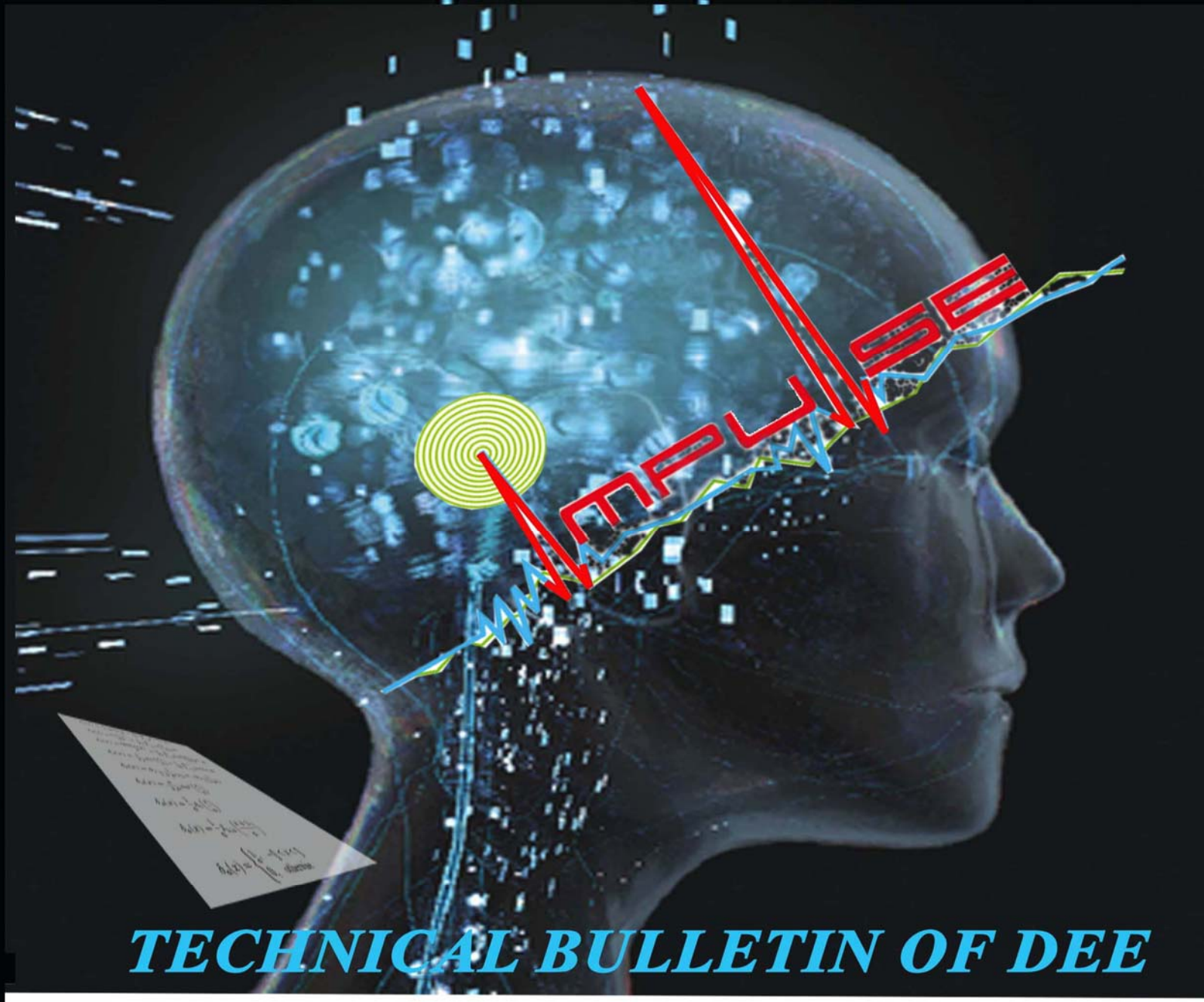


TECHNICAL BULLETIN OF DEE

CONTENTS

VOLUME I NOVEMBER 2008

Department of Electrical and Electronics Engineering

Director's note

Teaching is successful when the spark of creativity and quest for knowledge is kindled in students and allowed to brighten the world. This bulletin of Department of Electrical and Electronics Engineering gives ample scope for the overall development of the department faculty as well as the students. Congratulations for the venture & best wishes. May God bless you.

Rev. Fr. Jose Alex CMI

Principal's note

It is very encouraging to note that the Department of Electrical and Electronics is undertaking a venture to publish the department bulletin highlighting the milestones of the department, achievements and important events and novel research based works of faculty and students. The need of the hour is to acquaint ourselves with the rapid progress in our respective fields. Only then, does education become complete. I wish the department good luck in their endeavour.

Dr. J Issac

Hod's Desk

It is with immense pleasure that I am announcing the inaugural issue of the Electrical and Electronics Department Bulletin of RASET. Our endeavour is to bring out the manifold talents of EEE faculty members and students by encouraging their contributions in the form of articles that bring to light the latest developments in this field. In today's fast paced world, keeping abreast of the progress of the world is necessary to be successful and so the bulletin aims to incorporate recent advances in Electrical technology. Moreover plans for publishing research based works done by our staff are on the anvil. Apart from these, this bulletin will chronicle the laurels, achievements and milestones of the ELUXTRA fraternity.
Wishing the department venture all the luck for a quantum leap!!!

Ms. Jayasri R.Nair

Case-Based Reasoning and System Identification for Electrical Engineering Learning

Traditionally, the teaching of engineering has been teacher centered and unidirectional, with information being passed from teacher to students only. With the introduction of computers the need for students to engage in active learning has become more relevant. The students are able to use computers in a remote way, obtaining explanatory feedback on whether their actions are correct or incorrect. This service is based on system identification (SI) techniques to gain knowledge of the physical system and case-based reasoning (CBR) for exploiting this knowledge. Combining CBR and SI, an emulation of the real-time solution of the system is achieved.

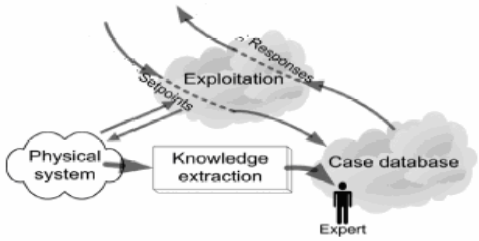


Fig:1 Knowledge Extraction (Supervised by an expert) and Exploitation

The students work directly with equipments and physical systems by sharing the resources through intranet. The issues that have to be solved are

1. Interaction with the students by the teacher
2. Sharing of a single physical system unit
3. Evaluation of independent work done by students
4. Work load of the teacher

These problems can be solved by email/chat sessions by teacher, the physical system is made available for 24 hrs a day and not limited to office time, and correct solutions discovered by students for a given task should be accepted independently of the method used and management of increased work load ensuring flexibility and high quality. Hence, the idea is to give students useful tools for active learning by providing access to physical resources so that students may use these resources whenever and wherever they wish. A combination of SI and CBR techniques should be able to resolve the problem of multi user access and offer services for these practices.

The CBR technique is based on solving problems (or cases) that have not previously occurred by using knowledge from the past. Hence, a large number of problems can be generated (even a different one for each student), with students required to complete a given task. In this way, teaching and learning is personalized.

Yet another advantage of this method is that students doing assignment work are assessed immediately. They do not need to wait for the teacher to check the solutions they propose.

Ref.: Perfecto Reguera Acevedo, Juan José Fuertes Martínez, Manuel Domínguez González, and Roberto García Valencia- IEEE TRANSACTIONS ON EDUCATION, VOL. 51, NO. 2, MAY 2008 271

Dr. P C Baby

A NOVEL APPROACH TO THE DESIGN OF A LEAD – LAG COMPENSATOR

The conventional method of designing a lead–lag compensator which is to be added in cascade with the plant is based on the dominant poles of a second order approximation for the compensated plant and on the static error constant. The dominant poles specify the transient performance indices and the static error constant decides the steady state performance of the system.

In the proposed method the design procedure is to minimize an objective function and to solve a set of simultaneous algebraic equations. The system considered for compensation consists of a linear plant with unity feedback. If the given linear plant is represented as,

$$G_p(j\omega) = \frac{g_1 + g_2 j\omega}{g_3 + g_4 j\omega} \qquad (1)$$

and the lead – lag compensator to be designed has the transfer function,

$$G_c(j\omega) = \frac{a_0 + a_1 j\omega + a_2 (j\omega)^2}{1 + b_1 j\omega + b_2 (j\omega)^2} \quad , \qquad (2)$$

the closed loop transfer function can be written as,

$$T(j\omega) = \frac{G_c(j\omega)G_p(j\omega)}{1 + G_c(j\omega)G_p(j\omega)} = \frac{N_1(j\omega)}{D_1(j\omega)} \qquad (3)$$

The desired closed loop transfer function, as per the design specifications, can be written in the form,

$$F(j\omega) = \frac{\alpha j\omega + \omega_n^2}{(j\omega)^2 + 2\zeta\omega_n j\omega + \omega_n^2} = \frac{N_2(j\omega)}{D_2(j\omega)} \qquad (4)$$

where, $s = -\omega_n^2 / \alpha$ is the closed loop zero, ζ is the damping ratio and ω_n is the natural frequency. The value of α is estimated form the velocity error constant k_v and the transient performance parameters ζ and ω_n. The relation is,

$$\alpha = 2\zeta\omega_n - \frac{\omega_n^2}{k_v}$$

The objective function to be minimized is,

$$J = \int_{\omega_1}^{\omega_2} \left| N_1 D_2 - N_2 D_1 \right|^2 d\omega$$

The lower and upper limits of integration can be conveniently chosen as $\omega_1 = 0$ *and* $\omega_2 = 5$ *rad* / sec.

This leads to the following algebraic simultaneous equations:

$$\frac{\partial J}{\partial a_0} = 0 \qquad \frac{\partial J}{\partial a_1} = 0 \qquad \frac{\partial J}{\partial a_2} = 0 \qquad \frac{\partial J}{\partial b_1} = 0 \qquad \text{and} \quad \frac{\partial J}{\partial b_2} = 0 .$$

Solving these simultaneous algebraic equations, the coefficients a_0, a_1, a_2, b_1 *and* b_2 can be determined. Substitution of these coefficients in equation (2) yields the compensator transfer function $G_c(s)$.

Prof. K.R.VARMAH

FDTD Simulated Propagation of Electromagnetic Pulses due to PD for Transformer Diagnostics

Chikku Abraham, Dept. of Electrical & Electronics, RASET

Partial discharge (PD) is one of the main causes for eventual equipment failure. It occurs where the electric field exceeds the local dielectric strength of the insulation. The Finite Difference Time Domain (FDTD) technique, which is a widely used electromagnetic computational method, has been used to model propagation PD discharges generated in the form of a Gaussian pulse. The wave propagation in free space, oil and with a cylindrical metallic obstruction representing core/winding, in two dimensions is realized and presented in this work. The Perfectly Matched Layer (PML) which is a flexible and efficient Absorbing Boundary Condition (ABC) has been incorporated in the simulations. Further, for localization Time Difference of Arrival (TDOA) approach has been used. PD is also accompanied by sound waves and electromagnetic waves at very high frequencies (300 MHz to 1500 MHz). UHF technique has an advantage of increased PD detection and localization accuracy due to lower signal damping. Since the signals are captured in UHF range, possibility of noise interference is almost eliminated.

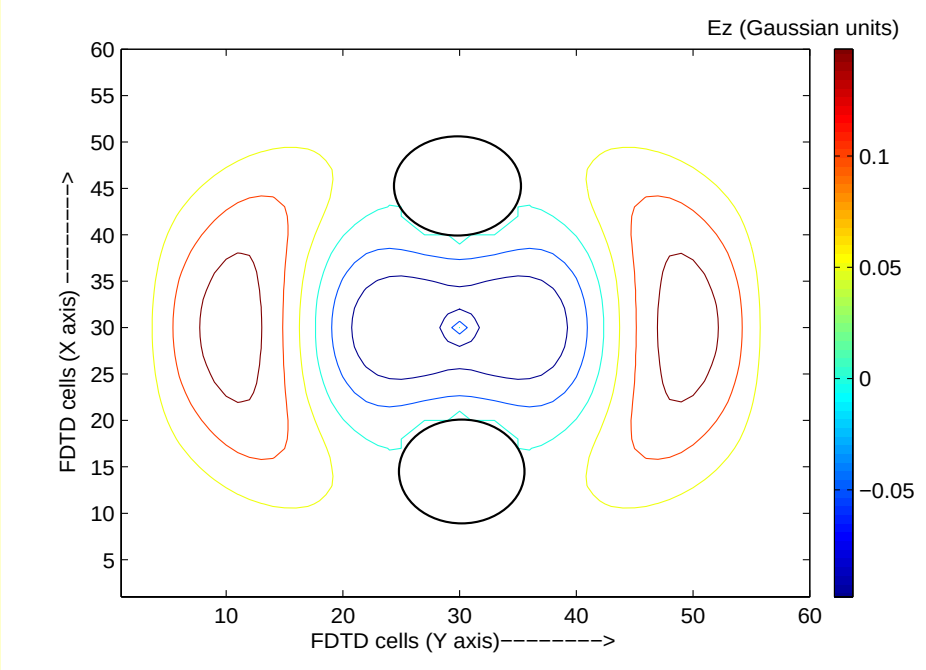


Fig.1 *Simulated contour of E_z field propagation after 100 time steps with pulse at (30,30) in oil and circular obstructions centered at (15, 30) and (45, 30)*

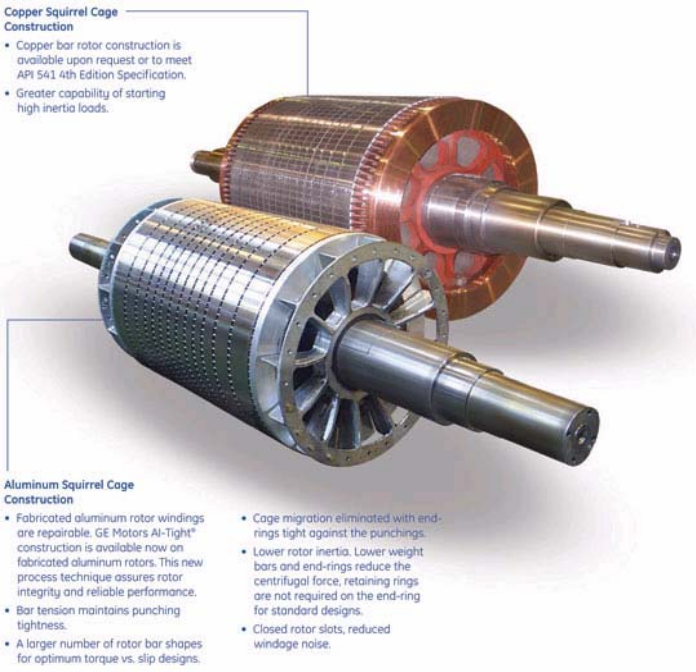
The challenges of PD detection circuits are the design of proper sensors (antennas) capable of signal detection in broadband range and the signal interpretation circuits. In this work an algorithm has been developed using FDTD method for PD detection and localization.

*Paper accepted for presentation at the IEEE "TENCON 2008" international conference to be held from 16-18 Nov.2008 at University of Hyderabad, India.

EFFECTS OF UNBALANCED VOLTAGES ON THREE PHASE INDUCTION MOTOR

(Perspective analysis in terms of power quality)

As we know the most widely used drives in industrial, commercial and residential systems are three phase induction motors. These machines are considered as the workhorse of industries because of the advancement in the area of power electronic speed controllers.



The ac power line supply provided to the industries is not always balanced and symmetrical. The voltage unbalance causes a lot of ill effects on induction motors. Voltage unbalance is regarded as a power quality problem of significant concern at the electricity distribution level. Although the voltages are quite well balanced at the generator and transmission levels, the voltages at the utilisation level can become unbalanced due to the unequal system impedances and the unequal distribution of single-phase loads. Voltage unbalance is usually caused due to incomplete transposition of transmission lines, open delta transformer connections, blown fuses in three phase capacitor banks.

Voltage unbalance is usually expressed in *percentage voltage unbalance factor* (VUF).It is the ratio of the negative sequence voltage component to the positive sequence voltage component expressed as a percentage. There are many unbalanced voltages possible with the same voltage unbalance factor (VUF).The different unbalanced cases are the following: single phase, two phase, three phase over-voltage and under-voltage.

Overheating, line-current unbalance, de-rating, torque pulsation, and inefficiency are some of the adverse effects of voltage unbalance. The overheating leads to winding insulation degradation. Due to much lower impedance, the negative sequence voltage component has high magnitude current and this gets induced in the rotor, if the voltages are unbalanced to a large extent. The significant adverse effects of unbalanced voltages are stator and rotor heating which further leads to winding and bearing failures (bearing current circulation) if not checked in time. The voltage unbalance would causes significant additional power losses which would result in the steady -state temperature rise of the windings and affect the performance of the machine.

The possible scope of research in this field is to study the presence of harmonics and how these unbalances and harmonic currents that are present in the line can affect the performance and working of a three phase induction motor and how measures can be estimated or developed, to minimize or eliminate these effects. The same study can be extended to three phase synchronous machines.

The study can be done by modeling the three phase induction machine in MATLAB and simulating the unbalances for the above machine and incorporating non linear harmonics.

- G.Muraleedharan

ROBOTIC ARM

Industrial development has its role in the development of each country. One of the milestones of industrial development is the automation of factories and other fields. Now-a-days, in developed countries, some of the complicated and unsafe processes are done by robots. It's high time we engineers should have idea on the working of robots and the technology behind it.

The robotic arm is modeled as a chain of six rigid links interconnected by revolute joints and has six degrees of freedom. Due to high step resolution, bipolar hybrid type stepper motors are used as actuators. There are six stepper motors in use. Stepper motor selection is based on the torque obtained at each joint. Stepper motor control is done by using a TMCM-610 module. The TMCM-610 is a stepper motor controller and driver module that can drive up to six bipolar two-phase stepper motors with a peak coil current of up to 1.5A for each coil. The module provides a complete motion control system. The "Trinamic Motion Control Language" (TMCL) is used to control the module.

MATLAB is a high-performance language for technical computing. It integrates computation, visualization, and programming in an easy-to-use environment where problems and solutions are expressed in familiar mathematical notation. The Robotic Toolbox in MATLAB is useful for simulation as well as analyzing results from experiments with real robots. Hence the motion of the robotic arm is simulated using MATLAB.

There is a lot of scope to improve on the above model. The general purpose I/O connector provides eight digital outputs and eight inputs that can either be used as digital or as analog inputs with 10 bit accuracy. These ports can be used to light the LED, to indicate the working of a particular motor. Switches can be used to control the motion of the motors manually. If the supply gets cut off while the program is running, the arm stops at the current position. When the supply comes back, the program will start executing, considering current position as the starting position, which will cause an error. Hence to bring back the arm to the initial position, *homing* feature can be incorporated. Homing can be done either by using stall guard or by using limit switch facility provided. To make the robotic arm more user friendly, creation of GUI can be done, so that a person who has no knowledge of TMCL programming can communicate with the arm and can be used for any application.

Robotics today is dealing with research and development in a number of interdisciplinary areas, including kinematics, dynamics, control, and motion planning, sensing, programming, and machine intelligence. Other applications of robotics are in areas where the use of humans is impractical or undesirable, such as nuclear waste disposal, etc.

Br. Mejo Paul

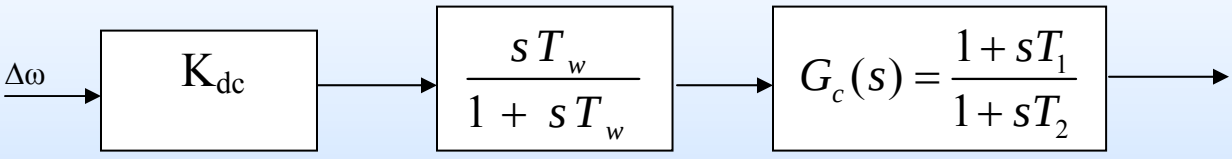
UPFC Based Damping Controller for Damping Low Frequency Oscillations In Power System

In power systems constrained by stability the limiting factor is not the first swing but the damping of low frequency oscillations in the system. In the case of an under damped system any minor disturbance can cause the machine angle to oscillate around its steady state value, at the natural frequency of the total electromechanical system. These oscillations in the rotor angle results in corresponding power oscillations around the steady state value of power transmitted.

In earlier days PSS(power system stabilizer) was used in the excitation system of the generator to damp the system oscillations. But with the advent of high power, high speed electronic FACTS (flexible ac transmission system) devices, their capability in damping power system oscillations has been explored and investigated as one of the potential applications. Unlike PSS at the generator location the speed variations of the machine of interest are not readily available to a FACTS controller on the transmission path. So we extract an input signal from the locally measurable quantities at the UPFC (unified power flow controller) location. Then UPFC can be used for damping system oscillations by judiciously applying a damping controller. The significant control parameters for the damping function of a UPFC are modulation index of the series and shunt inverters, and phase angle of series and shunt converter voltage.

An SMIB(single machine infinite bus) system including UPFC is modeled by incorporating UPFC into the basic Heffron- Phillip model.

In the damping controller using UPFC first the speed deviation signal is derived from the electric power P_e .The total electric power is measured at the UPFC location .It is then compared with the mechanical power, the error is integrated and multiplied by $1/M$ to derive the speed deviation signal .An electrical torque in phase with the speed deviation signal is to be produced in order to improve the damping of the system oscillations. The parameters of lead lag compensator are chosen so as to compensate the phase shift between control signal and the resultant electrical power deviation Thus an additional electrical power output is obtained in phase with speed deviation signal .The gain setting is chosen so as to get the required damping ratio of the electromechanical mode .The output of the damping controller modulates the reference setting of the power flow controller.



Structure of UPFC based damping controller

The structure of the damping controller is as shown above. It consists of gain, signal wash out and phase compensator. The parameters of the controller are obtained using phase compensation technique.

It was observed that the damping controller (δ_B) and (δ_E) exhibit robust dynamic performance as compared to damping controller (m_B) and (m_E) when dynamic

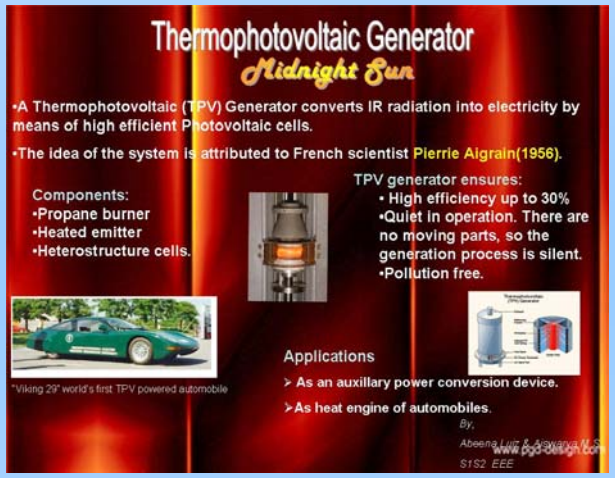
responses for a step load perturbation in mechanical power was studied using MATLAB.Inductance variations can be taken as a scope for further research work .

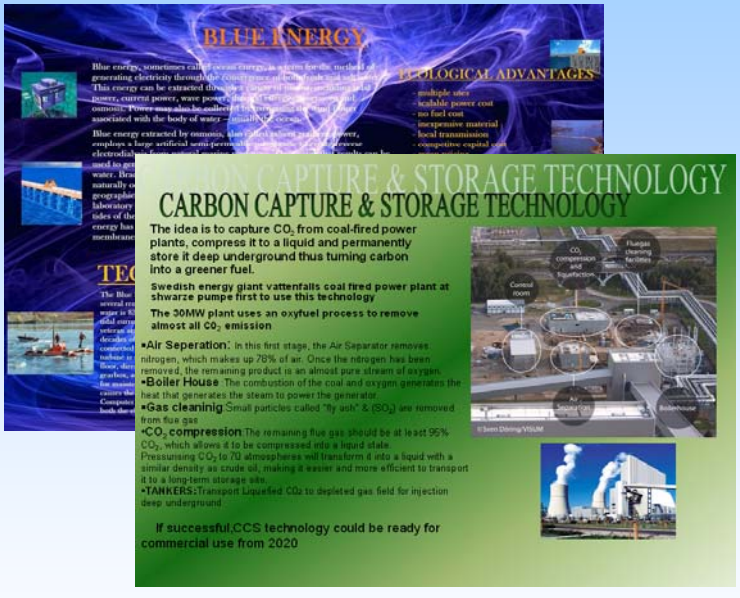
Athira. M

Student Posters

Abdul Azeem and Ajay Gopal of first year designed a poster on Blue- LEDs. These LEDs, invented in 1993 by Shuji Nakamura, a Japanese scientist, have a great improvement in illumination over conventional LEDs. They have already been put to use in the Blue ray Disc technology, an optical disc storage technology expected to replace CDs and DVDs. Other potential applications include High resolution Televisions, Image scanners, printers and in bio-medical instrumentation.

The TPV generator which is also called 'The midnight-sun' converts IR radiation into electricity by means of highly efficient solar cells. Fuel is burned continuously within a chamber to generate heat (IR radiation). TPV generators are already being used as auxillary power conversion devices. Viking-29, a hybrid car, is a notable project, where a TPV generator supports the IC engine, thereby leading to improved performance. This poster was prepared by Abeena Luiz and Aiswarya M.S of first year.





Other student posters included one on Blue Energy (by Alvin Kurien A and Amal Sharon) and another on Carbon capture and Storage Technology (by Amal G and Arjun. P)

Amidst the fusion and fission

(A report on the panel discussion organized by the Department of Electrical and Electronics on 'Energy Security of India –Challenges and Opportunities' on 24th September 2008 at RASET)

According to Prof. Suhas P Sukhathme, former chairman of Atomic Energy Regulatory Board, the nuclear deal with the United States has been well negotiated and will only serve to protect our indigenously developed nuclear programme.

He pointed out that only six percent of our energy requirement featured prominently on the list of those against the nuclear deal. In twenty years' time we would be producing almost four times the nuclear energy that we produce today. Addressing security concerns associated with the deal, he pointed out that only our civilian reactors have been put under IAEA safeguards, under the agreement.

He pointed out that the energy situation of the country, was quite grave, real and immediate. The best estimate is that there is enough oil only to last for 20 years. This, he said was reason enough for us to actively pursue alternative sources of energy.

India currently produces 4000MW electricity from nuclear power which is only three percent of the total power requirement. He opined that these figures are bound to increase when more technologies went into it.

As a concluding statement he expressed pride in the work done by the scientist fraternity in the development of India's nuclear energy programme.

Published by HOD, DEE, RASET, Rajagirivalley. Kochi, 682039, Edited by the Editorial Board

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