to minimize the losses and THD is achieved.
- The results show that THD level can be reduced along with the reduction of power loss if DGs & capacitors are properly located and sized.
- It is observed that, in certain circumstances like installing DG, which generates real power but absorbs reactive power, is not able to reduce THD levels. In such cases, shunt capacitors are necessarily required to bring THD levels within the limits along with DG.
- The proposed technique GA gives the best solution in terms of P-loss and THD level for minimizing the total power losses and THD.

PSE004

National Conference on Recent Trends in Power Engineering
Indian Institute of Technology Madras, Chennai 600 036, India
29-30 December 2015
Performance Analysis of Distribution Static Compensator

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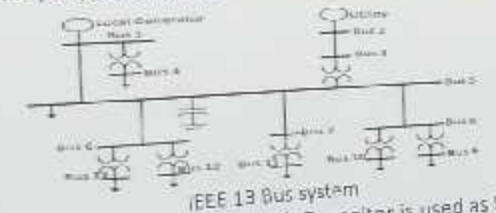
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Introduction

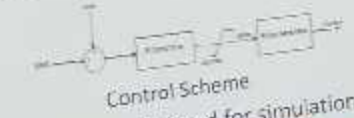
- Distribution Static Compensator (DSTATCOM) is a shunt connected power quality improvement device
- The performance of DSTATCOM is depends on control algorithm employed
- In this work a case study on DSTATCOM using PSCAD/EMTDC tool has been presented.

System Details

- IEEE 13 Bus System
 Utility supply of 69 kV and local generation source of 13.8 kV



- Six pulse VSC with DC link Capacitor is used as DSTATCOM
- Control Method uses PI controller and generated PWM with switching frequency 5KHz.



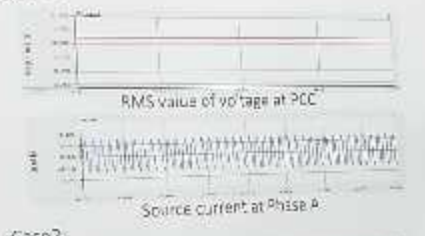
- Different Cases considered for simulation

Case No.	With DSTATCOM	With 1G Fault
1	No	No
2	Yes	No
3	No	Yes
4	Yes	Yes

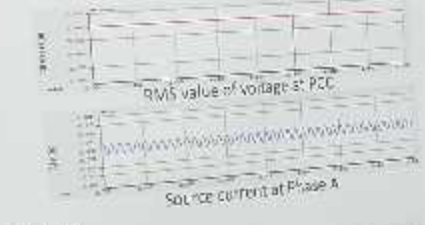
Simulation Results

- For simulation, Local generator is removed from the system and Line to Ground (LG) fault is considered at bus 3.

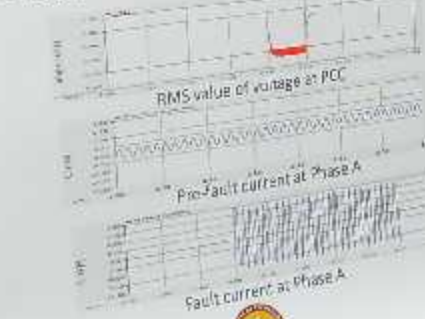
Case 1:



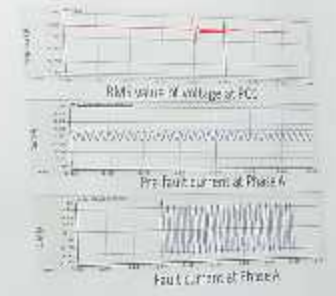
Case 2:



Case 3:



Case 4:



Summary of Results obtained

Case No.	Voltage at Bus 3 (pu)	Current THD (%)	Voltage THD (%)
1	0.954	0.070	-
2	1	1.128	0.04
3	0.949 (with LG)	0.023	-
4	1	1.141	0.04

Conclusions

- It can be observed that the DSTATCOM gives satisfactory performance in all the situations by maintaining voltage at point of connection, keeping it > 0.9 pu
- THDs are maintained within the IEEE 519 standard limit.
- It is observed that VSCM based control algorithm is suitable for mitigating voltage related disturbances
- For future study the DSTATCOM performance is to be analysed with presence of distributed generation sources with different types of fault.

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Synchrophasor Estimation under Dynamic conditions and its Application in Power Systems

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INTRODUCTION

This paper compares the performance of two algorithms (AMPE & LES) which have been reported in the literature to estimate the synchrophasor under dynamic conditions. Both algorithms are implemented in two of the power system applications. One is distance protection of transmission lines and other is estimation of transmission line parameters.

ALGORITHM 1: LES

Least Error Squares approach

Parameters of a digital filter determined by using LES approach are used to compute the real and imaginary components of the phasor. The signal considered is:

$$x(t) = a_1 \cos(\omega t + \theta_1) + a_2 \cos(2\omega t + \theta_2) + \dots + a_n \cos(n\omega t + \theta_n) + c e^{-t/\tau}$$

$$X(k) = \begin{bmatrix} x(k) \\ x(k-1) \\ \vdots \\ x(k-N+1) \end{bmatrix} = \begin{bmatrix} a_1 \cos(\omega k) + a_2 \cos(2\omega k) + \dots + a_n \cos(n\omega k) + c e^{-k/\tau} \\ a_1 \cos(\omega(k-1)) + a_2 \cos(2\omega(k-1)) + \dots + a_n \cos(n\omega(k-1)) + c e^{-(k-1)/\tau} \\ \vdots \\ a_1 \cos(\omega(k-N+1)) + a_2 \cos(2\omega(k-N+1)) + \dots + a_n \cos(n\omega(k-N+1)) + c e^{-(k-N+1)/\tau} \end{bmatrix}$$

$$c = (A^T A)^{-1} A^T Y$$

It gives Least error squares solution for x which represents left pseudo-inverse matrix of A and minimizes the squared error $e^T e$.

ALGORITHM 2: AMPE

Adaptive Mimic Phasor Estimator

- Based on conventional sliding DFT technique to remove the decaying dc component in the signal and obtains the accurate magnitude and angle of the signal
- Uses the transmission-line parameters information hidden in the voltage and current measurements to adaptively approximate the decaying dc time constant to the accurate value

$$x(t) = A_1 \cos(\omega t + \theta_1) + B e^{-t/\tau} \quad (1)$$

$$x(n) = A_1 \cos\left(\frac{2\pi n}{N} + \theta_1\right) + B T^{-n} \quad (2)$$

where the decaying parameter, $\Gamma = e^{-\Delta t/\tau}$

Accurate real part of phasor for $(k+1)^{th}$ window

$$X_r(k) = \text{Real}\{\psi(k+1)\} \quad (3)$$

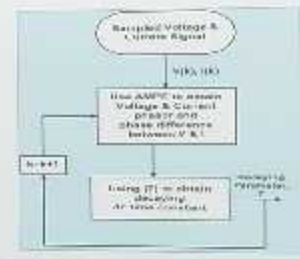
Accurate imaginary part of phasor for $(k+1)^{th}$ window

$$X_i(k) = \text{Imag}\{\psi(k+1)\} \quad (4)$$

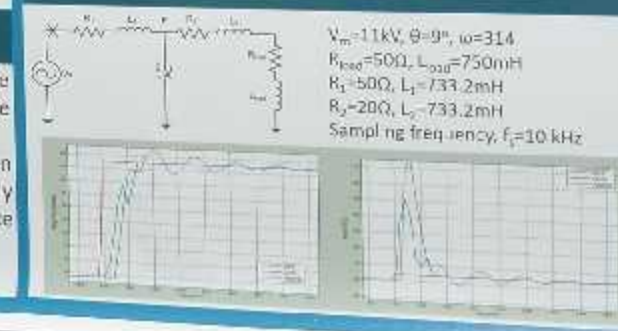
$$\psi(k+1) = \frac{[X_r(k+1) - X_r(k)] - j[X_i(k+1) - X_i(k)]}{\Gamma^{-1} \cos(2\pi/N) - 1 - j\Gamma^{-1} \sin(2\pi/N)} \quad (5)$$

$$\phi = \angle V - \angle I \quad (6)$$

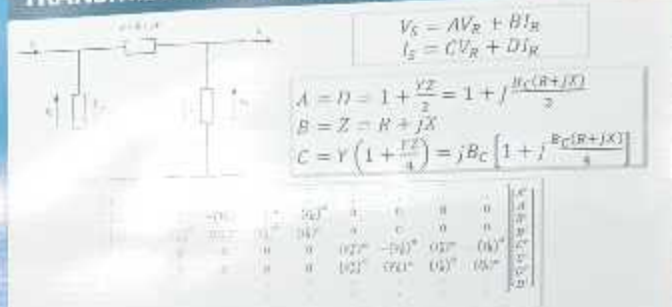
$$\tau = \frac{\Delta t \phi}{\omega} \quad (7)$$



DISTANCE RELAYING



TRANSMISSION LINE PARAMETERS ESTIMATION



Parameters	Actual values	Estimated values		Error	
		AMPE	LES	AMPE	LES
R (ohm/km)	0.0997	0.0996	0.1117	0.103%	15.5%
L (mH/km)	1.1002	1.1006	1.0914	0.045%	0.79%
C (uF/km)	0.010	0.01002	0.01029	0.2%	0.9%

CONCLUSION

- Both methods have good harmonic rejection capability and work satisfactorily in the presence of system dynamics and decaying dc component.
- AMPE method is easier to implement under dynamic condition.
- However performance of LES is better than AMPE under large disturbances since
 - it has lower response time and lower overshoot/undershoot values.
 - require less no of iterations to converge to the solution because convergence does not depends on the value of time constant assumed initially.
 - the decay rate during transients is not pre specified but is accounted automatically taking into consideration the effect of system resistance.





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Power Quality Issues in Steel Re-Rolling Mills in India
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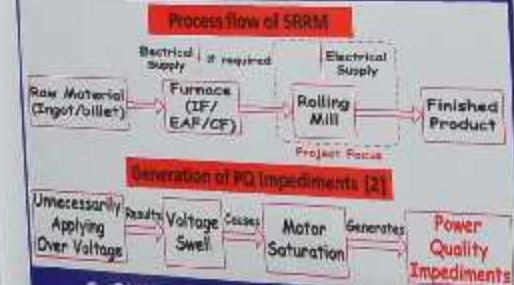
1. MOTIVATION

- Power Quality (PQ) issues are still largely underestimated, mainly because the losses are often hidden or not known.
- Steel re-rolling mill (SRRM) sector are prone to poor power quality and could have serious problems if not addressed in proper way.

2. OBJECTIVES

- To identify, the sources of the poor PQ areas and PQ issues plaguing the sector, through power quality audit and analyse the collected data in view of its compliance with the standards available [1].
- To make the SRRMs aware about the effects of poor PQ.

3. BLOCK DIAGRAMS



6. OVERVIEW OF TOTAL ANALYSIS

SRRM's Type	RMS		THD		Ia Harmonics	
	Va [V]	Variation	Va %	Ia %	5 th %	7 th %
Micro	217-250	33	1-9	4-55	13-52	8-45
Small	235-264	29	1-6	3-54	8-50	5-27
Medium	234-249	15	1-16	1-70	2-30	2-11

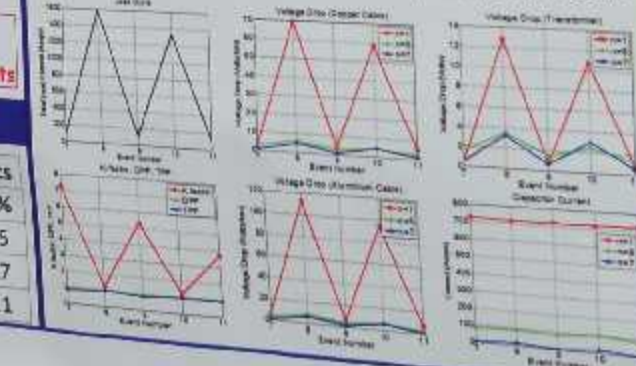
4. FIELD MEASUREMENTS

- PQ measurements of 15 SRRMs have been carried out in two cities (Nagpur and Raipur) of Central India by using Megger make PA9 PLUS V604 Portable PQ Analyzer.
- 15 SRRMs have been divided into three categories i.e. Micro, Small and Medium SRRMs. Out of 15 SRRMs, graphs and results of a plant, under Medium SRRM group, are presented.

5. IDENTIFICATION & EFFECTS OF PQ PROBLEMS

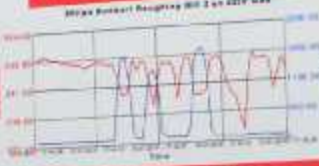
Electrical Distribution N/W of Plant

- Major Power Quality impediments are voltage sag & swell and harmonics.
- More pronounced PQ effects are increase in Voltage Drop (VD), transformer k-factor, & I²R loss, skin effect in cables, capacitor failure, decrease in motor lifespan & power factor.

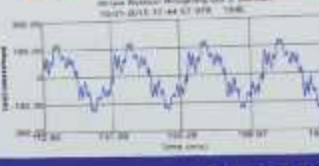


7. ACTUAL & SIMULATION RESULTS

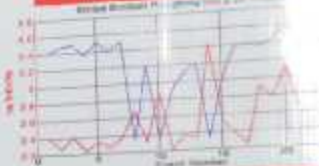
RMS Va & Ia Variations



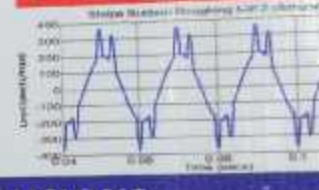
Actual (Ia_{THD} = 29.93 %)



Va & Ia THD Variation



Simulation (Ia_{THD} = 29.86 %)



8. CONCLUSIONS

- PQ analysis reveals all the PQ problems related to SRRMs.
- Real time field measurement and simulation modelling results are compared and found to be nearly same.
- This paper presents the effects of poor PQ, in SRRMs, generated due to saturation mode of motor operation
- This paper encourages the organizations, who deal with the international standards, to make some PQ standards for controlling the PQ problems generated by the saturable devices.
- Proper design of Electrical Configuration N/Ws are also discussed to avoid the PQ issues.

9. REFERENCES

- [1] IEEE Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems, IEEE Std. 519-1992, 1992.
- [2] R. C. Dugan, M. F. Mc Granaghan, S. Santoso, H. W. Beatty, "Electrical Power Systems Quality", McGraw-Hill Companies, New York, 2004.
- [3] O. Salor, B. Gültekin, S. Buhar, B. Boyrazoğlu, T. İnan, T. Atalık, A. Açık, A. Terciyanlı, Ö. Ünşar, E. Altıntaş, Y. Akkaya, E. Özdemirci, I. Çadırcı, and M. Ermiş, "Electrical Power Quality of Iron and Steel Industry in Turkey," in IEEE Transactions on Industry Applications, Vol. 46, No. 1, January/February 2010.

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Multiple Feedback-control-loops for Single-phase Full-bridge PWM Inverter

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1. INTRODUCTION

Power electronic converter (PEC) are widely used in applications such as power conversion, motor drives, and power systems. The use of power electronic converters has become a significant part of modern power systems. The use of power electronic converters has become a significant part of modern power systems. The use of power electronic converters has become a significant part of modern power systems.

2. SYSTEM MODELING

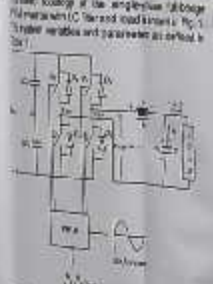


Figure 1: Block diagram of a single-phase full-bridge PWM inverter with feedback control loops.

3. DESIGN OF CURRENT LOOP

Consider only current loop of the inverter. The current controller controls i_a by controlling i_d . Here, i_d acts as disturbance. The output voltage disturbance is a compensated through voltage feedback as shown in Fig. 5 so that the controller needs to generate only i_d . Fig. 5 shows the simplified current loop which shows that the current loop is independent of the output voltage disturbance.



Figure 2: Inverter output voltage and load current for 1500 W Non-linear load.

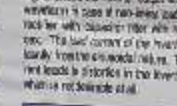


Figure 3: Inverter output voltage and current waveform for 1500 W Resistive load.



Figure 4: Inverter output voltage and current waveform for 1500 W 0.8 lag load.

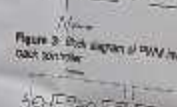


Figure 5: Inverter output voltage and current waveform for 1500 W 0.8 lead load.

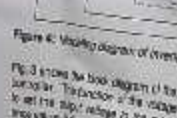


Figure 6: Inverter output voltage and current waveform when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 7: Inverter output voltage and current waveform when load is switched from resistive to non-linear load without Controller for 1500 W.



Figure 8: Inverter output voltage and current waveform when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 9: Inverter output voltage and current waveform when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 10: Inverter output voltage and current waveform when load is switched from resistive to non-linear load with Controller for 1500 W.

4. DESIGN OF VOLTAGE LOOP

Consider only voltage loop of the inverter. The voltage controller controls v_a by controlling v_d . Here, v_d acts as disturbance. The output voltage disturbance is a compensated through current feedback as shown in Fig. 6 so that the controller needs to generate only v_d . Fig. 6 shows the simplified voltage loop which shows that the voltage loop is independent of the output current disturbance.



Figure 6: Block diagram of the voltage feedback loop for the inverter.

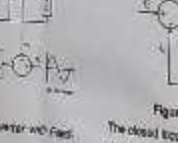


Figure 7: Block diagram of the current feedback loop for the inverter.



Figure 8: Block diagram of the inverter with both current and voltage feedback loops.



Figure 9: Block diagram of the inverter with both current and voltage feedback loops.



Figure 10: Block diagram of the inverter with both current and voltage feedback loops.



Figure 11: Block diagram of the inverter with both current and voltage feedback loops.



Figure 12: Block diagram of the inverter with both current and voltage feedback loops.

5. SIMULATION RESULTS

The design parameters for the inverter are $L = 50 \text{ mH}$, $C = 4.7 \text{ }\mu\text{F}$, switching frequency, $f_s = 5 \text{ kHz}$. The simulation is done using MATLAB/SIMULINK toolbox. The solver used is ode45 (Runge-Kutta) with fixed step size of 0.5 μs . The reference waveform of the inverter for non-linear load (diode bridge rectifier with capacitor filter) as well as linear (RL and RC) loads are shown in Fig. 9 to Fig. 12.

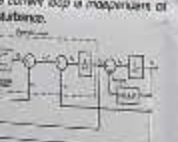


Figure 13: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 14: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.

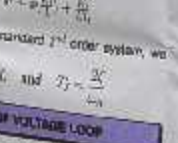


Figure 15: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.

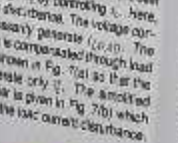


Figure 16: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 17: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 18: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 19: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.

6. CONCLUSION

The output voltage waveform of the inverter with non-linear load is significantly improved when the controller is used. For any kind of load, even though there is sudden change in load, the output voltage of the inverter remains constant at the desired voltage with low THD value if the controller is used.

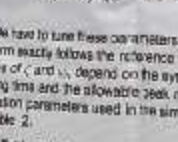


Figure 20: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 21: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 22: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.

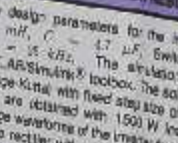


Figure 23: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 24: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 25: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.



Figure 26: Inverter output voltage & load current when load is switched from resistive to non-linear load with Controller for 1500 W.



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REVIEW OF MICRO INVERTER CIRCUIT TOPOLOGY AND INFLUENCE OF TEMPERATURE

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 **Professor & MOD, EEE Department, KPR Institute of Engineering and Technology, Coimbatore.

Abstract

The micro inverter circuit topology is reviewed in this paper. The influence of temperature on the performance of the micro inverter circuit is also studied. The influence of temperature on the performance of the micro inverter circuit is also studied. The influence of temperature on the performance of the micro inverter circuit is also studied.

Keywords

Micro inverter, Circuit topology, Influence of temperature.

1. Introduction

The micro inverter circuit topology is reviewed in this paper. The influence of temperature on the performance of the micro inverter circuit is also studied. The influence of temperature on the performance of the micro inverter circuit is also studied.

2. Micro Inverter Circuit Topology

The micro inverter circuit topology is reviewed in this paper. The influence of temperature on the performance of the micro inverter circuit is also studied. The influence of temperature on the performance of the micro inverter circuit is also studied.

3. Influence of Temperature

The influence of temperature on the performance of the micro inverter circuit is also studied. The influence of temperature on the performance of the micro inverter circuit is also studied.

4. Conclusions

The influence of temperature on the performance of the micro inverter circuit is also studied. The influence of temperature on the performance of the micro inverter circuit is also studied.

References

[1] P. Elanchezhian, V. Kumar Chinnaiyan, R. Sudhir Kumar, "Review of Micro Inverter Circuit Topology and Influence of Temperature", *National Conference on Recent Trends in Power Engineering*, Indian Institute of Technology Madras, Chennai, India, 29-30 December 2015.

PED014

Review of PWM Inverter

Feeding

National Conference on Recent Trends in Power Engineering
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29-30 December 2015
COGNITIVE MODELED INTELLIGENT CONTROLLER FOR ELECTRICAL DRIVE

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 Jawaharlal Nehru Technological University, Hyderabad, India^{1,2}

INTRODUCTION

In the proposed paper brain inspired emotional controller designed to control an electrical motor. As it is known fact that Emotional part of mammalian brain play vital role in balancing, movements and in speech therapy. The consequent concept can apply for an electrical motor, where the characteristics of motor varied with the disturbances occurred at internal and external variations. In the applications like hybrid vehicles, traction and variable speed applications where the control of speed is a challenging process with the change in load, different set constant speed with non linear change of stator currents and parameter variations.

OBJECTIVE

The main aim of this paper is to develop a bio-inspired intelligent controller considering the limbic system of mammalian brain. As per the mammalian brain, limbic system is responsible for emotions of an individual i.e., how faster an individual can take a decision on the issue. The emotional controller has been succeeding in many engineering applications; it is motivated to apply the emotional controller for electrical drives.

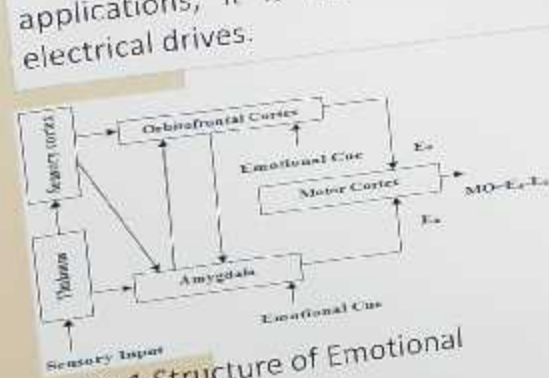


Fig.1 Structure of Emotional controller

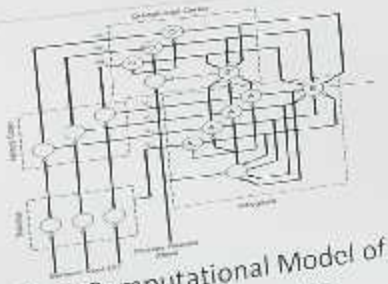


Fig.2 Computational Model of Emotional controller

RESULTS AND DISCUSSIONS

Case i) At No-Load

Case ii) Load T= 5N-m is applied at t=0.2

Case iii) When variable Load is applied

Fig. 3 Speed Performance of PMSM Drive Emotional controller



Fig. 4 Stator current performance of PMSM Drive

CONCLUSIONS

Simulation results of PMSM drive with Emotional controller are carried out at different load settings i.e. start no load to full load 5N-m and the speed tracking also carried out under constant load to variable load. It is observed that Emotional controller is very effective in controlling speed and stator current with change of load.





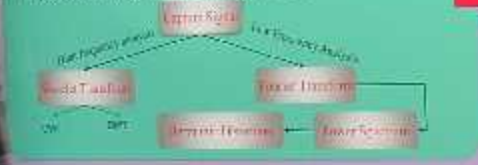
Behaviour of Water Droplets on Silicon Rubber Insulation Material

Gorla Vineeth, Palash Mishra, R.Sarathi
Indian Institute of Technology, Madras



Introduction

Water is a good conductor of electricity. It is a common insulator. However, when it comes to high voltage, it can become a problem. This is because of its dielectric strength. It is a common insulator. However, when it comes to high voltage, it can become a problem. This is because of its dielectric strength. It is a common insulator. However, when it comes to high voltage, it can become a problem. This is because of its dielectric strength.



Experimental Setup



The dielectric strength of the electrode is 20 cm. The water droplet is of 20 μm diameter.

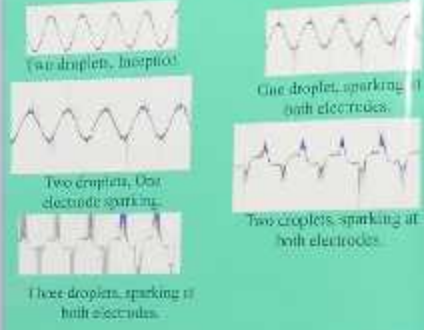
Some Notes

Why wavelet transform?

- Wavelet transform possesses the ability to analyze signals of a wide range of frequencies.
- It has very good time localization at high frequencies and very good frequency localization at low frequencies.
- On the other hand, Fourier transform gives the information on the energy present at each frequency.

The Fourier transform which provides the information on the energy present at each frequency is not suitable for the analysis of signals with varying frequencies. Wavelet transform is a better choice for the analysis of signals with varying frequencies.

The signals used for analysis



For these signals, wavelet transform was applied to find localized frequency content. The scalograms which represent energy content of the signal, are there. One can understand it.

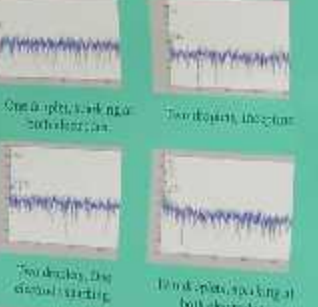
Results and Discussion

By the analysis, we can calculate the power of the signal present at each frequency. This power is the harmonic content of the signal. All the signals have the same harmonic content.

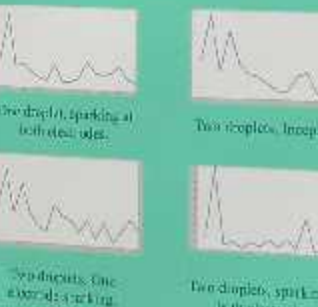
Wavelet transform analysis of the resulting scalograms:



Power Spectra



Harmonic Distortion Plots



Conclusion

- High frequency content exists throughout the discharge. These high frequencies are of the order of 100 kHz.
- As the number of droplets increases, the high frequency content becomes more prominent.
- Harmonic distortion also increases with voltage applied.
- The third harmonic appeared to be dominant, except the three-droplet case, where the second harmonic was dominant.
- The number of droplets, higher than 10 and 12th harmonics, become prominent.

Reference

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National Conference on Recent Trends in Power Engineering
 Indian Institute of Technology Madras, Chennai 600 036, India.
 29-30 December 2015

PED002

Field Computation of Efficiency of an Induction Machine Working on Unbalanced Conditions using Modified Non-Intrusive Air-Gap Method

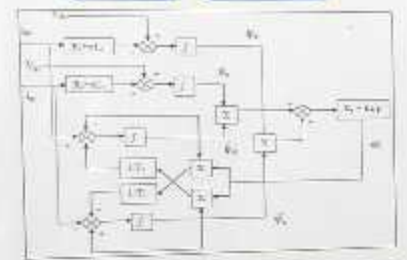
G. S. Grewal and B. S. Rajpurohit
 School of Computing & Electrical Engineering, Indian Institute of Technology Mandi, Mandi-175001, Himachal Pradesh, India

Introduction



Methods

MRAS for Speed Estimation
 (based on Landau concept on adaptation mechanism)



Modified Non-Intrusive Air-Gap Torque Method for Efficiency Estimation

Using Parks transformations in stationary reference frame, torque is given by

$$T_{air-gap} = \frac{\sqrt{3}P}{6} \int [(I_a - I_b)] \left[(V_{ca} + R_s(2I_a + I_b))dt + (2I_a + I_b) \int (V_{ab} - R_s(I_a - I_b))dt \right]$$

Case 1: IEEE Std. 112, F&W loss = 1.2% of rated O/P & SLL = 1.8% of rated O/P

$$S_{LL} = P_{in} \times \{0.025 - 0.005 \log_{10} \left(\frac{P_{out}}{1000} \right)\}$$

Experimental Setup

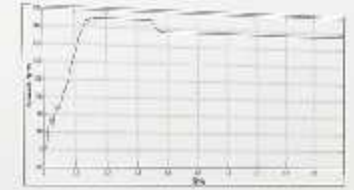
- For 45.8% unbalancing, Vab = 408 Volts, Vbc = 380 Volts & Vca = 400 Volts i.e. 5% Unbalancing.
 - For 55.78% loading, Vab = 392 Volts, Vbc = 366 Volts & Vca = 382 Volts.
- *Phasor computations are not required.



Results & Discussion

Speed estimation

Speed using MRAS	Speed using optical tachometer
1370 rpm	1394 rpm



Efficiency Estimation

% Load	Operating condition	Speed (rpm)	IEEE Standard 112 Method (Case 1) Efficiency (%)	IEEE Standard 112 Method (Case 1) Torque (Nm)	IEC 60034-2-1: 2007 (Case 2) Efficiency (%)	IEC 60034-2-1: 2007 (Case 2) Torque (Nm)
67.2	Balanced	1384	63.92	4.382	60.73	4.87
79.45	Balanced	1370	77.25	5.2196	73.67	4.87
96.1	Balanced	1328	80.51	3.843	75.38	3.37
45.8	Unbalanced	1489	71.59	3.1402	65.10	2.867
55.78	Unbalanced	1383	64.54	2.645	58.37	2.318

IM Parameters

Resistance R1	2.175 Ω
Resistance R2	12.224 Ω
Inductance L1	1.239 mH
Inductance L2	14.352 mH
Inductance Lm	146.375 mH

IM Nameplate

Voltage	415 Volts	Power factor	0.81
Power	2.2 kW	Efficiency	0.75
Current	2.45 A	Speed	1400 rpm
Efficiency	0.75	Speed	1400 rpm

Conclusions

Proposed Non-Intrusive Air-Gap Method is advantageous

- Torque sensor is eliminated
- No load test is not required
- Relies only on electrical terminal quantities
- No obvious error for nameplate inaccuracies
- Reduces the downtime of IM



Understanding the Surface Discharge Activity of Copper Sulphide Diffusion in Oil Impregnated Pressboard Material under AC Voltage

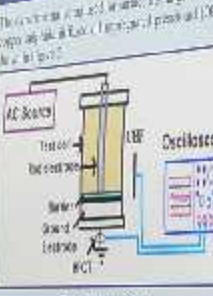
J. Sundara Rajan
R & D Management Division
Central Power Research Institute

K. Ganiga Venkat R. Suresh
Assistant Professor, Electrical Engineering Department
Central Power Research Institute

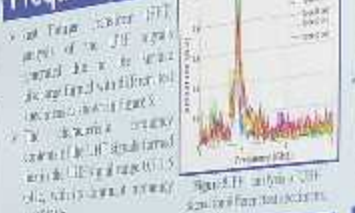
Introduction

The objective of this work is to study the surface discharge activity of oil impregnated pressboard (OIP) material under AC voltage. The study is carried out using a specially designed experimental setup. The results show that the surface discharge activity increases with the increase in the frequency of the AC voltage.

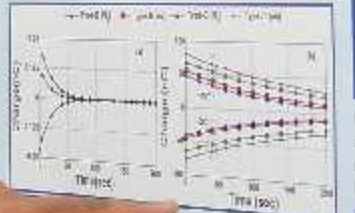
Experimental Setup



Frequency Domain Analysis



Analysis of Surface Charge Accumulation of OIP Material



Sample Preparation

The samples were prepared by impregnating the pressboard material with oil. The impregnation was carried out in a vacuum oven at 100°C for 24 hours. The samples were then cooled to room temperature and stored in a desiccator.

Surface Discharge Characteristics of OIP Material



To understand the charge deposition characteristics with the copper sulphide diffused pressboard insulation, the charges were deposited by corona discharge process to the surface of the pressboard under AC voltages, positive and negative DC voltages) to occur and the charges were allowed to spread over the insulating material. The deposited charges were measured using electrostatic voltmeter.

Energy Dispersive Spectrometry Studies

Table 1: Elemental Analysis using EDS technique for OIP test specimens in air and N₂ atmosphere

Typical Sample	C	N	S	O	air
Type A	5.18	0.12	0.14	0.2	
Type B	5.17	0.4	0.1	0.09	
Type C	10.02	0.02	0.07	0.08	

It was observed that with increase in ageing temperature the amount of copper and sulphur content has increased in both the atmospheres. The amount of copper and sulphur content on OIP is high in air atmosphere compare to N₂.

Conclusions

- The SWV and decay rate is decreasing with increasing thermal ageing duration due to the due to high thermal stress, chemical bonds in oil and cellulose in pressboard insulation break forming new molecules and acidic residues thereby accelerating further the degradation process of cellulose material.
- The SWV and decay rate is less in air atmosphere compare to Nitrogen because the amount of Copper sulphide diffusion is more pronounced in air atmosphere compare to Nitrogen.
- EDS studies confirm the level of diffusion of copper sulphide on the surface of OIP is more in air atmosphere compare to N₂. The amount of copper, sulphur content has increased in both atmospheres with increase in duration of ageing.

References

1. K. Ganiga Venkat R. Suresh, J. Sundara Rajan, "Understanding the Surface Discharge Activity of Copper Sulphide Diffusion in Oil Impregnated Pressboard Material under AC Voltage", *Journal of Electrical Engineering*, Vol. 14, pp. 201-204, 2019.

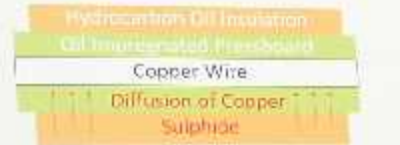




Accelerated Aging Study to Understand Chemical Changes in Transformer Insulation Oil and Pressboard in the Presence of Sulphur

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^{*}Department of Chemical Engineering and [†]Department of Electrical Engineering, Indian Institute of Technology Madras, Chennai - 600036, India
 Email: *ch131086@small.iitm.ac.in, †vinu@iitm.ac.in, ‡sarathi@ee.iitm.ac.in

Introduction



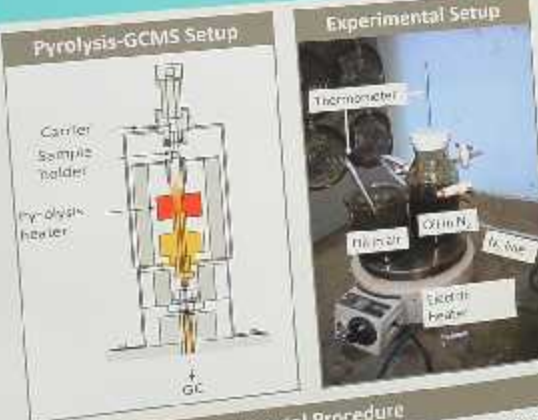
Schematic diagram of transformer insulation

- Transformers use hydrocarbon oil (transformer oil) as insulation with Oil Impregnated Pressboard (OIP) as spacer material between copper windings.
- It is claimed that Copper Sulphide forms in the transformer oil due to presence of Sulphur-containing impurities^[1]
- It can alter chemical composition of transformer oil and affect its insulation characteristics
- Diffusion of Copper Sulphide into OIP^[2] also affects its insulating properties and has been identified by recent studies to be a major threat to the operational lifetime of a transformer^[3]

Objective

To understand the process of Copper Sulphide formation in the transformer oil and the chemical changes induced by it in both in the oil and OIP

Experiments



Experimental Procedure

- Pressboard samples (4cm x 4cm) encased in copper strips were immersed in transformer oil containing 1000 ppm Dibenzyl Disulphide. Accelerated aging was done in nitrogen and air atmospheres at 140 °C. Oil and OIP samples were collected every ~100 hours for chemical analysis^[2]
- Chemical analysis of aged transformer oil was done by Gas Chromatography/Mass Spectrometry (GCMS). The temperature program used for GC is: start at 40 °C, ramp at 4 °C/minute up to 280 °C and maintain at final temperature for 3 minutes
- Chemical Analysis of aged OIP was done using a combination of Pyrolysis-GCMS. Pyrolysis temperature was set as 500 °C. The heating program used for GC is: maintain at 40 °C for 3 minutes, ramp at 5 °C/minute up to 130 °C, ramp at 20 °C/minute up to 250 °C and maintain at 250 °C for 3 minutes

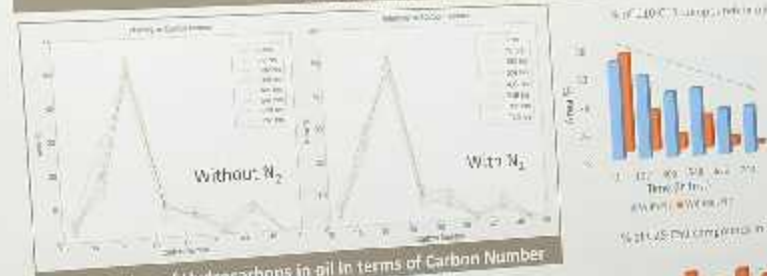
Results

Accelerated Aging Study



- Deposition of Copper Sulphide on pressboard and change in oil colour is more pronounced in the presence of air suggesting catalyzed oxidation of Cu by O₂

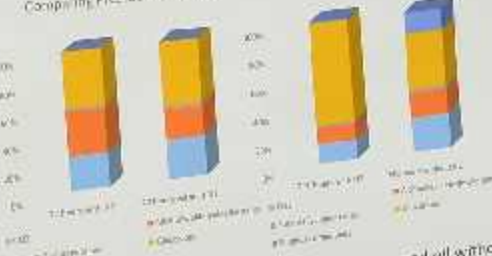
GCMS Analysis of Aged Samples



Distribution of Hydrocarbons in oil in terms of Carbon Number

There is a slight polymerization (increase in carbon number) of compounds in transformer oil with time that is catalyzed by Copper Sulphide. This effect is higher in the presence of O₂ (without N₂ case) due to ability of O₂ to accelerate oxidation of copper to form Copper Sulphide.

Comparing Pressboard Samples



- There is significant sulphur content in 740 hrs. aged oil without N₂ as compared to with N₂ case
 - Yield of glucosides obtained from cellulose decomposition is low in 740 hrs. aged pressboard without N₂ as compared to with N₂ case
- These suggest that Copper Sulphide diffuses into pressboard and catalyses degradation of cellulose

Conclusions

- Copper Sulphide is formed due to sulphur impurities in oil. Presence of O₂ accelerates the process
- Copper Sulphide catalyses slight polymerization of the transformer oil which may affect its insulation properties
- Copper Sulphide diffuses into the pressboard insulation and can lead to degradation of cellulose that may significantly affect its insulating ability and affect transformer performance

References

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2. N. Aparna, Nilesh J. Vasa, R. Sarathi, J. Sridhar, A. Raju, Feasibility study for detecting copper contaminants in transformer insulation using laser-induced breakdown spectroscopy, Appl. Phys. A: 117,281-288 (2013)

HVE
041

PED067

National Conference on Recent Trends in Power Engineering
 A New Single-Phase Adaptable Voltage Source Inverter



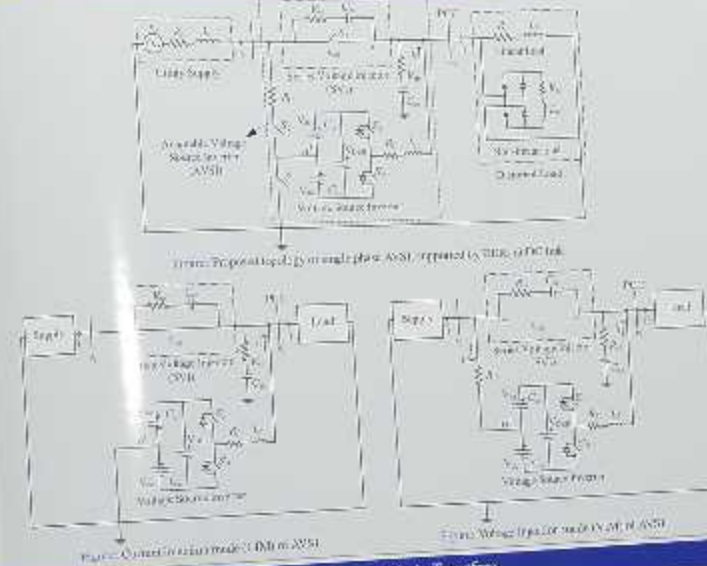
Yousangari Sai Gopal, Student Member, IEEE and Mubashir K. Mubashir, Senior Member, IEEE
 Department of Electrical Engineering, Indian Institute of Technology Madras, Chennai, India.
 Dec 28th 2017, 20:5

Abstract
 This paper presents a novel single-phase adaptable voltage source inverter (AVSI) topology for various load conditions. The proposed topology is able to regulate the output voltage and current by varying the duty cycle of the inverter. The AVSI is designed to be a single-phase inverter with a wide range of output voltage regulation. The proposed topology is able to regulate the output voltage and current by varying the duty cycle of the inverter. The proposed topology is able to regulate the output voltage and current by varying the duty cycle of the inverter.

Existing Solutions to Deal with Voltage Interruptions and their Limitations
 • Stopping of PFC voltage generator and restart of the system. This could cause the operation of the system to be interrupted.
 • Employing a VSI for power regeneration and energy storage. This could cause the operation of the system to be interrupted.
 • Employing a VSI for power regeneration and energy storage. This could cause the operation of the system to be interrupted.

Simulation Results
 The simulation results show the performance of the AVSI in various load conditions. The results show that the AVSI is able to regulate the output voltage and current by varying the duty cycle of the inverter.

AVSI Circuit Diagram and Configurations in Proposed Modes



Control Scheme During Different Modes and During Mode Transfers

Control Scheme During Different Modes and During Mode Transfers
 The control scheme is designed to regulate the output voltage and current. The control scheme is designed to regulate the output voltage and current. The control scheme is designed to regulate the output voltage and current.

Control Scheme During Different Modes and During Mode Transfers
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Control Scheme During Different Modes and During Mode Transfers
 The control scheme is designed to regulate the output voltage and current. The control scheme is designed to regulate the output voltage and current. The control scheme is designed to regulate the output voltage and current.



Conclusions

The proposed AVSI topology is able to regulate the output voltage and current by varying the duty cycle of the inverter. The proposed AVSI topology is able to regulate the output voltage and current by varying the duty cycle of the inverter.

Handwritten notes in blue ink on the whiteboard to the right of the poster.

Grid Adaptive Power Management Strategy for a Renewable Tied Grid using Hybrid Storage



Nikhil Karada, Student Member, IEEE and Nalini K. Viswan, Senior Member, IEEE
Department of Electrical Engineering, Indian Institute of Technology Madras, Chennai, India
National Conference on Recent Trends in Power Engineering
Dec 29th 30th, 2013

Abstract
Increased penetration of distributed generation systems into the distribution bus system poses several power quality operation and safety issues. Most common issue is the supply demand mismatch, for which the need to integrate renewable energy in the distribution bus system. This paper presents a novel adaptive power management strategy for a renewable tied grid using hybrid storage. The proposed strategy is designed to maintain the system voltage and frequency within the limits and also to provide the required power to the load. The proposed strategy is implemented in a real-time digital simulator (RTDS) and the results are compared with the conventional power management strategy. The proposed strategy is implemented in a real-time digital simulator (RTDS) and the results are compared with the conventional power management strategy.

Typical Grid Integrated Microgrid System [1], [2]

Classification of Grid Operating Modes

System Parameters for Experimental Studies

High Gain Converter Parameters	Value
L_1	1 mH
L_2	100 μ H
R_1	0.1 Ω
R_2	0.1 Ω
C_1	220 μ F
Supercapacitor Pack Parameters	Value
Terminal voltage V_{sc}	16.75 V
Max. stack current I_{sc}	225 A
Capacitance C_{sc}	98 F
Max. cell stack current I_{sc}	15 A
No. of parallel stacks	15
Battery Pack Specifications	Values
Terminal voltage V_{bat}	14.4 V
Terminal current I_{bat}	10 A
No. of parallel stacks	15
Utility System Parameters	Values
V_m	230 V (RMS)
f_m	50 Hz
DC and AC Parameters	Values
V_{dc}	1600 V
I_{dc}	10 A

Grid Adaptive Power Management Strategy

Experimental Results

Conclusions
The proposed adaptive power management strategy for a renewable tied grid using hybrid storage is implemented in a real-time digital simulator (RTDS) and the results are compared with the conventional power management strategy. The proposed strategy is implemented in a real-time digital simulator (RTDS) and the results are compared with the conventional power management strategy.

Experimental Setup

References

- [1] P. Kar, S. Kar, and S. Mishra, "A novel adaptive power management strategy for a renewable tied grid using hybrid storage," *IEEE Transactions on Power Electronics*, vol. 28, no. 12, pp. 3000-3010, Dec 2013.
- [2] P. Kar, S. Kar, and S. Mishra, "A novel adaptive power management strategy for a renewable tied grid using hybrid storage," *IEEE Transactions on Power Electronics*, vol. 28, no. 12, pp. 3000-3010, Dec 2013.



PED069

National Conference on Recent Trends in Power Engineering Supervisory Control of a Grid Interactive Microgrid

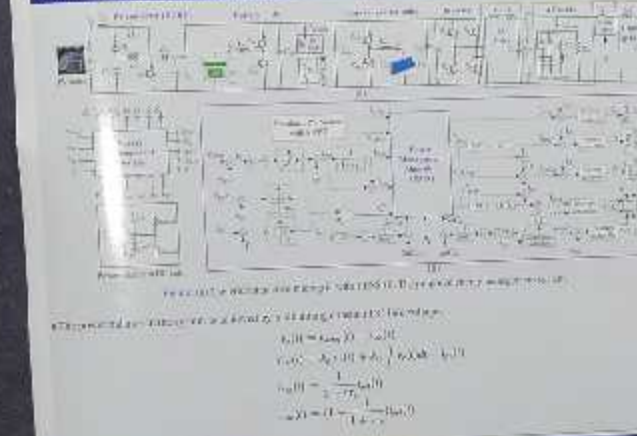


S. Ramesh, K. Mahesh K. Misra, Senior Member, IEEE
Department of Electrical Engineering, Indian Institute of Technology Madras, Chennai, India.
Nov 2015 - Dec 2015

Abstract
This paper presents a supervisory control strategy for a grid interactive microgrid (IGM). The proposed IGM is an autonomous system that can operate in both grid-connected and islanded modes. The IGM is designed to provide a reliable and secure power supply to the local loads. The proposed IGM is designed to provide a reliable and secure power supply to the local loads. The proposed IGM is designed to provide a reliable and secure power supply to the local loads.

Challenges in Proliferation of a Microgrid
• Multiple distributed energy resources (DERs) are connected to the microgrid.
• Multiple DERs are connected to the microgrid.
• Multiple DERs are connected to the microgrid.

Grid Interactive Microgrid and Proposed Control Strategy



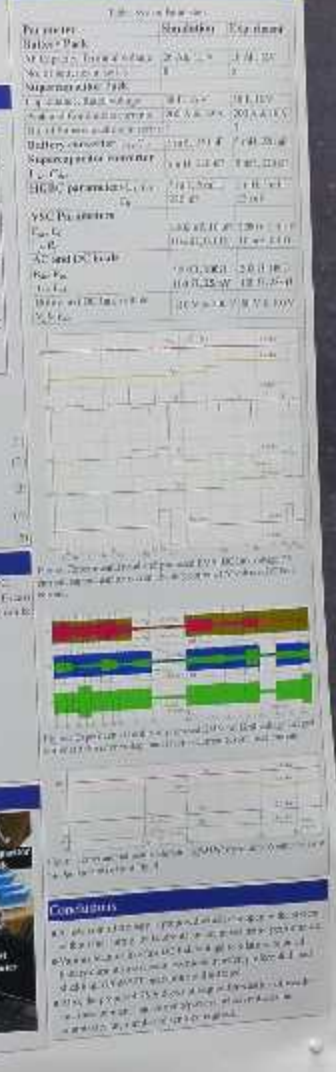
Power Management Algorithm



Experiments Setup



Experimental Results





National Conference on Recent Trends in Power Engineering
 Indian Institute of Technology Madras, Chennai 600 036, India.
 29-30 December 2015



DESIGN AND IMPLEMENTATION OF A SYMMETRICAL MULTILEVEL INVERTER TOPOLOGY

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INTRODUCTION

A traditional CMLI require more number of components and its switching scheme become complex if the number of levels are increased. These issues have been addressed by a new symmetrical MLI topology.

Level shifted bipolar SPWM techniques (POD, PD, APOD) are implemented over the proposed symmetrical seven level inverter topology.

PROPOSED RV TOPOLOGY

The proposed Reverse voltage (RV) topology is divided into two parts as shown in the Fig. 1.

The first part produces positive output voltage wave form (shown in fig.2) by using the switching scheme as shown in table. 1

The second part is a basic H-bridge inverter.

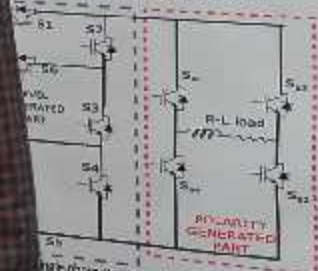


Fig. 1: Single phase structure of a three cell MLI



Fig. 2: Output voltage of level generation part.

V _i Levels	Switching scheme for seven level inverter					
	Switching States					
	Stage 1	Stage 2		Stage 3		
	S ₁	S ₂	S ₃	S ₄	S ₅	S ₆
+3V	1	0	0	0	0	1
+2V	0	1	1	0	0	1
+1V	0	1	0	1	0	1
0V	0	1	0	1	1	0

SIMULATION & EXPERIMENTAL RESULTS

Output voltages of RV topology are depicted in fig.3 based on simulated parameters: V_{dc} = 100V, R= 100Ω, L= 10mH, m_a = 0.9 and m_t = 25

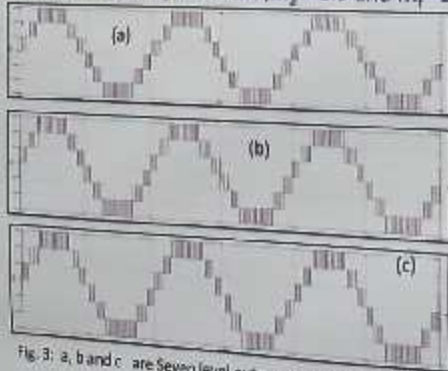


Fig. 3: a, b and c are Seven level output voltages of PO, PDD and APCD Techniques respectively

Relationship among modulation Index, %THD and output voltage for the proposed work are depicted in fig.4a, fig.4b.

The experimental results are shown in fig.5 based on resistive load of 1KΩ, 1 K Watt rating.

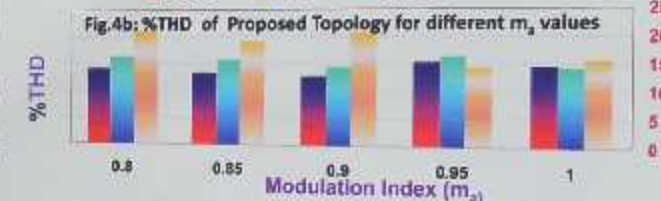
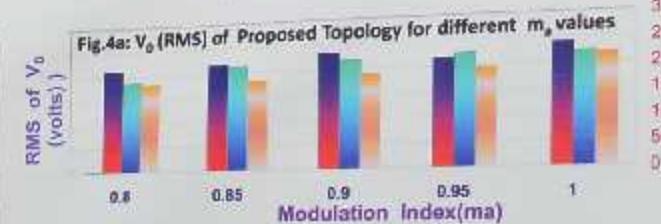
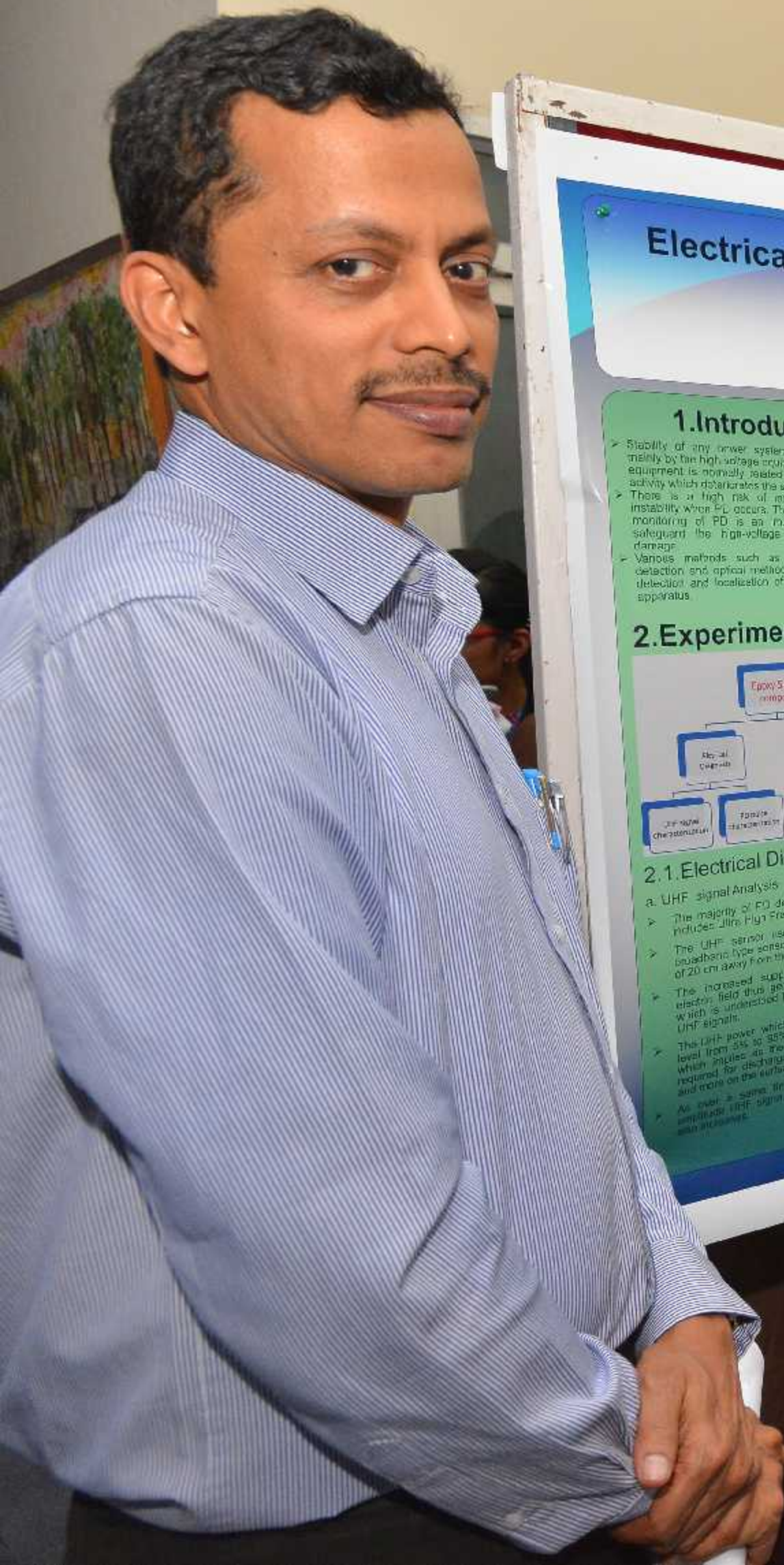


Fig. 5: (a), (b) are Photograph of prototype and Output voltage of proposed Topology respectively

CONCLUSION

- In this project, the proposed topology is simulated with different level shifted bipolar SPWM techniques.
- This modified topology perform better for POD technique than PD and APOD techniques



Electrical and Physicochemical Properties of Epoxy Sic Nano composites

HVE038

Animesh Sahoo R.Sarathi and R.Jayaganthan
Indian Institute Of Technology, Madras



1. Introduction

- Stability of any power system network is determined mainly by the high voltage equipment used. Failure of this equipment is normally related to partial discharge (PD) activity which deteriorates the system performance.
- There is a high risk of insulation system dielectric instability when PD occurs. Therefore, measurement and monitoring of PD is an important preventive tool to safeguard the high-voltage equipment from various damage.
- Various methods such as electrical, acoustic, UHF detection and optical methods have been proposed for detection and localization of PD in high voltage power apparatus.

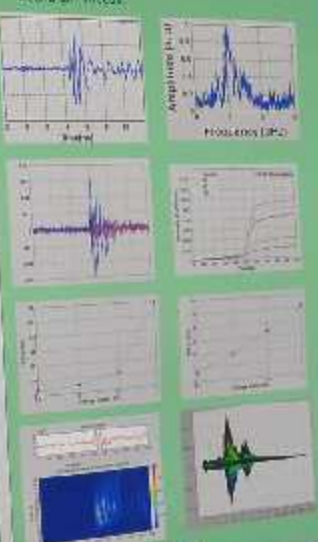
2. Experimental Study



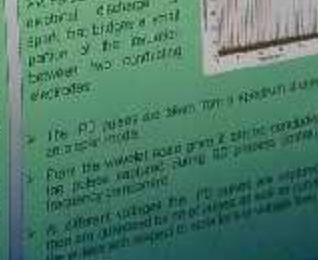
2.1. Electrical Diagnosis

- a. UHF signal Analysis
- The majority of PD detection systems that are used includes Ultra High Frequency (UHF) technique.
 - The UHF sensor used in the present study is a broadband type sensor, which is placed at a distance of 20 cm away from the test cell.
 - The increased supply voltage enhances the electric field thus generating more electrons, and as a result, the intensity of the UHF signal increases.
 - The UHF power, which is the transition of the intensity level from 5% to 95% of peak value also increases which implies that the voltage increase is directly related to the change in the intensity of the signal.
 - As over a same time window, the peak to peak amplitude of UHF signal, is increasing the RMS value also increases.

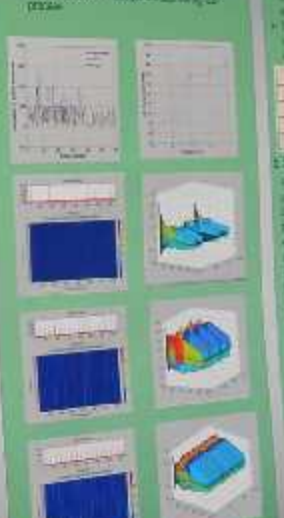
Wavelet Transform analysis of UHF is showing there is not variation in the frequency content during the discharges process.



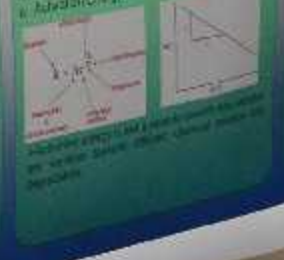
b. PD pulse Characterization



The PD pulse magnitude is increasing with voltage which implies that the magnitude of applied voltage is a major factor in determining the magnitude of the PD signal.



2.2. Physicochemical Diagnosis



3. Conclusion

- The UHF PD signal is used for the detection and localization of PD in high voltage power apparatus.
- The UHF PD signal is used for the detection and localization of PD in high voltage power apparatus.

References

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- IEEE Std C57.12.01-2000, IEEE Standard for General-Insulation Test Procedures for High-Voltage Power Apparatus, 2000.
- IEEE Std C57.12.02-2000, IEEE Standard for General-Partial Discharge Test Procedures for High-Voltage Power Apparatus, 2000.
- IEEE Std C57.12.03-2000, IEEE Standard for General-Overvoltage Test Procedures for High-Voltage Power Apparatus, 2000.
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- IEEE Std C57.12.10-2000, IEEE Standard for General-Interference Test Procedures for High-Voltage Power Apparatus, 2000.





सम्मेलन कक्ष 2
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EATABLES AND DRINKS
NOT PERMITTED INSIDE THE HALL



Behaviour of Water Droplets on Silicon Rubber Insulation Material
Geeta Viveeth, Palash Mishra, R. Sarathi
VIT Institute of Technology, Vellore

Introduction

Experimental Setup

Materials

Procedure

Results

Conclusions

References



National Conference on Recent Trends in Power Engineering Indian Institute of Technology Madras, Chennai 600 036, India. 29-30 December 2015

Insulation Deterioration of Twisted Pairs due to High Frequency Switching of Power Electronic Converters K.Elanseralathan, Narashimarao, B.Amirthavalli, C.Cijith, R.Pravinraj, S.Silambarasan Department of Electrical and Electronics Engineering, Pondicherry Engineering college, Puducherry

Introduction

- In Industries the motor speed is controlled with the help of Power Electronic Converters. But the output waveforms of the PEC's are highly distorted. It is a PWM output, which is a high frequency pulses.
- As the insulation is designed to operate with sinusoidal waveform, the life of insulation will be affected as it is stressed by PWM waveform. So the insulation must be designed in such a way that it should withstand these high distorted waveforms. This work focuses on the insulation test on primary layer of the twisted pair first followed by secondary one.

Methods

- Breakdown voltage test
- Withstand voltage test
- Thickness of primary and secondary insulation are 50 and 100 microns.
- Length of twisted pairs is 12cm and is twisted according to ASTM D 2307 standards



Figure1. Twisted pair samples



Figure2. Test setup for insulation testing

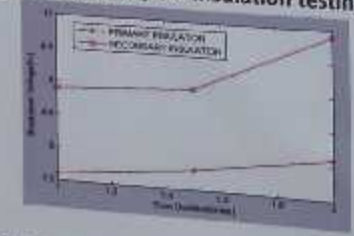


Figure3. Variation of Breakdown voltage between primary and secondary.

Results & Discussion

WIRE SIZE	BREAKDOWN VOLTAGE (KV)	TIME OF FAILURE (HRS)	WIRE SIZE	BREAKDOWN VOLTAGE (KV)	TIME OF FAILURE (HRS)
WITHSTAND VOLTAGE TEST OF MAGNETIC WIRE					
Primary Insulation	4	12	Primary Insulation	10	2.5
Secondary Insulation	6	30	Secondary Insulation	1.2	2
WITHSTAND VOLTAGE TEST OF MAGNETIC WIRE					
Primary Insulation	8	5			
Secondary Insulation	6	12			

- Compare the primary and secondary insulation of magnetic wire is in breakdown test by increasing the voltage gradually. From that we could identify maximum breakdown strength of the magnetic wire. So maximum breakdown strength of the secondary insulation is also measured.
- From withstand test, the maximum time duration of magnetic wire is identified at particular voltage which is found by statistical analysis by applying different voltages. From this, the maximum time duration of wire with both primary and secondary insulation are observed.

Conclusions

- Insulation degradation in electrical drives is due to various stress factors. The major stress factor considered in this study is the switching produced by the power electronic converters. It observed that the degradation is delayed in the secondary compared to primary insulation

References

- Francesco Gustavino, Andrea dardano, "Life Tests on Twisted Pairs in Presence of Partial Discharges: Influence of the Voltage Waveform", IEEE Transactions on Dielectrics and Electrical Insulation Vol.19 pp.45-52, No. 1; February 2012.
- A.Cavalliani, D.Fabiani, and G.C.Montanari, "Power Electronics and Electrical Insulation Systems - Part 1: Phenomenology Overview", IEEE Electrical Insulation Magazine, vol.26 pp.6-14, May/June 2010



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Partial Discharge Characteristics of Synthetic Ester-Pressboard Insulation System: Effect of Conducting Particle

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Introduction (Research Area- High Voltage Engineering)

Properties	Pressboard	Transformer Oil
Origin	Cellulose of highest quality	Paraffinic, naphthalene
Manufacture	Unbleached sulfate Cellulose	extracts from petroleum
Usage	Insulation and mechanical Support	Insulation well as cooling

- Partial discharge (PD)- electrical discharge partially bridges the insulation.
- PD- sign of insulation degradation and root cause of breakdown.
- In order to understand PD- artificial defects were added (i.e. conducting particles-Cu).

Experimental work (two parts)



Figure 1. a) Photos of oil filled cells of pressboard with Cu particles and b) PD experimental setup.

Results & Discussion (PRPD patterns)

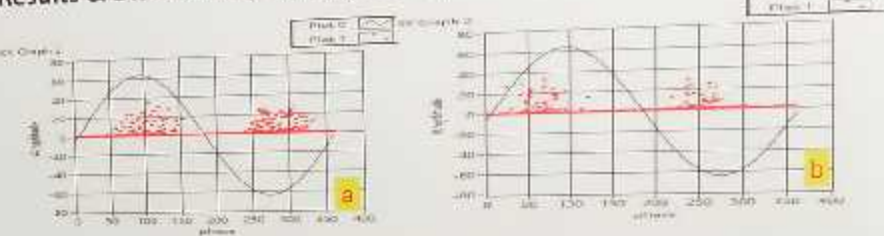


Figure 2. PRPD patterns of pressboard sample with Cu particles (PDIV=13.5kV) a) at centre of electrodes, b) near by earth electrode.

- Two samples- 1. Cu particles at centre of electrodes 2. Cu particle at near by earth electrode
- Measured value- PRPD pattern (Phase resolved partial discharge pattern)

Conclusions

- To check the suitability of synthetic ester for transformer insulation the PD experiment of Synthetic ester-pressboard with Cu particles has been carried out.
- As per the above PD patterns, Cu particles at the centre of the electrodes is having more repetitive pulses than Cu particles at nearby earth electrode.
- This PD patterns are used for condition monitoring of large transformers.

Reference

Sarathi, R., I.P. Merin, Sheema, J. Sundarajan, M.G. Daikas, "Influence of harmonic ac voltage on surface discharge formation in transformer insulation", IEEE Trans. on DEI, vol. 21, No.5, pp. 2183-92, 2014.



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PROJECTING INDUCTION MOTOR AS A BEST SUITABLE
MOTOR FOR ELECTRIC VEHICLE TRACTION APPLICATION

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Dr.S.Sutha
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DINDIGUL, TN, INDIA

Introduction:

- This research work aims to analyze various possibility to project Induction Motor (IM) as a Suitable Drive for Electric Vehicle Traction.

Why Induction Motors:



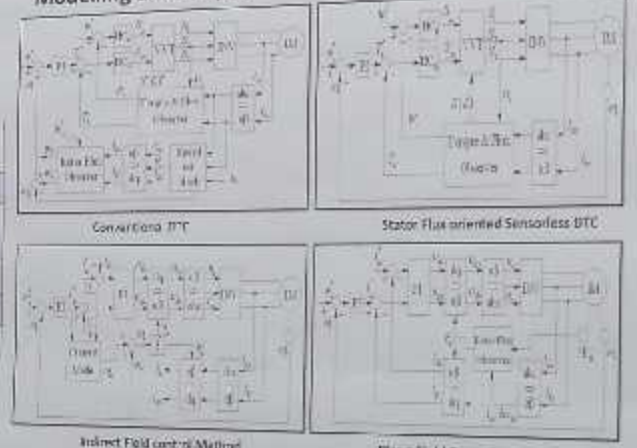
- Free from rare earth material
- Most trusted motor
- High temperature tolerant
- Cost

Methods to achieve IM as best motor for EV:

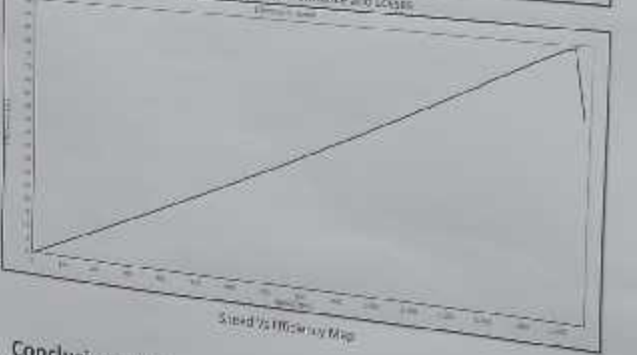


- Finding a separate and specific technology for EV
- Optimizing Independent Variables (10)
- Specific Nonlinear Constraints (15)
- Solid Iron/Steel Core, Laminated Silicon Steel, Amorphous Steel
- M250-35A, M270-50A, M310-50A, M270-35A, etc
- Capable of high fundamental frequencies (200-2500 Hz) and harmonics up to about 25 kHz.
- Additional feet w/standing capacity for new materials.
- High efficiency at low frequency and huge reduction in eddy current loss.
- (Direct & Indirect) DTC and Field oriented control according to requirement and Design nature.

Modelling and Output:



Control	Method	Efficiency	Power Factor	THD	Cost
Conventional	DTC	85%	0.95	5%	Low
Stator Flux oriented	Sensorless DTC	88%	0.98	3%	Medium
Indirect Field Control	Method	90%	0.99	2%	High
Direct Field Control	Method	92%	0.99	1%	Very High



Conclusions of research:

- Induction Motor can perform well if design dedicated to EV propulsion.
- When Control Methods adjusted according to requirement better performance can be achieved.
- Induction Motor provides Economical Advantage over other motors.






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 29-30 December 2015
Development of Quasi Multiple Input Converter for Dynamic Stability of Renewable Systems
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Introduction

- Intermittent renewable source
- Voltage stability of loads
- Simultaneous power transfer from multiple sources to load vs time-multiplexing
- Multiple Input Converter (MIC)

Quasi-MIC

- All sources could be able to drive the load simultaneously but not individually
- Certain inputs are used to aid primary inputs
- Three port system with PV, ultracapacitor and PV source
- Capable of driving the load individually at all conditions
- Ultracapacitor is used to aid the PV source, its generated voltage goes below the load
- On sudden variation in load, the ultracapacitor is used in conjunction with PV to maintain constant voltage
- Transition from normal mode to hybrid mode
- Adjustment of voltage level of source and load



State I **State II**

S_1, D_1, D_2	D_1, D_2
D_1, S_2, S_3	D_1, D_2

Results & Discussion




Figure 2: Mode Transition

- Voltage lift when the switch S_2 is turned ON
- Ultracapacitor aids PV in delivering power to load




Figure 3: Power sharing between ports

- Step variation in load applied
- Input port delivering constant power
- Excess load shouldered by ultracapacitor port
- Spikes could be handled with closed loop control

Conclusion

- An ultracapacitor could be used to aid a PV source as and when required
- Power from each port could be controlled
- Inductor-based hybridization of power sources proposed
- Closed loop control could help in dynamic stability of renewable system
- Could be extended to multiple ports

PED022

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Development of Quasi Multiple Input Converter for Dynamic Stability of Renewable Systems
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PED036



National Conference on Recent Trends in Power Engineering
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29-30 December 2015



A NOVEL TOPOLOGY FOR MULTILEVEL INVERTER BASED ON ASYMMETRIC SOURCE CONFIGURATION

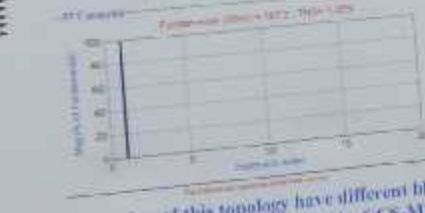
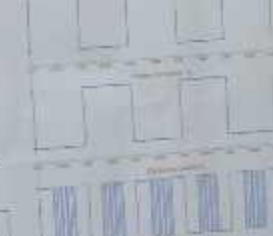
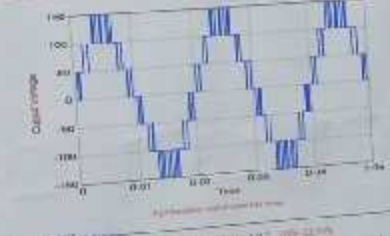
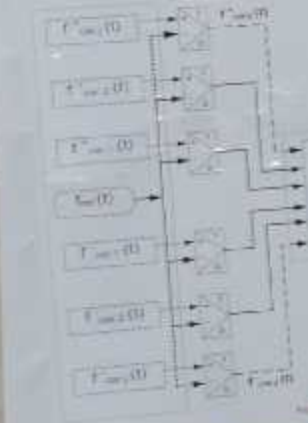
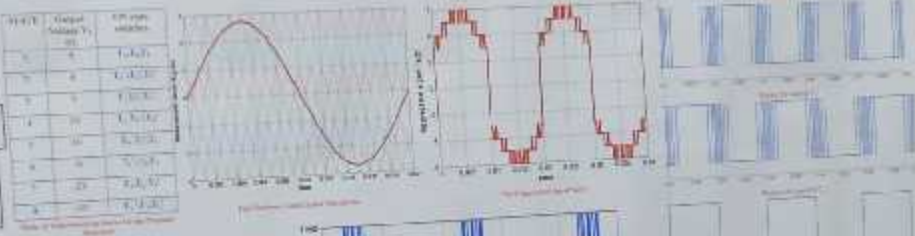
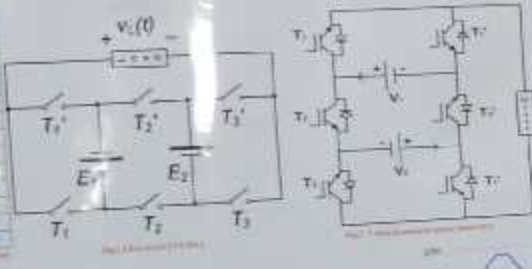
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Abstract - As multilevel inverters are gaining importance, new topologies are being proposed especially for increased number of levels while reducing the number of power switches. In this paper, a seven level asymmetric source based MLI is proposed for the recently proposed 'cross-connected sources based multilevel inverter (CCS-MLI)' topology. While increasing the number of levels in the output voltage, the proposed topology results in same number of power switching device count in the CCS-MLI. In this paper, an explanation of 7-level inverter is presented along with MATLAB/Simulink based simulation results.

Parameter	Level	2-level	3-level	4-level	5-level	6-level	7-level
Number of switches	4	6	8	10	12	14	16
Number of diodes	0	0	0	0	0	0	0
Number of DC sources	1	2	3	4	5	6	7
Number of output levels	3	5	7	9	11	13	15
Number of PWM signals	1	2	3	4	5	6	7
Number of carrier signals	1	2	3	4	5	6	7
Number of modulation signals	1	1	1	1	1	1	1
Number of output filters	1	1	1	1	1	1	1
Number of output inductors	1	1	1	1	1	1	1
Number of output capacitors	1	1	1	1	1	1	1
Number of output resistors	1	1	1	1	1	1	1
Number of output diodes	0	0	0	0	0	0	0
Number of output inductors	1	1	1	1	1	1	1
Number of output capacitors	1	1	1	1	1	1	1
Number of output resistors	1	1	1	1	1	1	1



CONCLUSION - A novel topology for 7-level inverter is proposed. Various switches of this topology have different blocking voltages and it employs asymmetric source configuration for maximization of levels in the output voltage waveform. Here a 7-level asymmetric source based MLI is proposed for the CCS-MLI topology for the increased number of levels in the output voltage waveform. A multicarrier PWM scheme is introduced which helps to optimize the switching frequencies of various power switches with different voltage stresses. Whereas the highest stress bearing switches operate at fundamental frequency and the lowest stress bearing switches operate at carrier frequency. Working of the switching structure is shown with the help of 7-level inverter. Simulation results based on the MATLAB/Simulink are presented to validate the proposed concept.





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Novel load emulation technique for performance evaluation of isolated Solar PV system under varying load conditions

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Introduction

- Performance of Renewable energy Sources are highly dependent upon operating conditions
- Mostly the source side converters are designed for ideal conditions. They give degraded performance under non-ideal conditions like high THD loads, fluctuating source, low power factor etc.
- The effects of load variation can be evaluated using load emulation technique, where a flexible load model is used to create different types of loads
- Load emulation can be done using mechanical systems, power electronic systems, analogue circuits or computer models. Out of which power electronic models are most advantageous for power supply applications.

Effect of load characteristics on Stand alone Solar PV systems

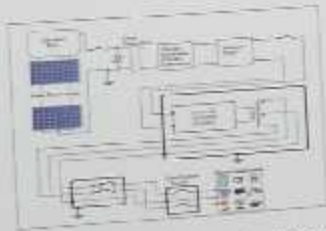


Fig. 1. Typical stand alone solar PV system

- Other than Solar variability, system design and Environmental/climatic conditions, the load variation also influence the performance of SPV systems
- Increase in core losses in transformer based systems
- Increase in current levels hence derating of equipments
- Interference with low voltage signals like control circuits and consequent malfunctioning.
- Components should be over rated to provide the required active power.
- The efficiency of power extraction from solar PV systems is reduced

Load emulation

- Emulation is the process of imitating the behaviour of a particular system using a different working principle
- Using load emulation, the operation of a system under various load conditions can be examined without the need for any electromechanical machinery or the actual load.
- A regenerative load emulator is a controllable sink which can provide a power exchange with either a grid or another power electronic converter system with characteristics as per the requirement of the user

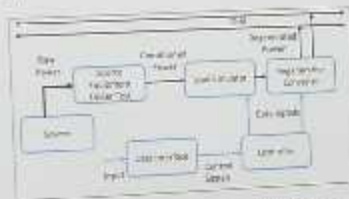


Fig. 2. Block Diagram of load emulation model

- In the proposed model, a new technique for obtaining variable power factor and variable THD load is derived using a decoupled current control method.
- The current is modulated using PWM technique to obtain in phase current, and out of phase current and variable THD

Simulation and Results

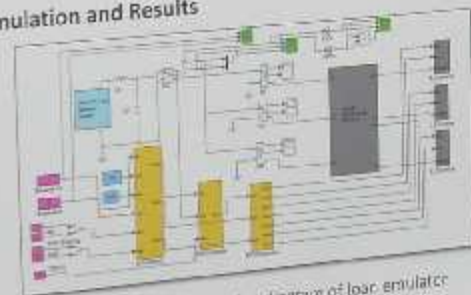


Fig. 3. Overall simulation diagram of load emulator

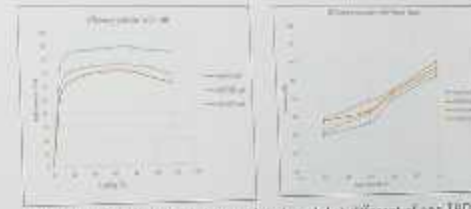


Fig. 4. Case studies using the simulated model at different of THD

- Efficiency is found to decrease as power factor varies from unity to 0.5 lagging.
- Efficiency is found to decrease as THD increases
- The proposed load simulator can provide different power factor and loading conditions as per the requirement
- The results are verified by hardware testing using the setup shown



Fig. 5. Experimental setup for verification of results

Conclusions

- Using the method of load emulation, different types of loads can be realised easily using a single flexible platform
- The simulation results of proposed model is found to be in good agreement with hardware results using actual load
- Unlike actual loading, the energy drawn by the load emulator can be regenerated easily. Hence the losses in testing and the cost can be reduced to a great extent.
- They can be used as virtual load for testing and validation of power electronic applications also.
- Compared to the existing load emulator methods, the proposed method gives more accurate and efficient emulation of variable THD loads.



PED041

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Synchronous Estimation under Dynamic Conditions and its Application in Power

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Optimal Placement and Sizing of Combined DG and Capacitor for Minimization of Power Loss & THD in Distorted Distribution Systems

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Calculation of Corona Generated Ions Currents of Extra High Voltage Transmission Lines Using New Computational Method

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Novel load emulation technique for peaking power in PV system under variable irradiance

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 * Central Power Research Institute, Bangalore,
 ** E&E department, Manipal Institute of Technology, Mysuru


Introduction

- Performance of Renewable energy sources are highly dependent on weather conditions.
- Usually the power rate converter are designed for rated conditions. They give inferior performance under variable conditions like high THD levels, fluctuating irradiance, low power factor etc.
- The effects of load variation can be modeled using load emulation techniques, where a flexible load model is used to create different types of loads.
- Load emulators can be done using mechanical systems, power electronic systems, analog circuits or computer models. Out of which power electronic models are most advantageous for power source applications.

Effect of load characteristics on Stand alone Solar PV systems



Simulation and Results






HVE040

Surface Discharge Activity of Oil Impregnated Pressboard Material under AC Voltage

Introduction

Frequency Domain Analysis

Energy Dispersive Spectrometry Studies

Conclusions

References

FRANKS THE HALL



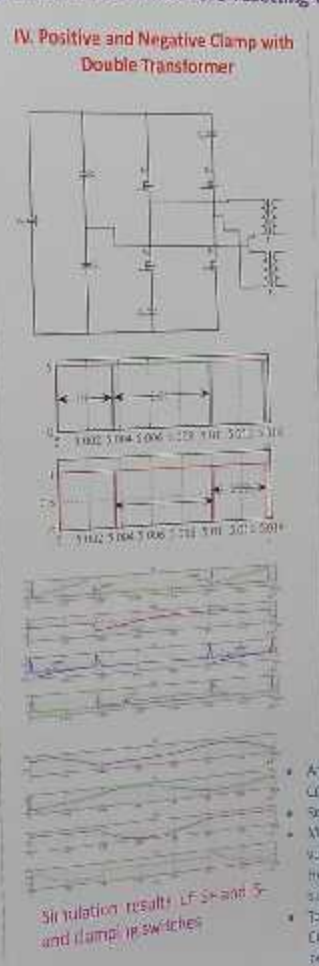
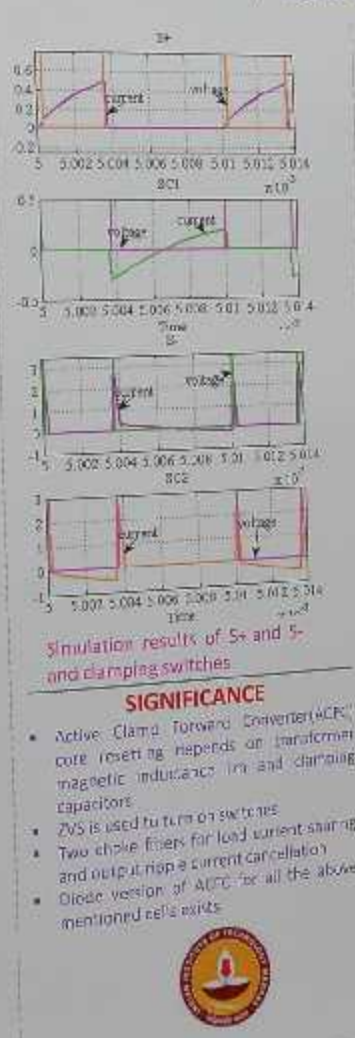
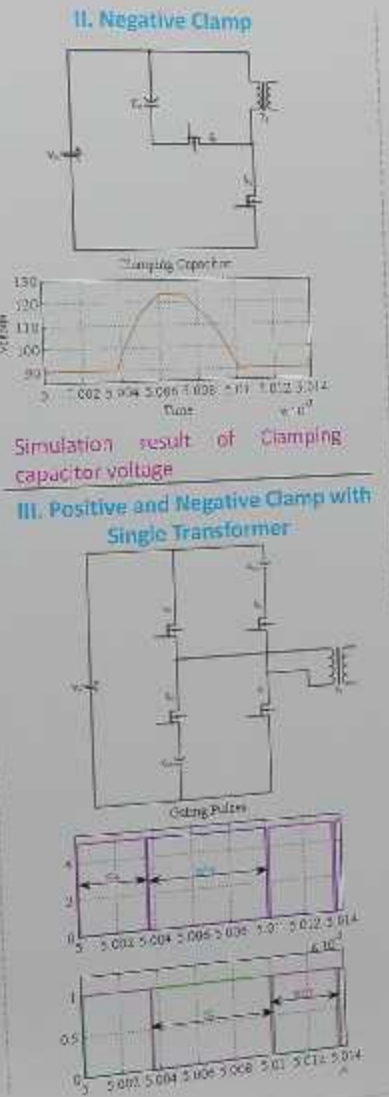
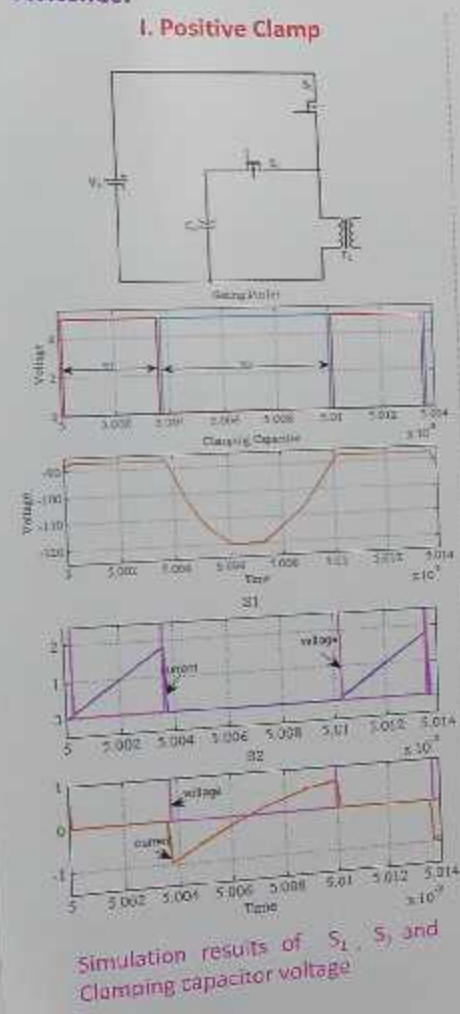


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NOVEL EFFICIENT CORE RESETTEING TECHNIQUES FOR ISOLATED FORWARD CONVERTER

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OBJECTIVE
To analyse various clamping cells like positive, negative and center for an isolated forward topology to optimize transformer core resetting and to enhance ZVS operation of switches.



CONCLUSIONS

- Active clamp cell, Center clamp converter reduces switching loss and EMI.
- Reduces loss.
- Multi-phase interleaved power converter with voltage high current inductors. The interleaved converter suitable for low-voltage power supplies.
- To increase high power density, soft-switching clamp converter with soft diode $S_{1/2}$ $S_{2/2}$ is recommended.

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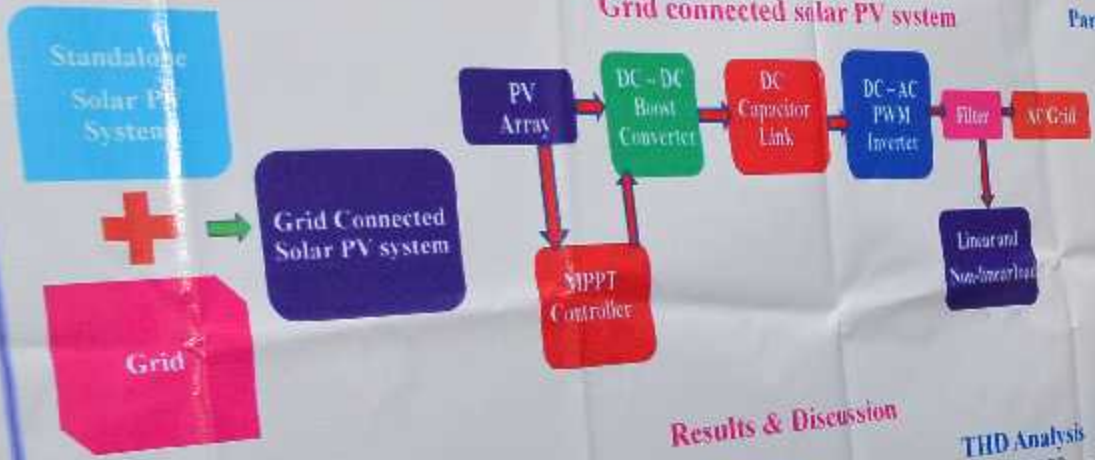
PSE025

Harmonic Analysis in Grid connected Solar Photovoltaic system

Vigneswari M
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Dr. Kalyani S
 Kamaraj College of Engg & Tech, Virudhunagar

Introduction

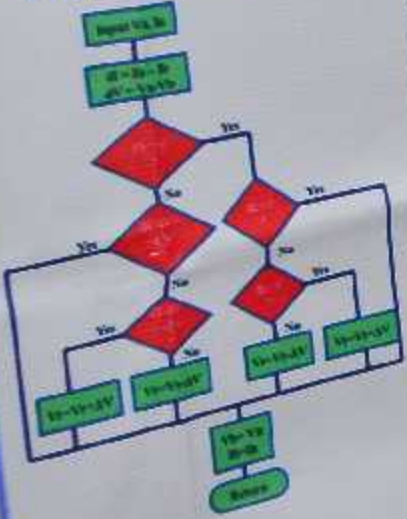


Parameter of the PV Cell in MATLAB/Simulink Mode

Parameter	Value
Current at Maximum Power	4.85A
Voltage at Maximum Power	35.2V
Circuit Voltage	44.2V
Circuit Voltage	52A
Coefficient of Short-Circuit Current	0.056%
Coefficient of Open-Circuit Voltage	0.7
Series Resistance	0
Shunt Resistance	1
Temperature	25

Results & Discussion

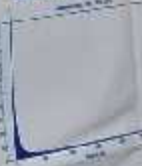
MPPT Algorithm



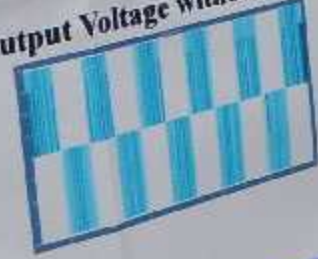
PV Cell Characteristics



THD Analysis



Output Voltage without filter



Output Voltage with filter



Conclusion

- Incremental conductance method used to track the maximum power.
- PWM based DC-AC inverter used to convert the DC to AC.
- Passive filter with inductor and capacitor used to minimize the harmonics in the output voltage.
- The THD of the output voltage is reduced to 3%.



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PSE011

FAULT DETECTION AND IDENTIFICATION ON SMART GRID BY USING SYNCHRONIZED MEASUREMENT UNIT

Keerthana.G¹ Dr.Umayal.SP²

¹PG scholar Muthayammal Engineering College,Rasipuram ²Professor and Dean Muthayammal Engineering College,Rasipuram.

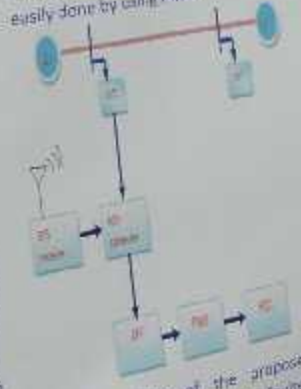
INTRODUCTION

The electric power system is complex man made system which should be reliable and supply electrical energy continuously without any interruption. Black out and outage in the system is to be avoided. One recently used technique is WAMPAC with time synchronized measurement. The main technology used in it is PMU and is most precise and advanced technology. It gives information about the current and voltage phasor, frequency, rate of change of frequency all this information is synchronized with high accuracy to a common reference time provided by GPS. Its operation is based on mathematical measurement algorithm. This work uses synchronized phasor measurement technology for power system real time monitoring, advanced network protection and control schemes. PMU facilitate innovative solution to traditional utility problems and offer power system engineer a whole range of potential benefits including precise estimates of power system states are obtained through GPS synchronization, it also helps to analyze the vulnerability of system against any contingency. This technology has been made possible by advancement in computer and processing technologies. We have designed this PMU model in MATLAB SIMULINK and validated in IEEE 9 bus system using MATLAB SIMULINK model.

PROPOSED TECHNIQUE

Synchrophasor vector processor allows us to use synchronized phasor data from various phasor measurement and control unit and relays, transmit data over Ethernet to other clients. This can provide a mechanism for collecting and time correlating synchrophasor data from as many as 20 PMU.

In PDC we can connect more than 500 PMU inputs with message rates up to 240 per second. Combine data multiple input message rates into a single output stream. Control downstream access with six individually configurable output streams. Wide area protection is easily done by using PMU.



The main idea of the proposed technique is to identify the faulted area. This is achieved by comparing the measured values at the positive sequence voltage magnitude at the main bus for each area. The minimum voltage value indicates the nearest area to the fault.

$$V_{n1} = \frac{1}{\sqrt{3}} (V_1 + a^2 V_2 + a V_3)$$

Where V_{n1} is the positive sequence voltage magnitude measured by PMU and located area 1, 2, ...n.

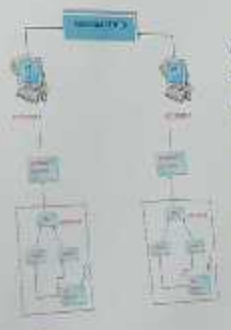
The absolute difference of positive sequence current angles are calculated for all lines connected with faulted area. These absolute angle difference values are searched to identify the faulted line. To find the faulted line we should compare the absolute difference of positive sequence current angles for all line connecting faulted area with all other neighboring area and then selecting the maximum one that can be explained as:

$$\text{Max}(|\Delta\theta_{n1}|, |\Delta\theta_{n2}|, \dots, |\Delta\theta_{nn}|)$$

When $|\Delta\theta_{n1}|$ is the absolute difference of positive sequence current angle for a transmission line connecting faulted area, 'n' with area '1', this can be described by the following equation:

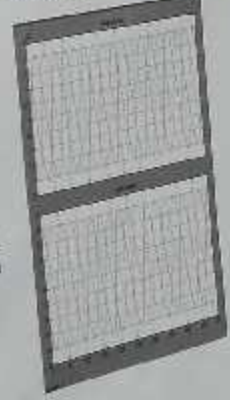
$$|\Delta\theta_{n1}| = |\theta_{n1} - \theta_{p1}|$$

PMU converts the analog voltage current signals to digital samples synchronized in time of measuring the discrete Fourier transform method. Inside PMU calculates the positive sequence voltage and current phasors.

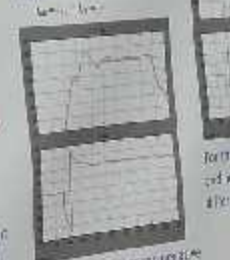


RESULTS AND DISCUSSION

During normal condition before the fault occurs the waveform of voltage and current will be as shown in Figure 1.



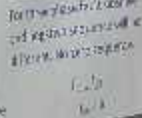
Comparing the positive sequence and zero sequence we can identify which types of fault occurred on the selected bus bar. For single line to ground fault, all sequence positive, negative and zero sequence is same.



For all types of faults, the magnitude of the zero sequence current is not zero.



The zero sequence current is not zero for phase-to-phase fault.



For the fault/ faulted bus and region, the voltage will be zero. Hence, it is region.



For the fault/ faulted bus and region, the voltage will be zero. Hence, it is region.



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A UNIFIED INHERENT COMPENSATION TECHNIQUE FOR VOLTAGE AND PHASE UNBALANCE WITHOUT USING SEPARATE DC SOURCE

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 M.K. Ilampooman,
 R. Jyothsna,
 National Engineering College, Chennai, Anna Institute of Technology, Chennai, Akshaya College of Engineering, Kancheepuram

Introduction

- Voltage Sag - Momentary voltage sags between 0.1 to 0.9 pu, for duration 0.5 cycle to 1 min.
- Voltage Unbalance - The rms values of the voltages or the phase angles of the voltages are not equal.
- Conventional compensation based on energy storage device with a series-connected voltage source inverter is not adequate for compensating high voltage sag or unbalance.

Compensation by AC Chopper

A new topology is proposed, which is able to provide voltage sag or unbalance compensation.

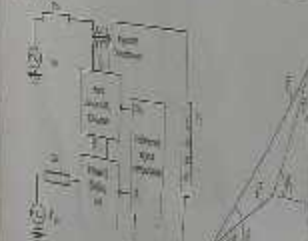


Fig. 1. Proposed topology for voltage sag or unbalance compensation.

Phase shifting is required to provide voltage sag or unbalance compensation.

In the proposed topology, the phase angle of the output voltage is adjusted by the phase angle of the compensating voltage.

The magnitude of the output voltage is adjusted by the magnitude of the compensating voltage.

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- converts fixed mains voltage directly to variable alternating voltage
- The output to input voltage ratio of AC-AC Chopper is given by,

$$V_{co} = \frac{2}{\pi} V_{ci}$$

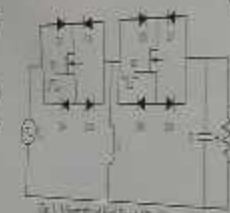


Fig. 2. Conventional AC-AC Chopper.

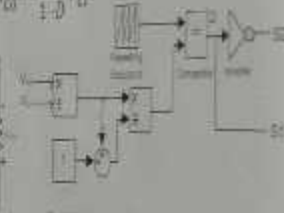


Fig. 3. Duty cycle control for AC Chopper.

Simulation Results



Fig. 4. Input voltage and compensating voltage.



Fig. 5. Simulation of single phase compensation & Source voltage (V_{ci} = 230V, 50Hz) with magnitude & phase unbalance.

- Input voltage to chopper ($V_{ci} = 100\angle -27.52^\circ$) is obtained by shifting phase-d voltage (V_{ci}) as shown in Fig. 5(b).
- Fig. 6(a) shows the compensating voltage ($V_{co} = 69.57\angle -27.52^\circ$) injected by AC Chopper.
- The phasor addition results in magnitude and phase adjusted output voltage as shown in Fig. 6(b).

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Conclusions

- The simulation of proposed topology was done in MATLAB and the results were found satisfactory. Experimental setup can be modeled for validating the simulation results.

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Feasibility of V2G Ideology in Developing Economy: Impact, Analysis and Operation
 Md. Samar Ahmad and S. Sivasubramani
 Indian Institute of Technology Patna, India

Abstract: Power shortage or shortage to meet the system electrical power demand is one of the major problems faced by power sectors operating in developing economies. This paper presents a study on the feasibility of V2G ideology in developing countries. The system demand is compared with its generation limit. Shortage of power, forced the end users to install emergency power capacity to meet its higher priority needs. These IBKs storage units operate independently from system with the only objective of power supply to end users in order to meet its higher priority needs. These IBKs storage units operate independently from system with the only objective of power supply to end users in order to meet its higher priority needs. These IBKs storage units operate independently from system with the only objective of power supply to end users in order to meet its higher priority needs.

Problem of Uncontrolled Charging:
 1. Operation of any power infrastructure is limited by its maximum generation capacity.
 2. When power demand is exceeded by supply, the network is limited by disconnection of loads.
 3. Load shedding reduces the system demand within generation limits.
 4. Demand exceeds generation at 12:00, 13:00, 19:00 to 21:00 hours due to charging loads.
 5. Hour 12:00 was within limit but under IBKs charging effect, its demand exceeds.



Controlled Operation of IBKs:
Case 1: Delayed Charging
 1. Load Shedding Schedule signal is issued beforehand.
 2. IBKs delay charging and charging scheme i.e. delay charging.
 3. Charging Power demand is reduced.
 4. Only hour 12:00 and 19:00 hours require rescheduling of load shedding.
 5. IBKs governing equation:

$$P_{max} = \sum_{i=1}^{10} (P_i + \sum_{j=1}^{30} P_{max(i,j)} \Delta U_j / U_j)$$

$$0.9 \geq \Delta U \text{ (State of charge } \geq 0.9 \text{; For V2G)}$$

$$\xi \geq 0.15 \text{ (For inverter mode } \xi \geq 0.1)$$



Conclusion:
 • Charging demand can exceed the peak power due to surplus demand for storage after load shedding.
 • Delayed charging can help in reduction of peak demand but not sufficient enough to cope with peak power.
 • Smart operation of IBKs help in reduction of frequency of load shedding e.g. area 2 load now with 3 hours of load shedding but earlier load shedding was done for 12 hour but is now reduced to 8 hours only.

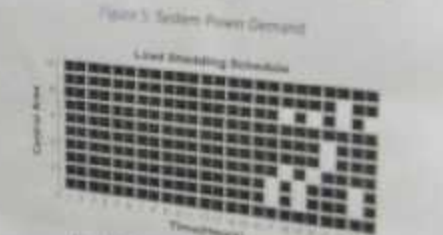
Forthcoming Research:
 • IBKs can help V2G in developing countries.
 • IBKs infrastructure form a base for future V2G.
 • IBKs acts as fast reserve.
 • IBKs capacity can be increase if users participate for power market profit as in V2G market.

Case 2: V2G Ideological Operation
 1. Smart operation of IBKs is controlled by system operator as V2G.
 2. Load Shedding process is optimized with IBKs charging demand.
 3. Problem is Converted into optimization problem of minimization:

$$\text{Min } P_{max} = \sum_{i=1}^{10} (P_i + \sum_{j=1}^{30} P_{max(i,j)} \Delta U_j / U_j)$$

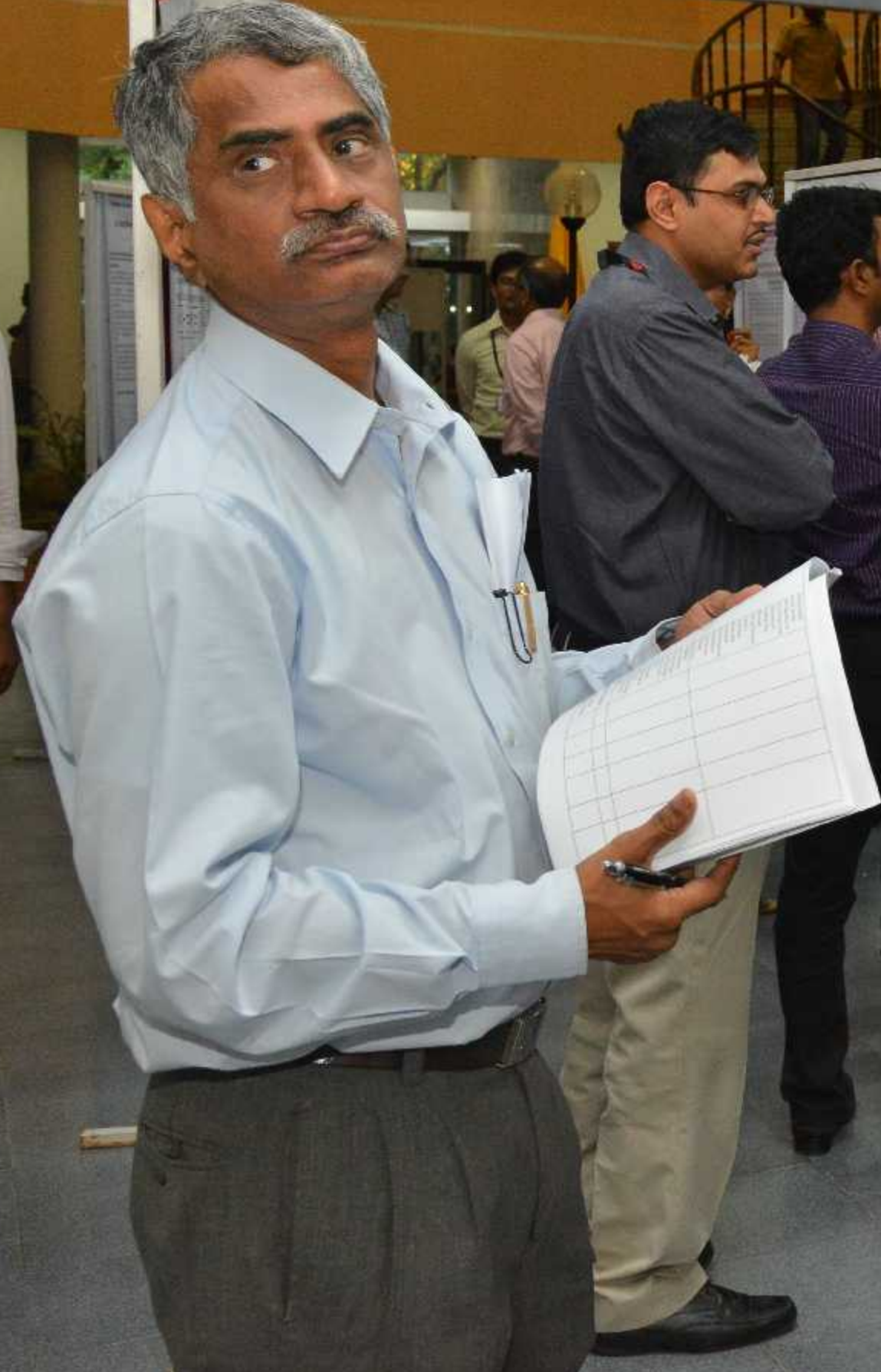
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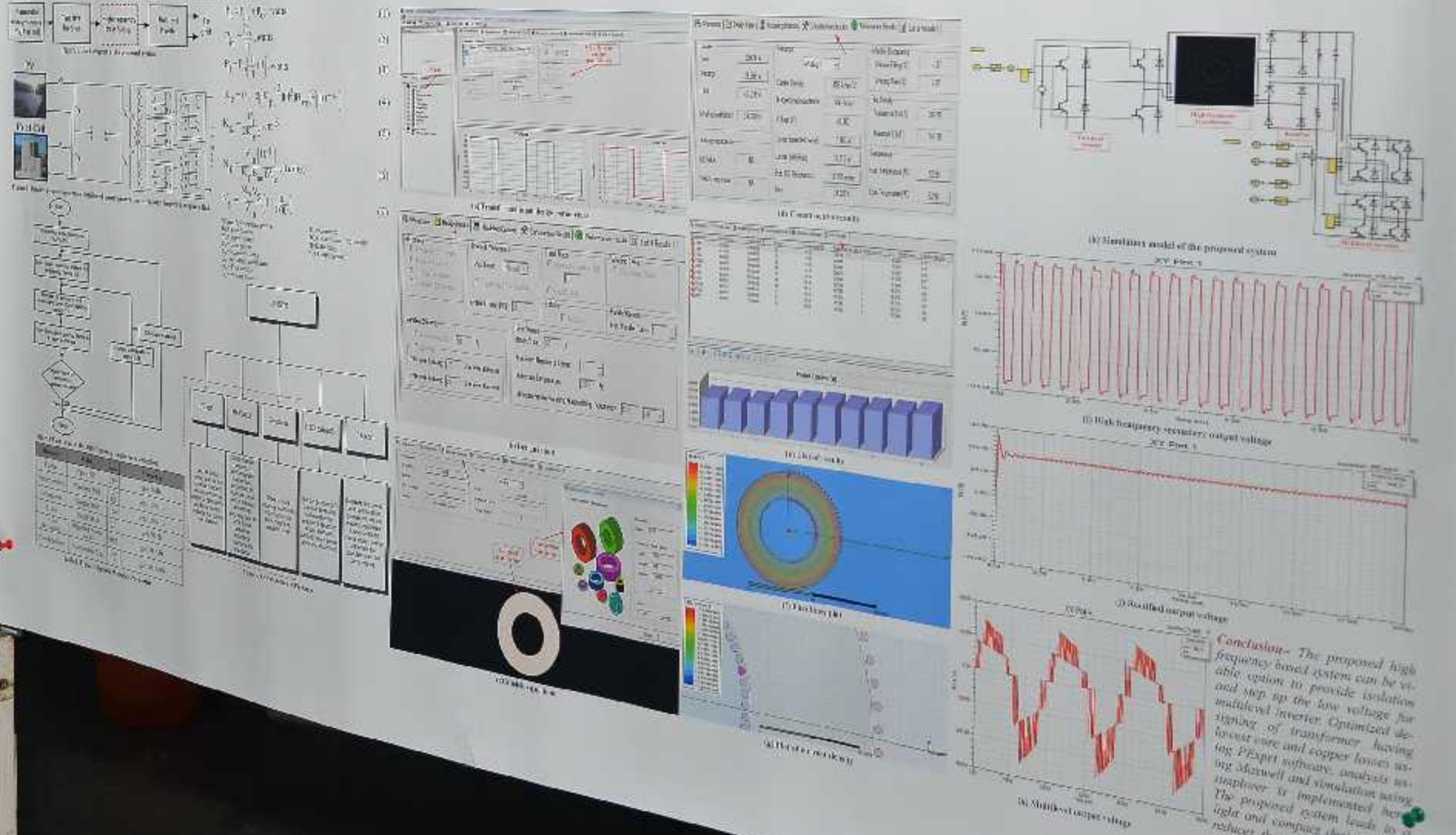


ANSYS-Maxwell based Design of High Frequency Link for Grid Connection of Renewable Energy Sources using MLI

Rekha Agrawal
Student, MANIT Bhopal, MP, India

Shailendra Jain
Professor, MANIT Bhopal, MP, India

Abstract Currently, high frequency transformer for power MLI is used for renewable energy interfacing applications. With the advancement in magnetic materials properties have led to the development of high frequency transformers for converters. Recently high frequency based magnetic material offers high saturation flux density and low core losses, used for designing of compact, light weight and efficient transformers. However, the designing of magnetic material is based on electro-magnetic concepts. So here, electro magnetic based software "ANSYS-Maxwell" is used to design a high frequency transformer in 2-D geometry. The design methodology is illustrated to optimize it with minimum core losses, copper losses in the high frequency transformer.



Conclusion- The proposed high frequency based system can be viable option to provide isolation and step up the low voltage for starting of transformer. Optimized design of transformer having lowest core and copper losses using FEMPT software, analysis using Maxwell and simulation using Ansoft is implemented using the proposed system leads to a light and compact design, which reduces the system size, installation area and cost.





GENTS



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A Systematic Approach towards Developing Proto- type AMI based DSM Model for Load Management

MANJU GUPTA¹, SUSHMA GUPTA², TRIPTA THAKUR³

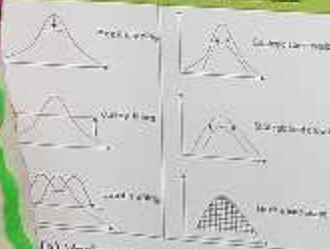
Maulana Azad National Institute of Technology, Bhopal (M.P.) India

ABSTRACT / INTRODUCTION

Participating in demand response has significant advantages for both consumers and electricity producers, i.e., saving on high electricity prices for the user, and helping utilities in peak load curtailment.

This research paper insight the development of Advanced Metering Infrastructure based Demand Side Management for load Management. The main objective of this application is consumption optimization and automation in operation. This paper proposes a fixed load control strategies with fixed forecasted photovoltaic generation with battery storage system and priority based load curtailment mechanism.

LOAD CONTROL STRATEGIES



CONFIGURATION OF ADVANCED METERING SYSTEM FOR DSM MODEL



1. Smart energy meter

provides two way communications between utility and end user and record of previous consumption for in its memory for lateral retrieval.

2. Meter Communication Module

To provide communication between smart meter and utility, broad band over power lines (BPL), power line communications (PLC), fiber optic, RF communications are used. Communications protocol / technologies are Modbus, GSM/GPRS, RS232/RS485 and TCP/IP, Zigbee etc with data communication rate of 1Mbps or 2Mbps.

3. Data Concentrator Unit

acquire data from meters and send it to the meter data management centre (MDMS) through GPRS communication.

The network interface connects data of distribution transformer to the central server.

PROPOSED METHODOLOGY



Fig 3 Architecture of load monitoring system
 Fig 4 Graph for modifications in the load curve after load management

DESIGN PARAMETERS OF DSM-AMI MODULE

RF Module with Relay : 2.4GHz or 865MHz ISM band operations Mesh Networking, Point-to-point, Star Networking topology, Configurable on air data rate of 250kbps, 1Mbps or 2Mbps Relay 5A, 220V, operation voltage 5/12V DC

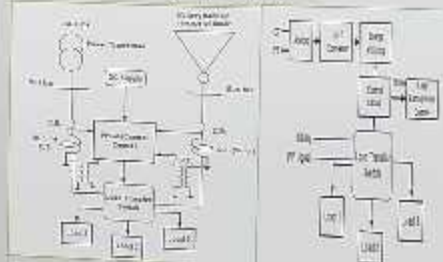


Fig 5 Single Line diagram
 Fig 6 Topology for load management

BASED ON CONSUMER PRIORITY

1. Highest priority load (Active / Critical)
2. Medium priority load (Essential)
3. Lowest priority load (Non-essentials)

SYSTEM DESCRIPTION

The system consists of a load transfer switch, A/D converter, zigbee to send information, current sensor (CT), voltage sensor (PT), control unit. FPGA kit is used for implementation of load control mechanism through HDL coding and design. The real time implementation is proposed through Lab VIEW. FPGA generates control signals which are concurrent in nature and 100 KHz clock pulse is used for running of LabVIEW. The control unit will generate control signals which control the load transfer switch and signal to energy management centre through universal asynchronous transmitter (UART) and zigbee).

Algorithm is based on K factor for selection of source:

specific factor (K) is difference between PV power and load demand
 If $K > \text{Default value}$: use power from photovoltaic system.
 $K = \text{Default value}$: use power from both sources (utility source and photovoltaic power)
 $K < \text{Default Value}$: use power from the utility source.

CONCLUSION / RESULT

The Proposed design of proto type of AMI based DSM model will manage load and improve the efficiency of PV and utility. The system simulation will be done on Lab VIEW.

ACKNOWLEDGEMENT

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Modified Pole Shapes on the Performance of Hybrid Switched Reluctance Motor

S.S. [Name], Professor, EEE Department, R.M.D Engineering College, Chennai
Dr.M. [Name], Professor EEE Department, SSN College of Engineering, Chennai

ABSTRACT

Hybrid Switched Reluctance Motor (HSRM) has constructional features of switched reluctance motor (SRM) and permanent magnet synchronous motor (PMSM). Auxiliary windings included in the stator of HSRM and investigate the effect of HSRM is altered for

RESULTS

Fig.3. Static torque, torque ripple and cogging torque characteristics of tapered pole

Motor Type	Avg Torque (Nm)	Torque Ripple (%)	Cogging Torque (Nm)
HSRM with tapered pole	2.860	3.973	0.000
HSRM with rectangular pole	3.000	4.000	0.000
HSRM with trapezoidal pole	2.800	3.800	0.000
HSRM with sinusoidal pole	2.750	3.750	0.000
HSRM with elliptical pole	2.700	3.700	0.000
HSRM with circular pole	2.650	3.650	0.000
HSRM with diamond pole	2.600	3.600	0.000
HSRM with hexagonal pole	2.550	3.550	0.000
HSRM with octagonal pole	2.500	3.500	0.000
HSRM with star pole	2.450	3.450	0.000
HSRM with crescent pole	2.400	3.400	0.000
HSRM with notched pole	2.350	3.350	0.000
HSRM with slotted pole	2.300	3.300	0.000
HSRM with perforated pole	2.250	3.250	0.000
HSRM with holey pole	2.200	3.200	0.000
HSRM with comb pole	2.150	3.150	0.000
HSRM with sawtooth pole	2.100	3.100	0.000
HSRM with triangular pole	2.050	3.050	0.000
HSRM with square pole	2.000	3.000	0.000
HSRM with pentagonal pole	1.950	2.950	0.000
HSRM with hexagonal pole	1.900	2.900	0.000
HSRM with heptagonal pole	1.850	2.850	0.000
HSRM with octagonal pole	1.800	2.800	0.000
HSRM with nonagonal pole	1.750	2.750	0.000
HSRM with decagonal pole	1.700	2.700	0.000
HSRM with hendecagonal pole	1.650	2.650	0.000
HSRM with dodecagonal pole	1.600	2.600	0.000
HSRM with tridecagonal pole	1.550	2.550	0.000
HSRM with tetradecagonal pole	1.500	2.500	0.000
HSRM with pentadecagonal pole	1.450	2.450	0.000
HSRM with hexadecagonal pole	1.400	2.400	0.000
HSRM with heptadecagonal pole	1.350	2.350	0.000
HSRM with octadecagonal pole	1.300	2.300	0.000
HSRM with enneadecagonal pole	1.250	2.250	0.000
HSRM with icosagonal pole	1.200	2.200	0.000
HSRM with hexaspherical pole	1.150	2.150	0.000
HSRM with heptaspherical pole	1.100	2.100	0.000
HSRM with octaspherical pole	1.050	2.050	0.000
HSRM with nonaspherical pole	1.000	2.000	0.000
HSRM with decaspherical pole	0.950	1.950	0.000
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HSRM with tetradecaspherical pole	0.750	1.750	0.000
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HSRM with hendecaspherical pole	0.150	1.150	0.000
HSRM with dodecaspherical pole	0.100	1.100	0.000
HSRM with tridecaspherical pole	0.050	1.050	0.000
HSRM with tetradecaspherical pole	0.000	1.000	0.000

Table1. Summarized results of HSRM performance ana

CONCLUSION

The tapering affects both the torque ripple and cogging torque. Also the average torque is reduced. By increasing the tapering angle, the average torque is reduced. The tapering angle of 1.5 degrees shows significant improvement in cogging torque and torque ripple.

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Effect of Modified Pole Shapes on the Performance of
Hybrid Switched Reluctance Motor

S.Saranya, Assistant Professor, EEE Department, R.M.D Engineering College, Chennai, India
Dr.M.Balaji, Associate Professor EEE Department, SSN College of Engineering, Chennai, India

INTRODUCTION

- Hybrid switched reluctance motor (HSRM) has constructional features same as conventional switched reluctance motor (CSRSM) with permanent magnets (PM) and auxiliary windings included in the stator core.
- In this work, we analyze the performance of HSRM and investigate its various characteristics. Also, the design of HSRM is altered for improving the motor performance.

DESIGN OF CSRSM AND HSRM



POLE SHAPE MODIFICATIONS



Fig.1. Structure of HSRM with shape of stator pole, permanent magnet and rotor pole



Fig.2. Structure of CSRSM with shape of stator pole, permanent magnet and rotor pole

RESULTS

Parameter	Value
Peak torque	1.2 N.m
Average torque	0.8 N.m
Peak current	1.5 A
Average current	1.0 A

Table 1. Summarized results of HSRM performance

CONCLUSIONS

Stator pole shape affects both the torque ripple and cogging torque in CSRSM. Also, the average torque is improved by modified pole shape. Non-linear air gap between stator and rotor induces torque ripple. It reduces proportionally. Also, the cogging torque increases with increase in air gap. Therefore, pole shape is modified with the stator pole and cogging torque average torque is improved proportionally.

Stator pole shape design with pole pole angle, 1.44 rad and 1.44 rad, minimum air gap angle and cogging torque without cogging torque. The stator pole shape design with pole pole angle, 1.44 rad and 1.44 rad, and cogging torque is reduced. Also, the cogging torque is reduced.

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Prof. Bhaskar Ramamurthi

(Director, IIT Madras)

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Plenary Talk on
"Enabling India with Electricity"
by



Prof. Ashok JhunJhunwala
Department of Electrical Engineering,






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Prof. Bhaskar Ramamurthi
(Director, IIT Madras)



Research and Development
- Where, When and How?

An engineers odyssey

Dr. V. Jagadeesh Kumar
Professor and HeadCEC
Department of Electrical Engineering
IIT Madras Chennai 600036 India

Measurements and Instrumentation Laboratory, Department of Electrical Engineering, IIT Madras





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Department of E
IIT

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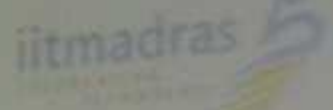




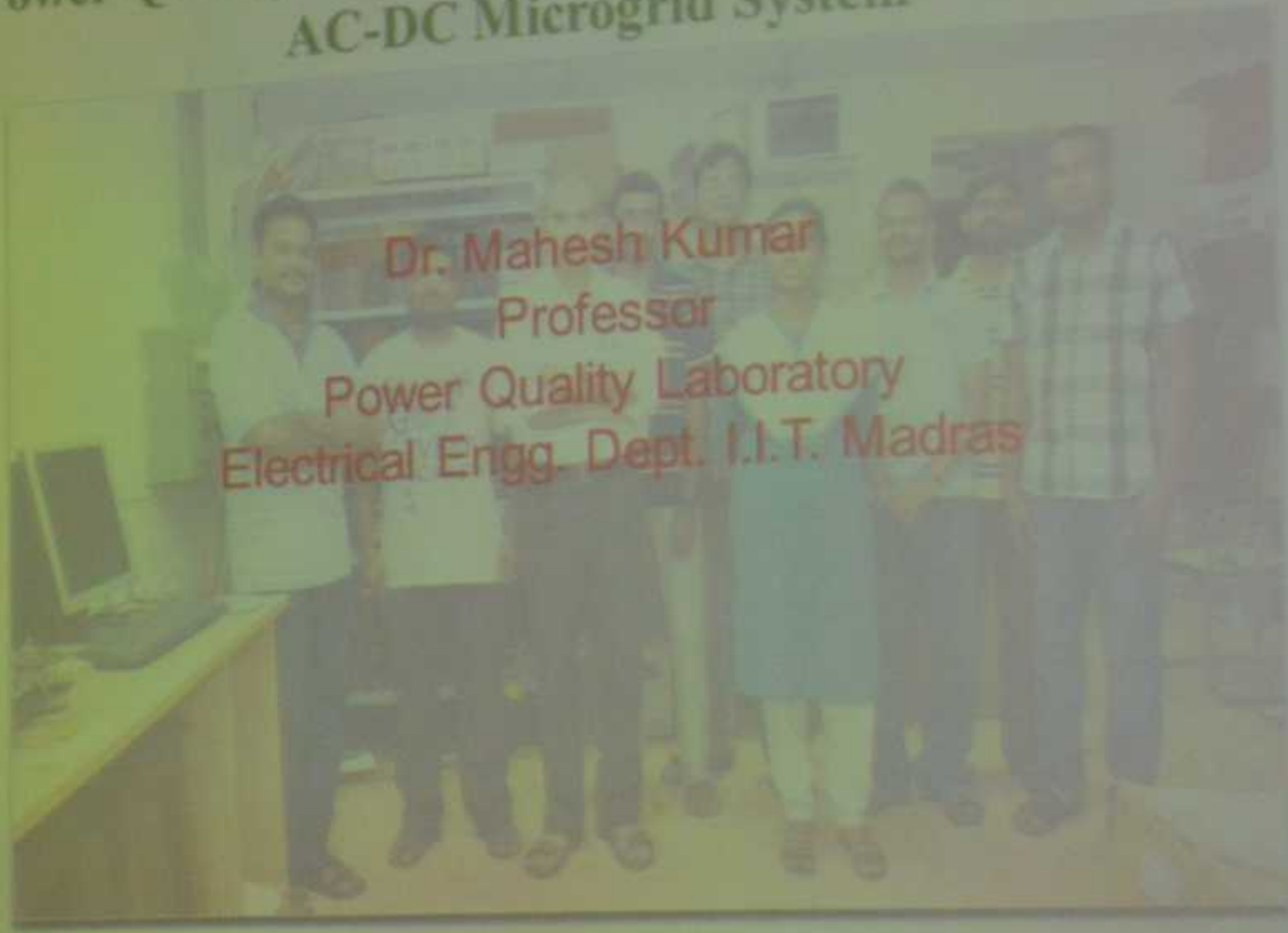




Power Quality Laboratory
Department of Electrical Engineering, IIT
Madras, Chennai - 36



Power Quality Aspects in Renewables Integration and AC-DC Microgrid System



Dr. Mahesh Kumar
Professor
Power Quality Laboratory
Electrical Engg. Dept. I.I.T. Madras





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Power Electronics and Drives



Driven by: Need for DC Transformers,
Need for AC Batteries





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Guest

Prof. Ramamurthi

(IIT Madras)

Research interests of UK

- Lightning modelling: Modelling of the return stroke evolution; Role of tall objects on ground; Upward connected leaders; ...
- Lightning protection: Definition of stress; Efficacy of different protection schemes; Strike to high voltage lines; Cables on towers and in soil; ...
- Electromagnetics for power engineering: Static fields; RC transient fields; Fields in DC insulation; Eddy current and moving conductor problems; Wave propagation in lightning, transmission lines and windings; ...
- High voltage engineering: Corona; Leader-streamer breakdown; Insulation aspects; Pollution performance of outdoor insulation; Grounding – power system and high voltage; ...

Prof. Umesh Kumar, Dept. of EE, IITM

amurthi
(as)

Thank You...

Dept. of Electrical Engineering, Indian Institute of Space and Astronautics





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Prof. Bhaskar Rama

(Director, IIT Madras)

&
Plenary Talk on
"Enabling India with Elec
by



Prof. Ashok JhunJh

Department of Electrical Engine
IIT Madras







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Improvement of Power System Reliability using New Fault Location System
A. Karthikeyan
Assistant Professor, Anna University

ABSTRACT	KEYWORDS
...	...



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National Conferences on Doctoral Thesis in Power Engineering
Indian Institute of Technology Madras, Chennai 600 045, India, 15-20 November 2014
Efficacy of SUPG Scheme in Solving Convection Problems
Siddhant Das, Prof. Jayaganesh
Department of Electrical Engineering, IIT Madras, Chennai-600 045, India

Abstract
The SUPG scheme is a popular method for solving convection dominated problems. It is a stabilized finite element method that is designed to handle the numerical instability associated with the convection term in the governing equations. This paper presents a detailed analysis of the SUPG scheme and its application to various convection problems. The results show that the SUPG scheme is highly effective in solving these problems and provides accurate results even in the presence of high Péclet numbers.

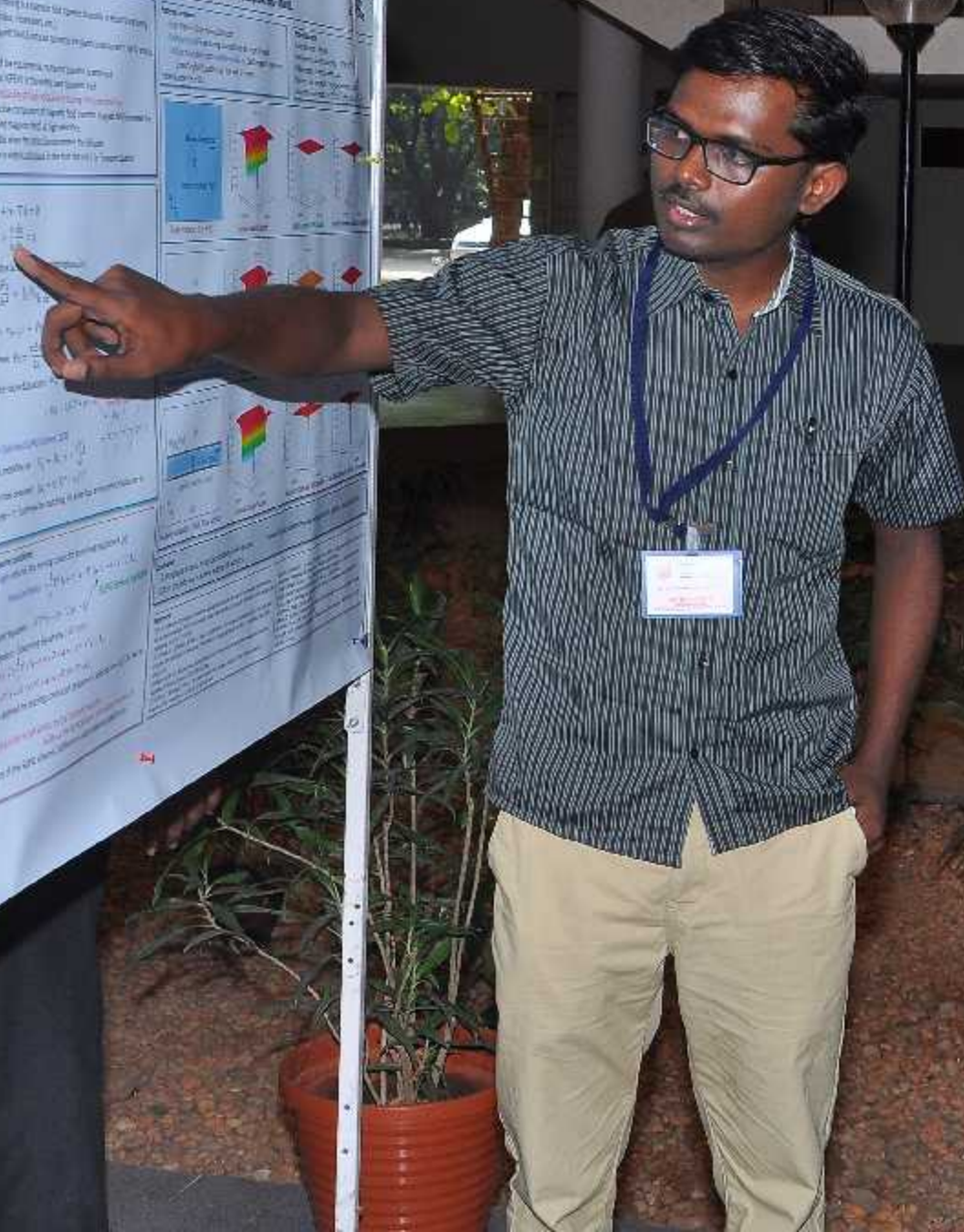
1. Introduction
Convection dominated problems are common in many engineering applications. The numerical solution of these problems is often challenging due to the presence of the convection term, which can lead to numerical instability. The SUPG scheme is a popular method for solving these problems. It is a stabilized finite element method that is designed to handle the numerical instability associated with the convection term in the governing equations. This paper presents a detailed analysis of the SUPG scheme and its application to various convection problems. The results show that the SUPG scheme is highly effective in solving these problems and provides accurate results even in the presence of high Péclet numbers.

2. Mathematical Formulation
Consider the following convection-diffusion equation:
$$\nabla \cdot (c \nabla u) + \mathbf{v} \cdot \nabla u = f$$

where c is the diffusion coefficient, \mathbf{v} is the velocity vector, and f is the source term. The SUPG scheme is a stabilized finite element method that is designed to handle the numerical instability associated with the convection term in the governing equations. It is based on the idea of adding a stabilization term to the weak form of the equation. The stabilization term is chosen such that it does not affect the accuracy of the solution but it does stabilize the numerical scheme. The SUPG scheme is highly effective in solving convection dominated problems and provides accurate results even in the presence of high Péclet numbers.

3. Numerical Results
The SUPG scheme is applied to various convection problems. The results show that the SUPG scheme is highly effective in solving these problems and provides accurate results even in the presence of high Péclet numbers. The SUPG scheme is compared with other methods and it is shown that it is superior to them in terms of accuracy and stability. The SUPG scheme is also shown to be robust and it can handle a wide range of convection problems. The results show that the SUPG scheme is a highly effective method for solving convection dominated problems and it is a good choice for engineers and scientists who are interested in solving these problems.

4. Conclusion
The SUPG scheme is a highly effective method for solving convection dominated problems. It is a stabilized finite element method that is designed to handle the numerical instability associated with the convection term in the governing equations. The results show that the SUPG scheme is highly effective in solving these problems and provides accurate results even in the presence of high Péclet numbers. The SUPG scheme is compared with other methods and it is shown that it is superior to them in terms of accuracy and stability. The SUPG scheme is also shown to be robust and it can handle a wide range of convection problems. The results show that the SUPG scheme is a highly effective method for solving convection dominated problems and it is a good choice for engineers and scientists who are interested in solving these problems.





PSE049



National Institute of Power Engineering
Indian Institute of Technology
Chennai 600 075



PROTECTION ISSUES IN DISTRIBUTION SYSTEMS

Shashank Shekar M.
JRS, IIT, BANGALORE

Introduction:

Requirement of Distributed Generation (DG) has increased in the distribution system. This has led to the protection issues. The protection issues in the distribution system are discussed in this paper. The protection issues in the distribution system are discussed in this paper. The protection issues in the distribution system are discussed in this paper.

Key Study:



Single phase fault at 20%

Relay 1

Relay 2

Whiteboard on the left side of the image, partially visible, containing text and diagrams.



Whiteboard on the right side of the image, containing text and diagrams. The text includes:

PSE065

National Conferences on Recent Trends in Power Engineering
Indian Institute of Technology Madras, Chennai 600 036, India.
20-24 December 2016

Development of Android Application for
Design of Solar PV System
Mithran K. Srinivasan, S. Madhan Natarajan, Pradeep
Srinivasan, Anandhan S. Tulaganathan

Abstract:

- The need to provide a mobile application for the design of solar PV system is discussed in this paper.
- The application is designed using Android Studio and Java.
- The application is designed to provide a user-friendly interface for the design of solar PV system.
- The application is designed to provide a user-friendly interface for the design of solar PV system.
- The application is designed to provide a user-friendly interface for the design of solar PV system.





National Conference on Recent Trends in Power Electronics
 Indian Institute of Technology Madras, Chennai 600 036, India.

Correlation Between Charge and Peak Current as Depicted by a Self Consistent Battery Stroke Model
 Sukesh A and Udaya Kumar
 Department of Electrical Engineering, Indian Institute of Science, Bangalore

Abstract
 This paper presents a self-consistent battery stroke model for the correlation between charge and peak current. The model is based on the self-consistent battery stroke model proposed by Sukesh A and Udaya Kumar [1]. The model is used to study the correlation between charge and peak current for different battery stroke models. The results show that the self-consistent battery stroke model is a good model for the correlation between charge and peak current.

Keywords
 Self-consistent battery stroke model, Charge, Peak current, Correlation.

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 The results show that the self-consistent battery stroke model is a good model for the correlation between charge and peak current. The model is based on the self-consistent battery stroke model proposed by Sukesh A and Udaya Kumar [1]. The model is used to study the correlation between charge and peak current for different battery stroke models. The results show that the self-consistent battery stroke model is a good model for the correlation between charge and peak current.

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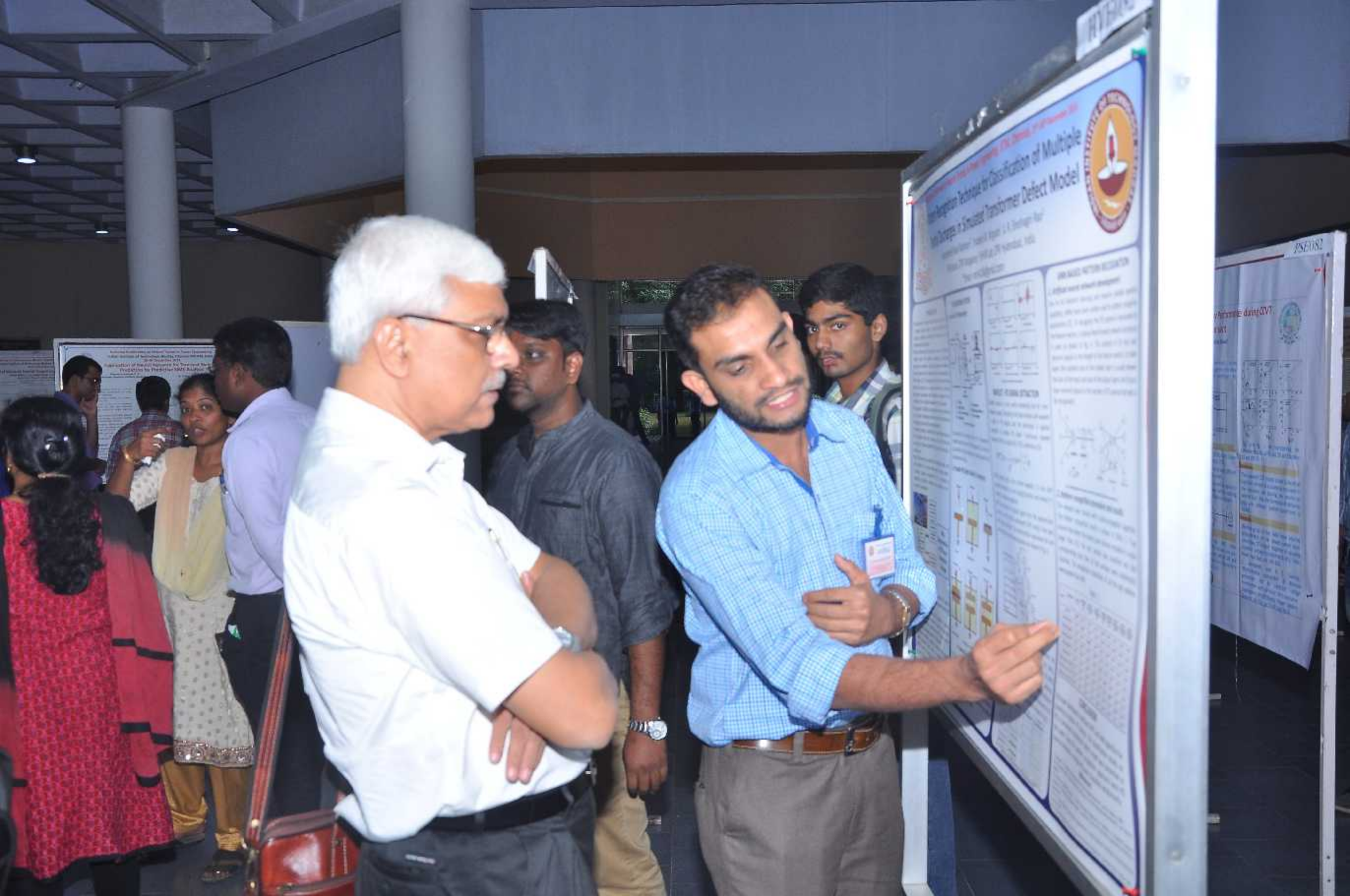
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Intelligent Technique for Classification of Multiple Faults in Smallest Transformer Defect Model
 Anna University, Chennai, India
 The author(s): [Name]
 The institution: Anna University, Chennai, India

ABSTRACT
 This paper presents an intelligent technique for the classification of multiple faults in the smallest transformer defect model. The proposed method is based on the use of a neural network classifier. The results of the simulation study show that the proposed method is effective in the classification of multiple faults in the smallest transformer defect model.

KEYWORDS
 Intelligent technique, Classification, Multiple faults, Smallest transformer defect model, Neural network classifier.

INTRODUCTION
 The transformer is one of the most important components in a power system. It is used to transfer electrical energy from one part of the system to another part. The transformer is also used to change the voltage level of the electrical energy. The transformer is a complex device and it is difficult to diagnose its faults. The most common faults in a transformer are short-circuit, open-circuit, and insulation failure. The detection and classification of these faults is a challenging task. This paper presents an intelligent technique for the classification of multiple faults in the smallest transformer defect model.

METHODOLOGY
 The proposed method is based on the use of a neural network classifier. The neural network classifier is trained using a set of fault data. The fault data is generated by simulating the transformer model. The neural network classifier is used to classify the faults in the smallest transformer defect model.

RESULTS AND DISCUSSION
 The results of the simulation study show that the proposed method is effective in the classification of multiple faults in the smallest transformer defect model. The accuracy of the classification is high.

CONCLUSION
 The proposed method is an effective technique for the classification of multiple faults in the smallest transformer defect model.

PSSE082
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Chief Guest

Bhaskar Ramamurthi

(Director, IIT Madras)

&

Plenary Talk on





Chief Guest

Prof. Bhaskar Ramamurti

(Director, IIT Madras)

&

Plenary Talk on



15th International Science, Peace & Power Conference
Anna University, Chennai
25th December 2015

Design of a Self Excited Induction Generator based Stand Alone Wind Energy Conversion System

K. Rishi **N. K. Sathya**
 Assistant Professor Professor

OBJECTIVES

- To design a self-excited induction generator based stand alone wind energy conversion system.
- To study the characteristics of the generator for a 1000 W and to compare the characteristics of the generator with the characteristics of the generator based on the conventional wind energy conversion system.
- To study the characteristics of the generator based on the conventional wind energy conversion system.
- To study the characteristics of the generator based on the conventional wind energy conversion system.

CONCLUSION

The self-excited induction generator based stand alone wind energy conversion system is designed and simulated. The characteristics of the generator are studied and compared with the characteristics of the generator based on the conventional wind energy conversion system.



15th International Science, Peace & Power Conference
Anna University, Chennai
25th December 2015

Influence of Recent Trends in Power Engineering on Renewable Energy Sources to the Distribution Grid

S. Chandan Raja **P. Venkatesh**
 Assistant Professor Associate Professor

Abstract

The paper discusses the influence of recent trends in power engineering on renewable energy sources to the distribution grid. The paper discusses the influence of recent trends in power engineering on renewable energy sources to the distribution grid.

Keywords

- Renewable energy sources
- Distribution grid
- Power engineering
- Recent trends



15th International Science, Peace & Power Conference
Anna University, Chennai
25th December 2015

Using New Fault Location System

Abstract

The paper discusses the use of a new fault location system in power engineering. The paper discusses the use of a new fault location system in power engineering.

Power Grids in India: Trends in Power Engineering
 All India Institute of Technology Madras, Chennai 600 036, India.
 26-27 December 2015

DESIGN AND IMPLEMENTATION OF MULTI-INPUT CONTROLLER FOR ENHANCING POWER SYSTEM DYNAMIC STABILITY.

Dr. Srinivasan
 All India Institute of Technology Madras, Chennai 600 036, India

Dr. Chokkikulraj Ranganath
 All India Institute of Technology Madras, Chennai 600 036, India

Abstract

The problem of dynamic stability in power systems is a complex one. This paper presents a multi-input controller for enhancing power system dynamic stability.

Keywords

Multi-input controller, dynamic stability, power system.

Results & Discussion



The proposed multi-input controller is designed to enhance the dynamic stability of the power system. The controller is implemented in the form of a multi-input feedback controller.

The results show that the proposed controller significantly improves the dynamic stability of the power system. The system response is faster and more damped compared to the conventional controller.

The proposed controller is suitable for implementation in real-time power systems.

PED063



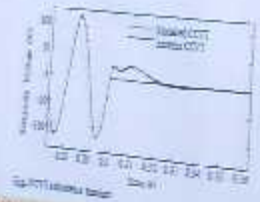
CCVT Modelling and Distance Relay Performance during CCVT Subsidence Transient

Sandeep Biswal, Dr. Monalisa Biswal
NIT Raipur, India

Introduction

In high voltage or extra high voltage transmission system, the application of coupling capacitor voltage transformer (CCVT) is more economical. Faults that cause very depressed voltage. The CCVT output may not always track the system voltage due to the internal CCVT energy storage element. Under high source impedance ratio (SIR) and zero crossing fault, the secondary voltage is not the exact replica of primary one due to CCVT internal energy storing elements. This phenomenon is commonly known as CCVT subsidence transient.

To mitigate the overreach, various conventional relaying algorithms (time delay and zone reduction technique) are successfully applied.



Objective

Modeling of CCVT in PSCAD which is same response with the practical CCVT.

Distance relay performance under different conditions like SIR and burden.

Distance relay algorithm will be applied to solve overreach problem without applying time delay and zone reduction approach.



Results & Discussion

Figure 1 shows the MHO relay characteristics both for in-zone and out-zone faults with system various SIR and burden. Fig. 1 represent the characteristics for SIR 0.2 and burden 1 VA.

Fig. 2 and Fig. 3 are characteristics for SIR 5 and 10 and 100 VA.

Conclusions

The proposed CCVT model shows significant amount of subsidence on the secondary side during external fault. Also, Performance of distance relay with different system parameters is studied.

References

- Working group of the subcommittee of the protection committee of the power system engineering research center, 'Transient recovery voltage of capacitor voltage transformer', Power App. Syst., vol. PAS-11, no. 1, pp. 11-15, 1986.
- C. Venkatesh, and S. Venkatesh, 'Performance assessment of distance protection fed by transformer with electronic suppression circuit', Elect. Research, Vol. 132, pp. 12-15, 2005.



HVE029

PP-18

National Conference on Recent Trends in Power Engineering
Indian Institute of Technology Madras, Chennai 600 036, India
29-30 December 2015

Comparison of Conventional and Phase Shift Methods for Condition Monitoring of Metal Oxide Surge Arrester

Likitha S¹ (likitha_rj@epu.in) | Iithin Paul P¹ | M Kanyakumari¹ | R S Shiyakumara Aradhya²
¹ Central Power Research Institute, Bangalore | ² Acharya Institute of Technology, Bangalore

INTRODUCTION

Large arrester protects the power system from the effects of over voltages. During the arcing is subjected to severe thermal stresses leading to slow & increasing the leakage current. The arrester ultimately leading to failure.

It is important to perform the monitoring of the arrester in performance by measuring the current drawn by it. The leakage measurement is difficult. Therefore, extraction is very essential.

The total I_L obtained based on the total I_L because that the manufacturer does not extract total I_L without I_L is required for this purpose.

In this paper, laboratory method has been used. I_L readings are recorded using resistive probe method in the laboratory. These results are compared with the manufacturer's data. If work is achieved, the test is performed using the proposed method.



METHODOLOGY

A MATLAB code was developed to implement the proposed current algorithm. In order to approximate the leakage current, experiments were carried out up to 1.25 kV AC RMS. The steps of the method are given in Table 1. The performance index is shown in Figure 4.

Parameter	Value
Maximum Voltage (kV)	1.25
Frequency (Hz)	50
Current (A)	100
Leakage Current (A)	0.1
Temperature (°C)	25
Humidity (%)	60
Pressure (kPa)	101.3
Altitude (m)	1000

Method	Accuracy (%)	Time (s)
Conventional	95	10
Proposed	98	5

EXPERIMENTAL RESULTS

The proposed method is compared with the manufacturer's data. The results are shown in Figure 5. The proposed method is found to be more accurate than the manufacturer's data.

CONCLUSIONS

The proposed method is compared with the manufacturer's data. The results are shown in Figure 5. The proposed method is found to be more accurate than the manufacturer's data.

SHIELDING

The shielding method is used to protect the electrical equipment from the effects of lightning strikes.





सम्मेलन कक्ष - 2
CONFERENCE HALL 2

Design of a Self-Excited Induction Generator based Stand Alone Wind Energy Conversion System

Poster with technical diagrams and text, partially obscured by people.

Poster with technical diagrams and text, partially obscured by people.

COMPARISON OF SURGE ARRESTERS SPECIFICATION USED IN LT/VT SYSTEMS
Sri Lanka Institute of Technology, Sri Lanka
WVE020

Parameter	Specification
Rated Voltage	11 kV
Rated Current	1000 A
Rated Power	110 MVA
Rated Frequency	50 Hz
Rated Short-Circuit Capacity	1000 MVA
Rated Surge Current	10 kA
Rated Surge Voltage	11 kV
Rated Surge Energy	100 kJ
Rated Surge Impedance	100 Ω
Rated Surge Duration	100 μs
Rated Surge Repetition Rate	1000 / year

Bar chart showing comparison of surge arrester specifications.

Advances in Power Engineering

Thermal 930 036, India
2023

Protection Scheme for Transmission Lines

Kamritha Sreeni
PG Scholar, Department of EEE
K.J.Somaiya Institute of Technology, Vasai

RESULTS

- ✓ Load limit and sag are minimized
- ✓ Low computation time
- ✓ Increased the security of power system

CONCLUSION

In this paper, a protection scheme, based on the use of load limit and sag, is proposed. This scheme minimizes the impact of fault on the power system by quickly and accurately determining the fault location.




← आडिटोरियम
AUDITORIUM

← शौचालय
REST ROOM



Control of DG Placement to enhance the performance of Distribution Network

Dr. Shampada Kulkarni, Assistant Professor
Department of Electrical Engineering, K.J.Somaiya Institute of Technology, Vasai

ABSTRACT

The paper discusses the optimal placement of Distributed Generation (DG) in a distribution network to improve its performance. The study involves various parameters and results, including a table of results.

Case	Loss (kW)	Voltage Drop (%)
Case 1	1200	5.5
Case 2	1000	4.5
Case 3	800	3.5
Case 4	600	2.5
Case 5	400	1.5

CONCLUSION

The study shows that the optimal placement of DG significantly reduces the power loss and voltage drop in the distribution network, thereby enhancing its performance.

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JM



National Conference on Smart-Terrestrial Power Systems
Indian Institute of Technology Madras, Chennai 600 033, India,
28-30 December 2015

Analysis and Design of a Self-Excited Induction Generator based Stand Alone Wind Energy Conversion System

Dr. Sankar Sanyal
Sankar Sanyal, IIT Madras


Dr. Sankar Sanyal
Sankar Sanyal, IIT Madras

Dr. Sankar Sanyal
Sankar Sanyal, IIT Madras

ABSTRACT

INTRODUCTION

CONCLUSION





PED049

Impact Of The Layout On The Performance Of A High Frequency Synchronous Buck Converter.

Rajat Channappanvar and Santanu Mishra
Department of Electrical Engineering, Indian Institute of Technology Kanpur, India



IMPORTANT CONSIDERATIONS FOR HIGH FREQUENCY POWER BOARD LAYOUT

- Plan the layout
- Use Thick Cu Trace for power line
- Multiple Vias to reduce resistance
- Small Switch Node Area to reduce EMI
- Large Thermal pads: To Act as Heat Sink

Minimize Current Loop Surface Area

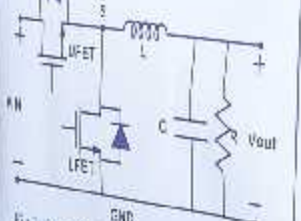


Fig. 1. Schematic of Synchronous Buck Converter

CURRENT PATHS IN SBT

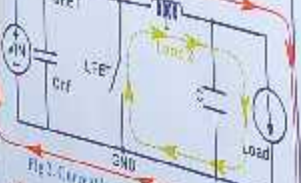


Fig. 2. Current paths along direction.

- Loop 1: I_{in} current of Buck converter; Fig. 3: Switch (UFET) is ON.
- Loop 2: I_o current of Buck converter; Return Switch (LFT) is ON.

MAGNETICS OF THE LAYOUT

Magnetic Flux \propto Magnetic Field \times Loop Area
 $\Phi_b = BA \cos \theta$ (1)

- Φ_b - Magnetic Flux
- B - Magnetic Field
- A - Loop Surface Area
- θ - angle between field and area's unit vector

CURRENT PATHS ON PCB

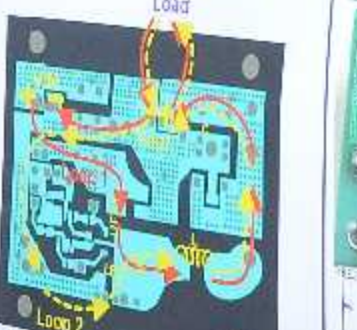


Fig. 3. Current paths in an imperfect layout.

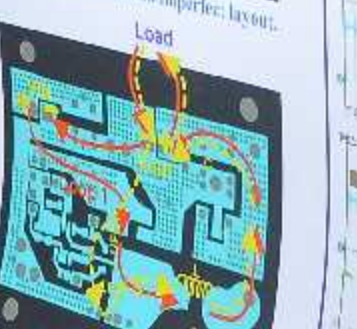


Fig. 4. Current paths for improved layout.

EXPERIMENTAL VERIFICATION



Fig. 5. Experimental setup of Synchronous Buck Converter with Current Paths marked. Case 1: Imperfect Layout Case 2: Improved Layout



Fig. 6. Correction introduced to improve the imperfect experimental setup.

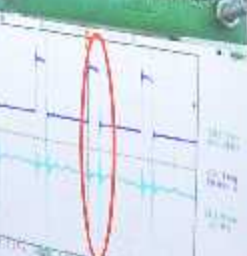


Fig. 7. Switch node voltage and output voltage of the imperfect layout of SBC.

Switch Node spikes: 2 V
Output spikes: 14 V



Fig. 8. Switch node voltage and output voltage of circuit with improvements in fig. 6.

Switch Node spikes: 2 V
Output spikes: 2 V



National Conference on Recent Trends in Power Engineering
 Indian Institute of Technology Varanasi, Chhatra EK 203, India
 25-26 December 2015



Reduction in Intersymbol Interference (ISI) in Power Line Communication

Nikhil Singh
 JRF, CPRI Bangalore

Dr. M. Suresh
 Prof. AET Mysore

Introduction

Smart grid systems enable a intelligent monitor and control every line in order to improve the efficiency and reliability of power delivery. For monitoring and control requires low cost and high reliable two-way communication between customers and utility. To enable this wireless communication is required.

Power line communication (PLC) which was introduced in 1950s and being used in communication medium. Power line is mainly designed for energy transmission. PLC is also treated as high frequency. There are three different characteristics of PLC at frequency range where the loss is very high and it is not suitable for long distance communication. This is the reason why PLC is not used for long distance communication.

Research work is done to reduce the loss and to improve the communication. There are many techniques to reduce the loss and to improve the communication. One of the techniques is to use the adaptive modulation and coding (AMC) technique. This technique is used to reduce the loss and to improve the communication. This technique is used to reduce the loss and to improve the communication.

Methods

The proposed method is to use the adaptive modulation and coding (AMC) technique. This technique is used to reduce the loss and to improve the communication. This technique is used to reduce the loss and to improve the communication.



Block Diagram



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CENTRE FOR
INDUSTRIAL CONSULTANCY
&
OPERATIONAL RESEARCH



**NATIONAL CONFERENCE
ON
RECENT TRENDS IN POWER ENGINEERING**

(For Research Scholars)

Date: 29 - 30 December 2015

Venue : IC & SR Auditorium

Department of Electrical Engineering

Indian Institute of Technology Madras





पंजीकरण
REGISTRATION





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Auditorium
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पंजीकरण
REGISTRATION









Venue : IC & SR Auditorium



Chief Guest

Prof. Bhaskar Ramamurthi

(Director, IIT Madras)

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Prof. Asho

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