SPECIAL FEATURE

Digital Solar Inverter with Battery Auto-Charging

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Future of Artificial Intelligence

All of us have watched many Hollywood movies like I Robot, The Matrix and The Terminator portraying robots as super intelligent machines that are capable of 'thought processes'. Now researchers are bringing imagination to reality - experiments are being conducted to link biology and technology, in an attempt to create true cyborgs. The premise is that the robot will have a biological brain made up of human neurons. Inevitably, such attempts give rise to many social and ethical questions about Artificial Intelligence (AI). If these robots are to be more intelligent than humans then are they going to make important future decisions and will they have all the same social rights as humans? Extensive research is on-going to incorporate AI for the betterment of humanity. Actual AI goods and services are currently available in the market, like the personal assistant Siri in iPhone, self driven cars, Google search algorithms and IBM's Deep Blue and Watson. Most of today's artificial intelligence is known as narrow AI, capable of performing facial and pattern recognition, internet searches and similar tasks. But scientists are trying to create a strong AI which will outperform humans in cognitive aspects, which require actual 'thinking'. Moreover, different brain-computer interfaces are also being used for therapeutic purposes to diagnose and treat neurological and physiological disorders. The frontier of AI opens up avenues for connecting a human brain with a computer network through an implant, which will develop distinct features of machine intelligence in the long run. Robots will also be able to solve climate problems, storing a mind-boggling number of statistics. Using big data, AI could one day identify trends and use that information to come up with solutions to the world's biggest problems.In 2015, at the Artificial Intelligence conference held in Puerto Rico, research and deliberations showed that human level AI could likely be achieved by 2060. This would indeed be a significant milestone in the AI arena and the human-machine platform. Research is being carried out to develop Robots as companion. However, a company in Japan has made the first big steps toward a robot companion who can understand and feel emotions. In 2015 “Pepper” the companion robot went on sale. The robot was programmed to read human emotions, develop its own emotions, and help its human friends stay happy.

On the flip side, many famous scientists and entrepreneurs like Stephen Hawking, Elon Musk and Steve Wozniak have expressed serious concerns about the adverse effects of Artificial Intelligence. According to them, humans control the planet because they are the smartest; if we are no longer the smartest, are we still assured in retaining control? We are in a position where we have influence over how our future unfolds - we can use AI to our advantage and create a force to reckon with, that will benefit humankind.

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Automatic Load Frequency Control using Whale Optimization Algorithm

Abstract: *This project work proposes Whale Optimization Algorithm (WOA) based load frequency control for suppressing oscillations in the power system operation and control. WOA is a newly developed population based meta heuristic algorithm which is based on the hunting techniques of the humpback whales. The algorithm is divided basically into two phases: exploration and exploitation. This algorithm simulates hunting behavior with random or best search agent to chase the prey and the use of a spiral to simulate bubble net attacking method of humpback whales. The proposed work has considered two area non-reheat thermal systems which are equipped with proportional integral controllers (PI). WOA [1] is employed to minimize the integral time absolute error (ITAE) to obtain suitably designed controller parameters. The analysis shows that the performance of the proposed controller is much better than the conventional PI controller [2], GA [2] and BFOA [2]. Finding a proper balance between the exploration and exploitation phase is the most important job in this algorithm. We have taken a two area system to test the efficiency of this algorithm.*

Keywords: PI controller, ITAE, BFOA, WOA

I. Introduction

Power system is used for the conversion of natural energy to electric energy. For the optimization of electrical equipment, it is necessary to ensure the electric power quality. It is known three phase AC is used for transportation of electricity. During the transportation, both the active and reactive power balance must be maintained between the generation and utilization AC power. When either frequency or voltage changes equilibrium point will shift. Good quality of electrical power system means both the voltage and frequency to be fixed at desired values irrespective of change in loads that occurs randomly. It is in fact impossible to maintain both active and reactive power without control which would result in variation of voltage and frequency levels. To cancel the effect of load variation and to keep frequency and voltage level constant a control system is required. Though the active and reactive powers have a combined effect on the frequency and voltage, the control problem of the frequency and voltage can be separated. Frequency is mostly dependent on the active power and voltage is mostly dependent on the reactive power. Thus the issue of controlling power systems can be separated into two independent problems. The active power and frequency control is called as load frequency control (LFC). The most important task of LFC is to maintain the frequency constant against the varying active power loads, which is also referred as un- known external disturbance. Power exchange error is an important task of LFC .Generally a power system is composed of several generating units. To improve the fault tolerance of the whole power system, these generating units are connected through tie-lines. This use of tie-line power creates a new error in the control problem, which is the tie-line power exchange error. When sudden change in active power load occurs to an area, the area will get its energy through tie-lines from other areas. Eventually the area that is subject to the change in load should balance it without external support. Or else there will be economic conflicts between the areas. This is why each area requires separate load frequency controller to regulate the tie line power exchange error so that all the areas in an interconnected system can set their set points differently. In short, the LFC has two major duties, which are to maintain the desired value of frequency and also to keep the tie line power exchange under schedule in the presence of any load changes. Also, the LFC has to be unaffected by unknown external disturbances and system model and parameter variation. In order to maintain the load variation within the stability limits we are taking optimization techniques to control the controller parameter of the power system.

II. Control Design of System Under Study

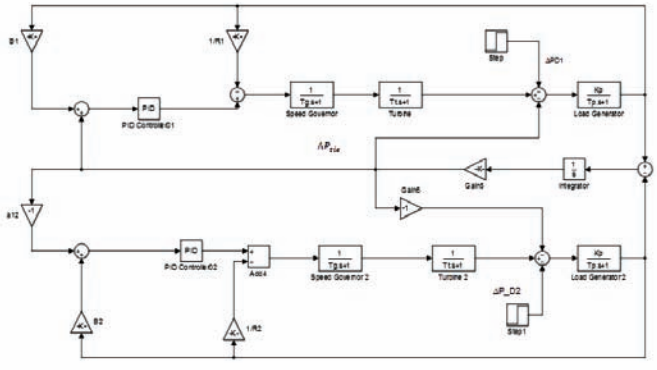

Fig. 1: Two Area system

This project takes into account three systems under study. This system consisting two identical areas of thermal non reheat turbine in each area with PID controller in different

modes of PI and PID. The multi-area system consists of hydro, thermal with reheat turbine and gas units. The models reheat turbines, hydro turbines, gas turbines are linearised and are used for simulation which has its own participation and regulation parameters. The parameters contribute to the nominal loading and summation of all participation factor of each control should be equal to 1. The two areas consider same to simplify analysis. A step load perturbation is given in area1 and the effect in frequency deviation in each area, area control area error (ACE1, ACE2), settling time, minimum damping ratio of each dynamic parameter and the stability of the system consider under observation.

In figure 1, f_i is the system frequency(Hz), R_1 is the regulation constant of area1, R_2 is the regulation constant of area2, T_{G1} the speed governor time constant of area1(s) ,T_{G2} the speed governor time constant of area2(s), T_{T1} is the turbine time constant of area1(s), T_{T2} is the turbine time constant of area2(s) and T_{P1} is the power system time constant of area1(s), T_{P2} is the power system time constant of area2(s), ACE_1 is the area control error of area1, ACE_2 is the area control error of area2, ? P_{D1} is the load demand change of area1, ? P_{D2} is the load demand change of area2, ? P_{G1} is the change in governor valve position for area1, ? P_{G2} is the change in governor valve position for area2, K_{P1} is the power system gain of area1, K_{P2} is the power system gain of area2 and ? P_{tie} is the change in tie-line power,B_1 is the stiffness constant of area1, B_2 is the stiffness constant of area2.

2.2. Problem Formulation

For the two area system, a performance index can be defined by the Integral of time multiply Absolute Error (ITAE) of the frequency deviation of both areas and tie line power, the objective function J is given by

$$J=\int_0^\infty t(|\Delta f_1| + |\Delta f_2| + |\Delta P_{tie}|)dt$$

Based on this objective function J optimization problem can be stated as:

Minimize $J=\int_0^\infty t(|\Delta f_1| + |\Delta f_2| + |\Delta P_{tie}|)dt$

Subjected to: $K_p^{min} \le K_p \le K_p^{max}$
$K_i^{min} \le K_i \le K_i^{max}$

To simplify the study, the interconnected areas were considered identical. The optimal parameter are such that K1=K2=K. The study focuses on the optimal tuning of the controllers for LFC and tie power control using Whale Optimization Algorithm. The aim of the optimization is to search for the optimum controller parameters setting that maximize the minimum damping ratio of the system. On the other hand the goals are control of frequency and inter area tie line power with good oscillation damping and also obtaining a good performance under all operating conditions.

Whale Optimization Algorithm

3.1. Introduction

WOA is a population based newly developed algorithm. This algorithm includes three operators to simulate the search for prey, encircling prey, and bubble net foraging behavior of humpback whales. Algorithm describes the special hunting behavior of humpback whales, the whales follows the typical bubbles causes the creation of circular or '9-shaped path' while encircling prey during hunting. Simply bubble-net feeding/hunting behavior could understand such that humpback whale went down in water approximate 10-15 meter and then after the start to produce bubbles in a spiral shape encircles prey and then follows the bubbles and moves upward the surface. Mathematic model for Whale Optimization algorithm (WOA) is given by the encircling prey and bubble-net prey method.

3.2. Origin of WOA

Whale Optimization Algorithm was proposed by Seyedali Mirjalili and Andrew Lewis in 2016 by studying the preying technique of humpback whales. Using the knowledge of previously used optimization techniques and observing the preying pattern of nine humpback whales the optimization technique was derived.

3.3. WOA Concept

This algorithm includes three operators to simulate the search for prey, encircling prey, and bubble net foraging behavior of humpback whales. Algorithm describes the special hunting behavior of humpback whales, the whales follows the typical bubbles causes the creation of circular or '9-shaped path' while encircling prey during hunting. Simply bubble-net feeding/hunting behavior could understand such that humpback whale went down in water approximate 10-15 meter and then after the start to produce bubbles in a spiral shape encircles prey and then follows the bubbles and moves upward the surface. Mathematic model for Whale Optimization algorithm (WOA) is given by the encircling prey and bubble-net prey method. Humpback whales can recognize the location of prey and encircle them. Since the position of the optimal design in the search space is not known a priori, the WOA algorithm

assumes that the current best candidate solution is the target prey or is close to the optimum. After the best search agent is defined, the other search agents will hence try to update their positions towards the best search agent.

The same concept can be extended to a search space with *n* dimensions, and the search agents will move in hyper-cubes around the best solution obtained so far. As mentioned in the previous section, the humpback whales also attack the prey with the bubble-net strategy. In order to mathematically model the bubble-net behavior of humpback whales, two approaches are designed shrinking encircling mechanism and spiral updating position. Population-based meta-heuristic optimization algorithms share a common feature regardless of their nature. The search process is divided into two phases: exploration and exploitation. Exploration is the ability of expanding search phase, where the exploration is the ability of finding the optima around a good solution. In premier iterations, a heuristic search algorithm explores the search space to find new solutions. To avoid trapping in a local optimum, the algorithm must use the exploration in the first little iteration. So exploration phase is an important part in the population based heuristic algorithm. By lapse of iterations exploration fades out and exploitation fades in so the algorithm tunes itself in semi optimal points. Although mutation and other evolutionary operations might have been included in the WOA formulation to fully reproduce the behavior of humpback whales, we decided to minimize the amount of heuristics and the number of internal parameters thus implementing a hybrid scheme of a very basic version of the WOA algorithm and swarm optimization algorithm.

Population-based meta-heuristic optimization algorithms share a common feature regardless of their nature. The search process is divided into two phases: exploration and exploitation. Exploration is the ability of expanding search phase, where the exploration is the ability of finding the optima around a good solution. In premier iterations, a heuristic search algorithm explores the search space to find new solutions. To avoid trapping in a local optimum, the algorithm must use the exploration in the first few iterations. So exploration phase is an important part in the population based heuristic algorithm. By lapse of iterations exploration fades out and exploitation fades in so the algorithm tunes itself in semi optimal points.

To have a high performance search, an essential key is a suitable trade-off between exploration and exploitation. All the population based heuristic algorithms employ the exploration and exploitation phase but they use different approaches and operators. In general they have a common framework but their approaches are quite different from each other. The members of a population based search algorithm pass three steps in each iteration to realize the concepts of exploration and exploitation: self-adaption, cooperation and competition. In self adaption step each member improves its performance. In the cooperation step members collaborate with each other by information transferring. Finally in the competition step members compete to survive. These steps have usually are in stochastic forms and could be realised in different ways. These steps inspired from nature are the principle ideas of the population based heuristic algorithms. These concepts guide an algorithm to find a global optimum. However all population based search algorithms provide satisfactory results but there is no heuristic algorithm that could provide a superior performance than others in solving all optimization algorithms. In other words, an algorithm may solve some problems better and some worse than others. Hence proposing new high performance heuristic algorithms are always welcome. This optimization process is carried out with three basic operations mutation, crossover and selection operators, to reach an optimal solution.

The basic steps used in the WOA optimization algorithm are-

1. Initialization
2. Mutation
3. Crossover
4. Selection

WOA is a simple population based, meta heuristic algorithm. This algorithm is based on the hunting techniques of the humpback whales. The most interesting thing about the humpback whales is their special hunting method. This foraging behavior is called bubble-net feeding method. Humpback whales prefer to hunt school of krill or small fishes close to the surface. It has been observed that this foraging is done by creating distinctive bubbles along a circle or '9'-shaped path as shown in Figure. 2

Fig. 2: 9- shaped path of Whales

Humpback whales can recognize the location of prey and encircle them. Since the position of the optimal design in the search space is not known a priori, the WOA algorithm assumes that the current best candidate solution is the target prey or is close to the optimum. After the best search agent is defined, the other search agents will hence try to update their positions towards the best search agent.

III. Simulation Results And Discussions

The proposed WOA algorithm has been applied to the system to ensure its feasibility and applicability. All this work was implemented in MATLAB R2015a on a computer system (INTEL(R) Core i5 CPU@ 2.8 GHz, 8GB RAM), 64bit operating system. The integral time absolute error was optimized using WOA algorithm to obtain the optimized values of the convergence curve. In this paper multi-area system has been considered for verification of results.

This WOA problem has been simulated for two area systems for two controllers. The values of controllers were taken from ref.[2]. In order to tune our controller values we used the value of constant 'e' taken as 0.22. We simulated the algorithm for 20 iterations for 30 sec duration for several times. We compared our ITAE values with other optimization techniques and we obtained best among other ITAE values. Settling time using WOA was better as compared to other optimization techniques except BFOA which was very close to that of WOA. Damping ratio is better as compared to other optimization techniques. The results of change of frequency in area 1 and 2 are shown in figure 3 and 4.

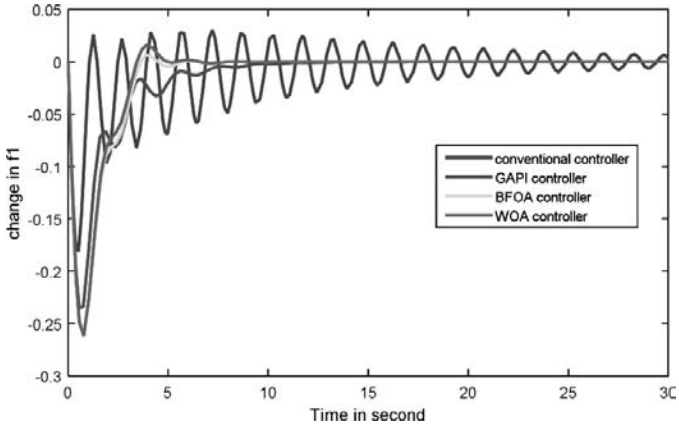

Fig. 3: Change in Frequency In Area 1

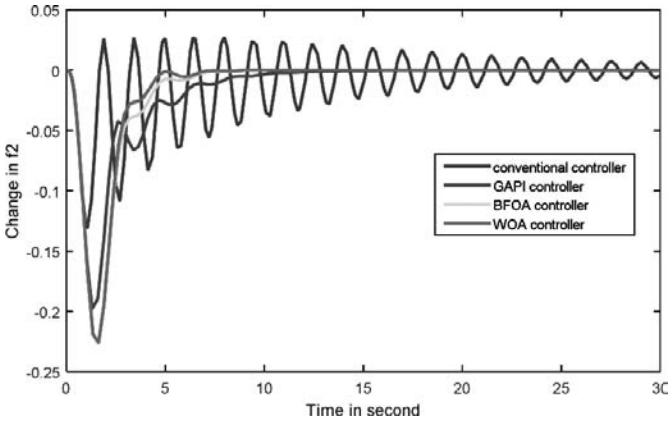

Fig. 4: Change in Frequency in Area 2

The results of change in tie line power is shown in figure 5 using controller optimized by different optimization techniques.

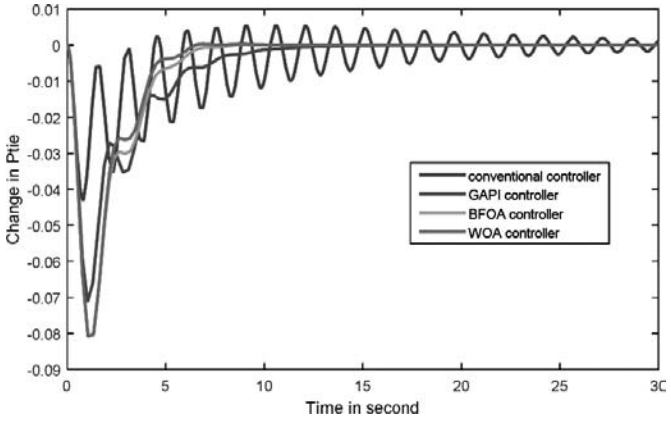

Fig. 5: Change in Tie Line Power

V. Conclusions

WOA was successfully implemented on two area system. It has an ability to find out optimum solution with constrained handling which includes both equality and inequality constraints. While obtaining optimum solution constraint limits should not be violated. Adaptive technique causes faster convergence, randomness and stochastic behavior for improving solutions. The WOA result of various unconstrained problems proves that it is also an effective method in solving challenging problems within unknown search space.

VI. Acknowledgements

We would like to express our gratitude to our project guide and head of department Dr. Rajkishore Swain for his inspiration, excellent guidance, continuing encouragement and unwavering confidence and support during every stage of this project work without which, it would not have been possible for us to complete this task successfully. We would also like to convey our sincere gratitude to all other faculty members and staff members of Electrical and Electronics Engineering department, SIT Bhubaneswar, who bestowed their great effort and guidance at appropriate times without which it would have been very difficult to complete our project work.

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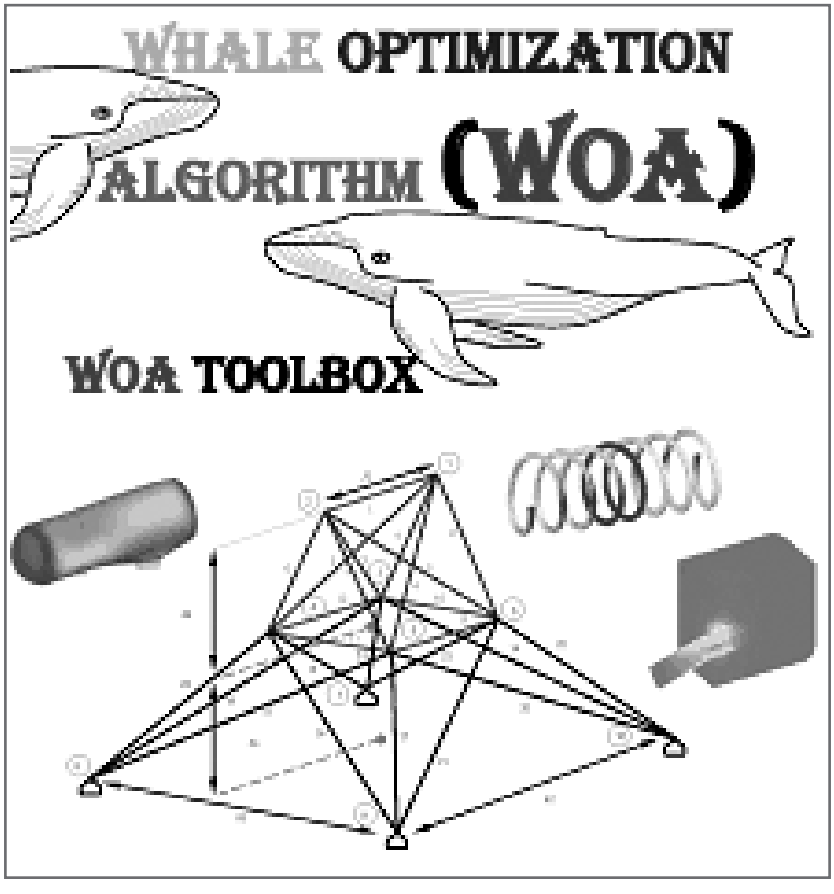

Digital Solar Inverter with Battery Auto-Charging

Abstract: *The aim of this article is to design and implement a single phase inverter which can convert DC voltage to AC voltage. Solar and wind powered electricity generation are being favoured nowadays as the world increasingly focuses on environmental concerns. Power inverters, which convert solar-cell DC into domestic-use AC, are one of the key technologies for delivering efficient AC power. A low voltage DC source is inverted into a high voltage AC source in a two-step process. First the DC voltage is stepped up using a boost converter to a much higher voltage. This high voltage DC source is then transformed into an AC signal using pulse width modulation. Another method involves first transforming the DC source to AC at low voltage levels and then stepping up the AC signal using a transformer. The latter method is the one used to implement this project.To deliver such performance, Arduino Uno R3, a microcontroller board based on the ATmega328P is used. Therefore this microcontroller is the heart of the system and controls entire system. The microcontroller is programmed using embedded C compiler. The output is then amplified, fed to power stage and finally to transformer.The design is essentially focused upon low power electronic home appliances. To build the design it is first mathematically modelled then is simulated in Multisim and finally the results are practically verified.*

I. Introduction

Solar energy is radiant light and heat from the Sun that is harnessed using a range of ever-evolving technologies such as solar heating, photovoltaic, solar thermal energy, solar architecture. The large magnitude of solar energy available makes it a highly appealing source of electricity.Advances in microcontroller technology have made it possible to perform functions that were previously done by analog electronic components. With multitasking capability, microcontrollers today are able to perform functions like comparator, analog to digital conversion (ADC), setting input/output (I/O), counters/timer, among others replacing dedicated analog components for each specified tasks, greatly reducing number of component in circuit and thus, lowering component production cost. Flexibility in the design has also been introduced by using microcontroller with capability of flash programming/reprogramming of tasks.

The proposed approach is to replace the conventional method with the use of microcontroller. In this project ArduinoUno R3 microcontroller was used. It has low cost and reduces the complexity of the circuit. The focus of this report is on the design and prototype testing of a DC to AC inverter which efficiently transforms a DC voltage source to a high voltage AC source similar to the power delivered through an electrical outlet (220Vrms, 50Hz) with a power rating of approximately 100W.

II. Description

The overall inverter can be viewed in different stages which are connected to give desired output. There are mainly three stages in the construction of inverter. These stages are described below as shown in Fig. 1:

Driver stage:

The tasks that are performed in driver stage are generation of modified sine wave, monitoring the battery voltage, handling the other housekeeping tasks such as short circuit protection, overload protection etc.Cd4047 IC can be used to generate modified sine wave. But here we are using Arduino Uno R3. Battery voltage is monitored every 20ms using timer interrupt.

Power Stage:

As the inverter output power is 100VA and it is 75% efficient. Now this current amplification task is performed by the power stage. In this stage, two N-Mosfets are configured in push-pull topology to amplify the current. Mosfet's chosen are IRFZ44N.

Transformer:

Now this is very simple, the output waveform from the push-pull topology is fed into the step-up transformer to generate the 220V.

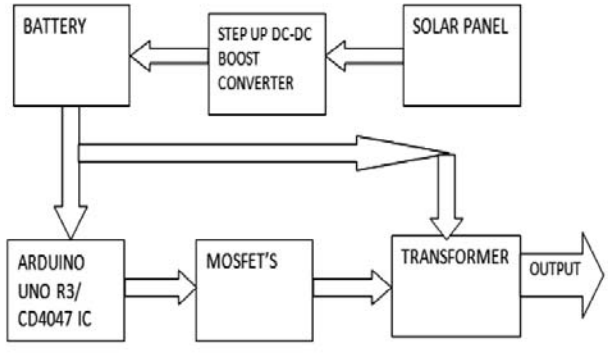

Fig. 1: Block Diagram

III. Elements of the Inverter

i) Solar Panel

Fig. 2: Solar Panel

In this project, we are using solar panel made up of 4x9 solar cells as shown in Fig. 2. The specifications are as follows:

- Maximum power- 10W
- Voltage at maximum power-17.40V
- Current at maximum power-0.58A
- Open circuit voltage-21.2V
- Short circuit current-0.66A

ii) STEP UP DC-DC

Fig. 3: Step up DC-DC module

This DC-DC Module as shown in fig3 is based on IC XL6009E1 which is a high-performance step-up switching current (BOOST) module. The DC output voltage from the battery is in relatively small amplitude compared to standard nominal single phase voltage rating for use with domestic household products or to be transferred at grid.

iii) Battery

Fig. 4: 12V Battery

Lead-acid battery of 12v is used which is rechargeable and capacity is 7Ah. A twelve-volt battery has six single cells in series producing a fully charged output voltage of 12volts shown in fig 4.

iv) CD4047

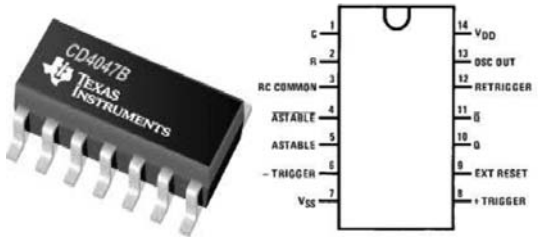

Fig. 5: Pin Configuration of CD4047

The IC can be configured as a running as table mode and also monostable mode. In-built oscillator with variable frequency option through an external RC circuit.

v) Arduini Uno r3

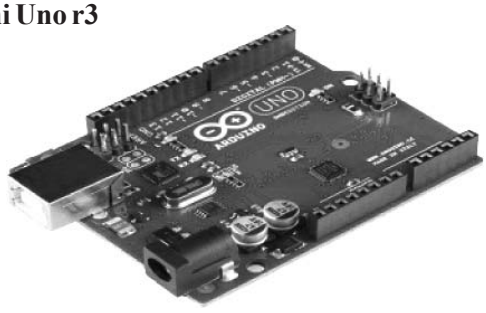

Fig. 6: Arduino Uno R3

Arduino Uno is a microcontroller board based on the ATmega328P (datasheet). It has 14 digital input/output pins (of which 6 can be used as PWM outputs), 6 analog inputs, a 16 MHz quartz crystal, a USB connection, a power jack, an ICSP header and a reset button.

vi) Power MOSFETS

Fig. 6: IRFZ44N MOSFET

A power MOSFET is a specific type of metal oxide semiconductor field-effect transistor (MOSFET) designed to handle significant power levels. Advantages are high switching speed and good efficiency at low voltages. The design of power MOSFETs was made possible by the evolution of CMOS technology, developed for manufacturing integrated circuits in the late 1970s.

vii) Transformer

Fig. 7: Transformer

A transformer is an electrical device shown in fig.7 that transfers electrical energy between two or more circuits through electromagnetic induction. Step up transformer is used in electronics circuit where voltage boosting is required.

viii) Implementation and Results

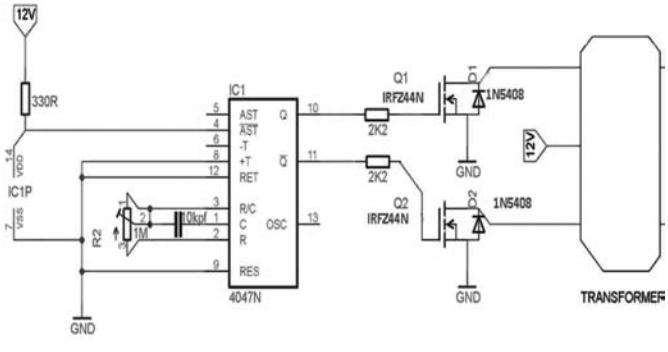

Fig. 8: Circuit Diagram

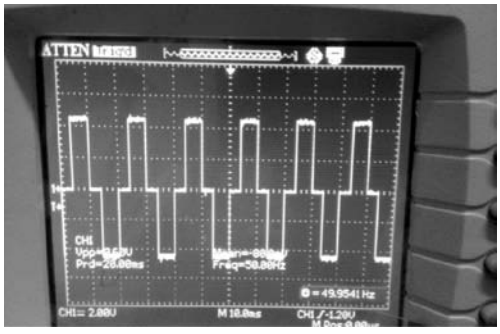

Fig. 9: Output - Modified Sine Wave

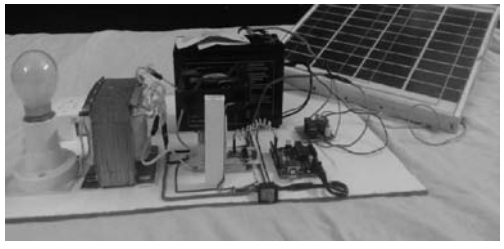

Fig. 10: Complete Inverter Circuit

V. Conclusions

Some of the important conclusions that can be drawn from this work are:Output waveform frequency was found to be satisfactory at 50Hz equivalent of standard power system.Modified sine pulse with modulation circuit is much simplified by the use Arduino Uno R3 microcontroller. In addition with the high programming flexibility the design of the switching pulses can be altered without further changes on the hardware.

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Performance Analysis of Boost Converter Using Different MPPT Algorithms

Abstract: *The clean and silent nature of producing power through solar cells has made the evolution of Photovoltaic (PV) power generation as one of the premier mode of power generation globally.*

The efficiency of the PV plant is a major concern as it depends mainly on the functioning of PV Panel, the Inverter and the Maximum Power Point Tracking (MPPT) algorithm .MPPT algorithms are necessary because PV arrays have a Non-Linear voltage-current characteristic with a unique point where power produced is maximum. The objective of the thesis is to compare two different MPPT algorithms: Perturb & Observe (P & O) and Incremental Conductance (IC) on the basis of switching characteristics of a Boost Converter with a resistive load .The non-linear power converter is first linearized using the state space averaging technique and the pulse to trigger the Mosfet is provided through a PWM process. The direct method of MPPT control algorithm is used for switching and regulating the output voltage of the converter.

The Matlab and Simulink environment is used for modelling and finally the performance of the converter with and without MPPT is simulated and compared.

I. Introduction

One of the major concerns in the power sector is the day-to-day increasing power demand but the unavailability of enough resources to meet the power demand using the conventional energy sources. Demand has increased for renewable sources of energy to be utilized along with conventional systems to meet the energy demand. Renewable sources like wind energy and solar energy are the prime energy sources which are being utilized in this regard. The continuous use of fossil fuels has caused the fossil fuel deposit to be reduced and has drastically affected the environment depleting the biosphere and cumulatively adding to global warming.

Solar energy is abundantly available that has made it possible to harvest it and utilize it properly. Solar energy can be a standalone generating unit or can be a grid connected generating unit depending on the availability of a grid nearby. Thus it can be used to power rural areas where the availability of grids is very low. Another advantage of using solar energy is the portable operation whenever wherever necessary.

In order to tackle the present energy crisis one has to develop an efficient manner in which power has to be extracted from the incoming solar radiation. The power conversion mechanisms have been greatly reduced in size in the past few years. The development in power electronics and material science has helped engineers to come up very small but powerful systems to withstand the high power demand. But the disadvantage of these systems is the increased power density. Trend has set in for the use of multi-input converter units that can effectively handle the voltage fluctuations. But due to high production cost and the low efficiency of these systems they can hardly compete in the competitive markets as a prime power generation source.

+The constant increase in the development of the solar cells manufacturing technology would definitely make the use of these technologies possible on a wider basis than what the scenario is presently. The use of the newest power control mechanisms called the Maximum Power Point Tracking (MPPT) algorithms has led to the increase in the efficiency of operation of the solar modules and thus is effective in the field of utilization of renewable sources of energy.

II. Problem Statement

Photovoltaic (PV) generation is becoming increasingly important as a renewable source since it offers many advantages such as incurring no fuel costs, not being polluting, requiring little maintenance, and emitting no noise, among others. The photovoltaic array is an unstable source of power since the peak power point depends on the temperature and the irradiation level. Therefore, to maximize the efficiency of the renewable energy system, it is necessary to track the maximum power point of the input source. The I-V and P-V characteristic curves specify a unique operating point at which maximum possible power is delivered. At the MPP, the PV operates at its highest efficiency.

To improve its efficiency, a PV must work at maximum power point which is always change depends on sun irradiation and temperature. A change of temperature and irradiation shifts the maximum power point and reduce the PVs efficiency. The maximum power point tracking (MPPT) usually is implemented by a power electronic circuit which provides an interface between PV and load.

A DC to DC converter is needed for implementing MPPT. The DC-DC converter delivers the maximum power from PV module to load by adjusting the duty cycle and able to distribute a maximum power when load is changes.

This project is dealing with implementation of IC on Boost converter by adjusting its PWM duty cycle. Boost converter generates bigger or lower voltage output depends on the duty cycle.

III. Block Diagram

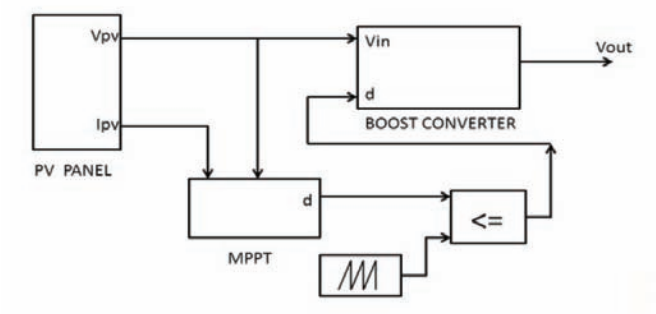


Fig. 1 : Block diagram

The voltage from PV panel is fed both to the MPPT tracker and to the boost converter. The MPPT tracks the maximum power point and sends a corresponding duty cycle to the boost converter for maximum power output to the load.

IV. Solar Cell Modeling

A solar cell is the building block of a solar panel. A photovoltaic module is formed by connecting many solar cells in series and parallel. Considering only a single solar cell; it can be modeled by utilizing a current source, a diode and two resistors. This model is known as a single diode model of solar cell. Two diode models are also available but only single diode model is considered here as shown in fig 2.

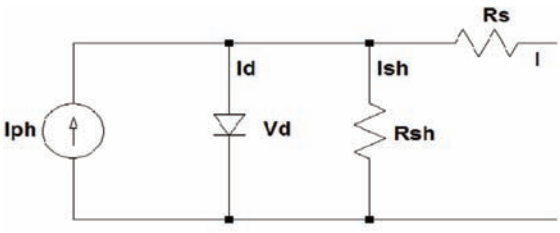


Fig. 2: Single diode model of a solar cell

The characteristic equation for a photovoltaic cell is given by:-

$$I = Ilg - Ios * \left[exp\left\{q * \frac{V + I * Rs}{A * K * T}\right\} - 1\right] - \frac{V + I * Rs}{R_{sh}}$$

Where,

$$Ios = Ior * \left(\frac{T}{T_r}\right)^3 * \left[exp\left\{q * Ego * \frac{\frac{1}{T_r} - \frac{1}{T}}{A*K}\right\}\right]$$

$$Ilg = \{Iscr + Ki * (T - 25)\} * lambda$$

I & V : Cell output current and voltage;

I_{0s} : Cell reverse saturation current;

T : Cell temperature in Celsius;

k : Boltzmann's constant, 1.38 * 10^{-19} J/K;

q : Electron charge, 1.6*10-23 C;

K_i : Short circuit current temperature coefficient at Iscr;

lambda : Solar irradiation in W/m^2;

I_{scr} : Short circuit current at 25 degree Celsius;

I_{lg} : Light-generated current;

E_{go} : Band gap for silicon;

A : Ideality factor;

T_r : Reference temperature;

I_{or} : Cell saturation current at Tr;

R_{sh} : Shunt resistance;

R_s : Series resistance;

The characteristic equation of a solar module is dependent on the number of cells in parallel and number of cells in series. It is observed from experimental results that the current variation is less dependent on the shunt resistance and is more dependent on the series resistance.

$$I = Np * Ilg - Np * los * \left[exp\left\{q * \frac{\frac{V}{N_s} + I + \frac{R_s}{N_p}}{A * K * T}\right\}\right] - \frac{V * (\frac{N_p}{N_s}) + I * R_s}{R_{sh}}$$

The I-V and P-V curves for a solar cell are given in the following figure. It can be seen that the cell operates as a constant current source at low values of operating voltages and a constant voltage source at low values of operating current

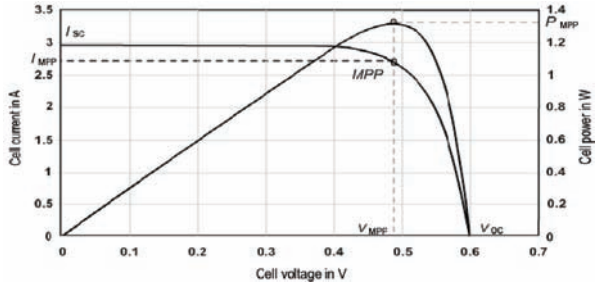


Fig. 3 : P-V I-V curve of a solar cell at given temperature and solar irradiation.

A. Effect of variation of solar radiation

The P-V and I-V curves of a solar cell are highly dependent on the solar irradiation values. The solar irradiation as a result of the environmental changes keeps on fluctuating, but control mechanisms are available that can track this change and can alter the working of the solar cell to meet the required load demands. Higher is the solar irradiation, higher would be the solar input to the solar cell and hence power magnitude would increase for the same voltage value. With increase in the solar irradiation the open circuit voltage increases. This is due to the fact that, when more sunlight incidents on to the solar cell, the electrons are supplied with higher excitation energy, thereby increasing the electron mobility and thus more power is generated as shown in fig 4 & fig 5.

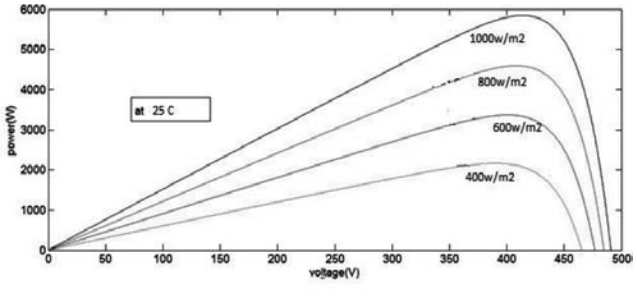


Fig. 4: Variation of P-V curve with solar irradiation

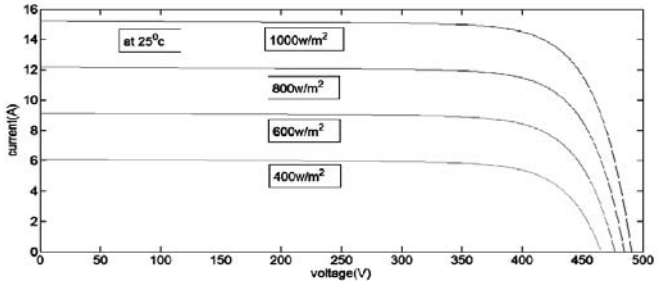


Fig. 5: Variation if I-V curve with solar radiation

V. Maximum Power Point Tracking

Maximum power point tracking is a technique used commonly with wind turbines and photovoltaic(PV) solar systems to maximize power extraction under all conditions. Although solar power is mainly covered, the principle applies generally to sources with variable power: for example, optical power transmission. Maximum power point tracking technique is used to improve the efficiency of the solar panel.

B. Perturb & Observe Algorithm

The Perturb & Observe algorithm states that when the operating voltage of the PV panel is perturbed by a small increment, if the resulting change in power _P is positive, then we are going in the direction of MPP and we keep on perturbing in the same direction. If P is negative, we are going away from the direction of MPP and the sign of perturbation supplied has to be changed.

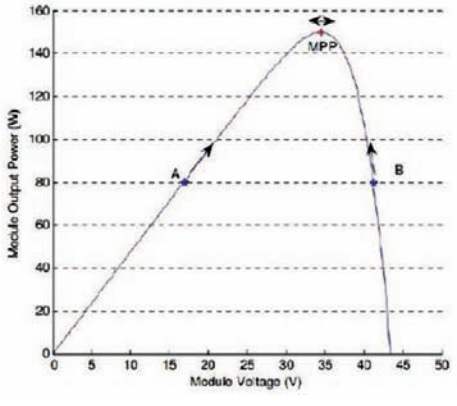


Fig. 5: MPPT operating points A and B

Figure 5 shows the plot of module output power versus module voltage for a solar panel at a given irradiation. The point marked as MPP is the Maximum Power Point, the theoretical maximum output obtainable from the PV panel. Consider A and B as two operating points. As shown in the figure above, the point A is on the left hand side of the MPP. Therefore, we can move towards the MPP by providing a positive perturbation to the voltage. On the other hand, point B is on the right hand side of the MPP. When we give a positive perturbation, the value of P becomes negative, thus it is imperative to change the direction of perturbation to achieve MPP.

Limitations-In a situation where the irradiance changes rapidly, the MPP also moves on the right hand side of the curve. The algorithm takes it as a change due to perturbation and in the next iteration it changes the direction of perturbation and hence goes away from the MPP as shown in the figure.

However, in this algorithm we use only one sensor, that is the voltage sensor, to sense the PV

array voltage and so the cost of implementation is less and hence easy to implement. The time complexity of this algorithm is very less but on reaching very close to the

MPP it doesn't stop at the MPP and keeps on perturbing in both the directions. When this happens the algorithm has reached very close to the MPP and we can set an appropriate error limit or can use a wait function which ends up increasing the time complexity of the algorithm.

C. Incremental Conductance

The disadvantage of the perturb and observe method to track the peak power under fast varying atmospheric condition is overcome by IC method . The IC can determine that the MPPT has reached the MPP and stop perturbing the operating point. If this condition is not met, the direction in which the MPPT operating point must be perturbed can be calculated using the relationship between dl/dV and –I/V This relationship is derived from the fact that dP/dV is negative when the MPPT is to the right of the MPP and positive when it is to the left of the MPP. This algorithm has advantages over P&O in that it can determine when the MPPT has reached the MPP, where P&O oscillates around the MPP. Also, incremental conductance can track rapidly increasing and decreasing irradiance conditions with higher accuracy than P and O.

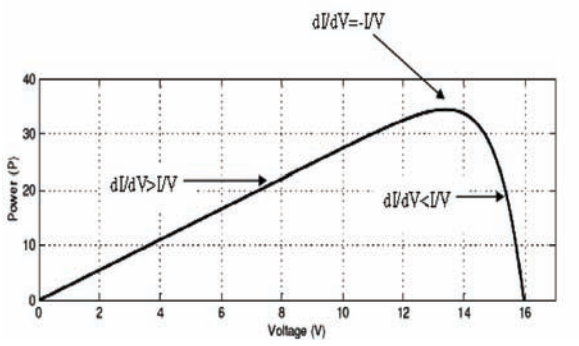


Fig. 6: Slope of PV curve a MPP

Fig. 6. shows that the slope of the P-V array power curve is zero at the MPP, increasing on the left of the MPP and decreasing on the Right hand side of the MPP. The basic equations of this method are as follows.

$$\frac{dI}{dV} = -\frac{1}{V} \quad \text{at MPP} \qquad (1)$$

$$\frac{dI}{dV} > -\frac{1}{V} \quad \text{left of MPP} \qquad (2)$$

$$\frac{dI}{dV} < -\frac{1}{V} \quad \text{right of MPP} \qquad (3)$$

Incremental conductance method uses two voltage and current sensors to sense the output voltage and current of the PV array. This method exploits the assumption of the ratio of change in output conductance is equal to the negative output Conductance Instantaneous conductance. We have,

$$P = VI$$

Applying the chain rule for the derivative of products yields to

$$\frac{\partial P}{\partial V} = \frac{[\partial (VI)]}{\partial V}$$

At MPPT, as $$\frac{\partial P}{\partial V} = 0$$

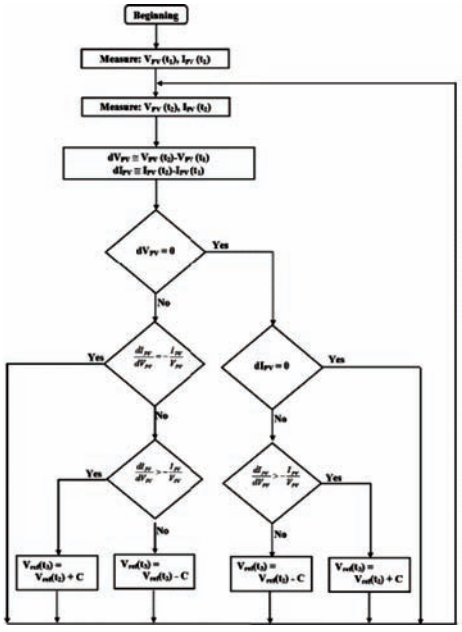
The above equation could be written in terms of array voltage V and array current I as

$$\frac{\partial I}{\partial V} = -\frac{I}{V}$$

The MPPT regulates the PWM control signal of the dc – to – dc boost converter until the condition:

$$\frac{\partial I}{\partial V} + \frac{I}{V} = 0$$

is satisfied. In this method the peak power of the module lies at above 98% of its incremental conductance.



VI. Boost Converter

A boost converter (step-up converter) is a DC-to-DC power converter that steps up voltage (while stepping down current) from its input (supply) to its output (load). It is a class of switched-mode power supply (SMPS) containing at least two semiconductors (a diode and a transistor) and at least one energy storage element: a capacitor, inductor, or the two in combination. To reduce voltage ripple, filters made of capacitors (sometimes in combination with inductors) are normally added to such a converter's output (load-side filter) and input (supply-side filter).

A. State Variables

The internal state variables are the smallest possible subset of system variables that can represent the entire state of the system at any given time. The minimum number of state variables required to represent a given system, n is usually equal to the order of the system's defining differential equation. If the system is represented in transfer function form, the minimum number of state variables is equal to the order of the transfer function's denominator after it has been reduced to a proper fraction. It is important to understand that converting a state-space realization to a transfer function form may lose some internal information about the system, and may provide a description of a system which is stable, when the state-space realization is unstable at certain points. In electric circuits, the number of state variables is often, though not always, the same as the number of energy storage elements in the circuit such as capacitors and inductors. The state variables defined must be linearly independent, i.e., no state variable can be written as a linear combination of the other state variables or the system will not be able to be solved.

B. Linearization

The output from the boost converter can be linearized by using state space averaging method. After applying state space averaging method to the matrices, we get the results as follows.

$$\frac{\widetilde{V_0}(s)}{\tilde{d}(s)} = C[SI - A]^{-1}\,[(A_1 - A_2)x + (B_1 - B_2)V_d] + (C_1 - C_2)$$

VII. Simulation and Results

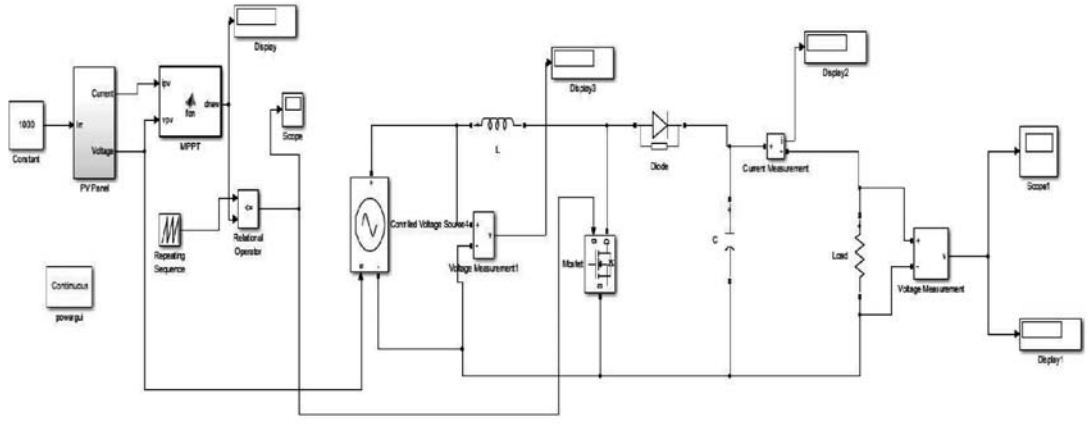


Fig. 8: Complete simulink model in matlab

P-V characteristics of PV panel:

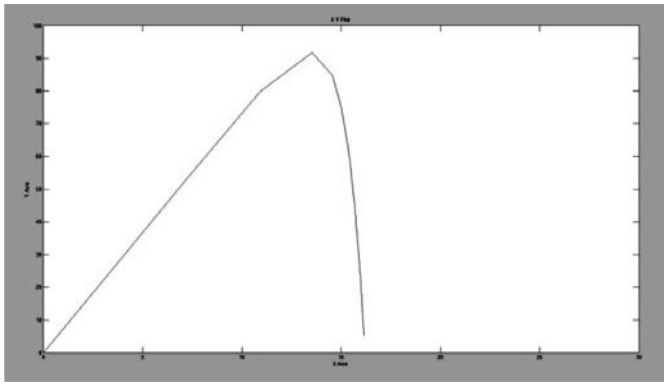


Fig. 9: P-V curve of simulated PV panel

I-V characteristics of PV panel:

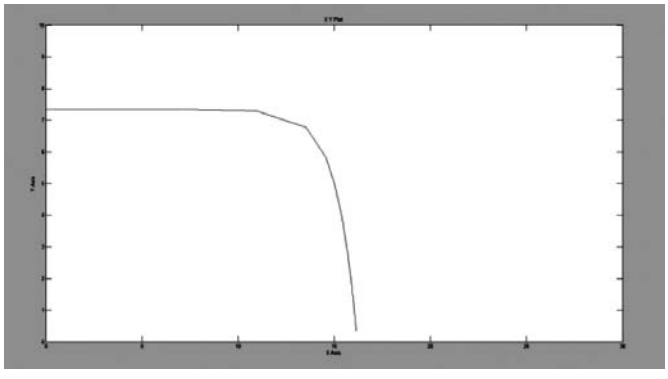


Fig. 10: I-V curve of simulated PV panel

Output waveform of boost converter without mppt:

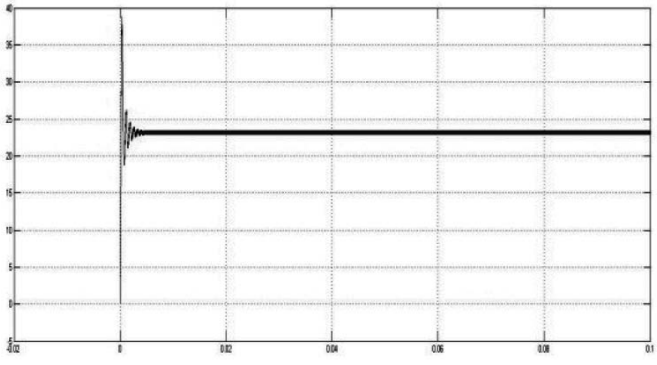


Fig. 11: Output waveform of boost converter

VIII. Results

Output of boost converter with incremental conductance mppt.

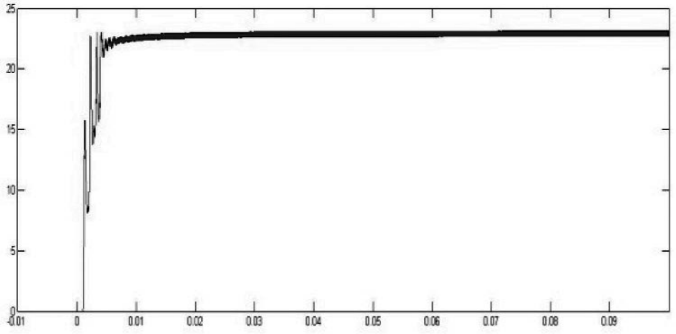


Fig. 12: Output of boost converter with incremental conductance

It can be noticed that with the use of incremental conductence that the overshoot has decreased considerably and also the steady state is reached quickly.

Output of boost converter with p & o mppt.

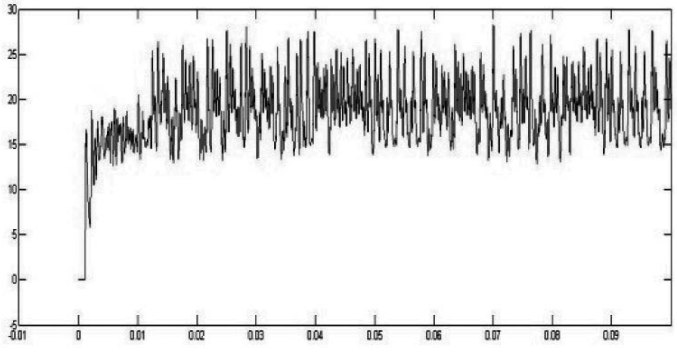


Fig. 13: Output of boost converter with p&o mppt.

Table-I Analysis of output waveforms.

PERFORMANCE PARAMETERS	B00ST CONVERTER WITHOUT MPPT CONTROL	BOOST COVERTER WITH MPPT (IC)	BOOST CONVERTER WITH MPPT (P&O)
INPUT VOLTAGE	16V	16.18V	16.18V
OUTPUT VOLTAGE	23.39V	23.12V	19.28V
V_{peak}	38.87V	23V	28.2V
t_{peak}	3.5×10^{-4} sec	3.35 msec	3.35msec
MAXIMUM OVERSHOOT	142.93%	44.5%	74.29%

With $l_{rr} = 1000 W/m^2$, $V_{PV} = 16.18 V$

IX. Conclusions

Here, it was targeted to analyze MPPT implementation on boost converter by using Incremental Conductance method. The performance was compared to P&O algorithm. PV system, MPPT and Boost converter were simulated on Matlab Simulink. The simulation result shown the IC method had a better performance when it compared to P&O method. Using IC method, the output of boost converter had less maximum overshoot as compare to P&O method. The IC method also successfully suppressed the oscillation around MPP point. Using IC method the transient was less in output where as using P&O algorithm, transient was more. Hence by comparing the two MPPT techniques, it was observed that Incremental Conductance method is better than P&O method.

X. References

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Earthquake Lights…..a rare and unusual phenomena

On September 8, 2017 the world witnessed a very unusual scientific phenomena - Earthquake Lights ! Mexico was hit by a magnitude 8.2 earthquake, and mysterious bright blue and green flashes of light emanating from the ground lit up the night sky of Mexico City, witnessed by many. These lights are often associated with severe earthquakes, typically of magnitude 6 or higher. Scientists theorize that massive amounts of energy due to tectonic plate movements were released, resulting in this rare occurrence.

One explanation is that the generation of lights as a result of earthquakes could be due to the ionization of oxygen to oxygen anions. These ions can travel through small cracks and fissures in the rocks until they reach the atmosphere forming plasma light.

Another plausible hypothesis points to the creation of an intense electric field caused by the movement of rocks containing quartz minerals; when two rocks rub against one another a positive voltage spike could result on a large scale, which in turn may produce earthquake lights.

Unsupervised Change Detection Techniques of Remotely Sensed Images

Abstract: *In the last decades there has been a huge increase in number of satellites and the sensors around the earth's surface which has helped us to remotely sense changes happening around the world. By making use of these data from the satellite, we can analyze and improve some of the aspects of our generation like study of land occupation changes, study on changes in cultivable lands, change in population, assessment of deforestation and so on. In general the output of a satellite can be considered as images which vary with time called the multi temporal images. Remote sensing has been improved drastically with new and improved sensors, as consequence of which improved quality of multi temporal images are obtained which in turn increases the need for better tools and techniques to analyze the changes. Change detection is such a process in which we can able to find the deviation between two images taken at different time. We are going to study some of the existing unsupervised techniques of change detection and we will try to improvise it.*

I. Introduction

Change detection is a process of detecting the temporal effects of multi-temporal images. This process is used for finding out the changes in land covers over time by analyzing the remotely sensed images of a geographical area captured at different time instances. Changes can occur due to natural hazards, urban growth, deforestation, etc.

There are various applications of change detection such as land use analysis, monitoring urban growth, burned area identification, etc. Change detection can be viewed as an image segmentation problem, where two groups of pixels are to be formed, one for the changed class and the other for the unchanged one. Process of change detection can be broadly classified into two categories viz. 1.Supervised and 2. Unsupervised.

In unsupervised techniques have certain advantages such as they can explicitly recognize the kinds of changes occurred and are robust to different atmospheric and light conditions of acquisition dates. Having several advantages, the applicability of supervised methods in change detection is poor due to mandatory requirement of sufficient amount of ground truth information, collection of which is expensive, hard, and monotonous too. Unsupervised approach, there is no need of additional information like ground truth. Due to the depletion of labeled patterns, unsupervised techniques seem to be compulsory for change detection [1]. Unsupervised change detection process can be of two types: context insensitive and context sensitive. Histogram threshold is the simplest unsupervised context- insensitive change detection method which has the main disadvantage of not considering the spatial correlation between the neighborhood pixels in the decision process. To overcome this difficulty, context-sensitive methods using Markov random field (MRF) are developed. These techniques also suffer from certain difficulties such as requirement of selection of proper model for statistical distribution of changed class and unchanged class pixels[2]. On the contrary, change detection methodologies based on neural networks are free from such limitations. The work along this direction is being carried out employing the neural networks for change detection both using the supervised and unsupervised learning. As mentioned earlier, the applicability of supervised approaches in change detection is very rare. This is mainly due to the dependency of the supervised methods on traits of the available labeled patterns. This inadequacy of labeled information can be handled in two ways: semi-supervised learning and active learning. Both the learning approaches attack the same problem by following different roadways. If the labeled patterns are collected without any guidelines then it might be possible that these costly labeled patterns will not increase the training accuracy. This is due to the fact that the set of training patterns may consist of redundant samples. In turn, such labeled patterns may increase the time consumption of the training algorithm. Both semi-supervised learning and active learning avoid this problem by starting the learning algorithm with a few labeled patterns. Afterward, in semi-supervised learning, the “most confident” unlabeled patterns are iteratively included in the training process; whereas, in case of active learning, some of the “most confused” patterns are repeatedly collected from the pool of unlabeled patterns using the well-defined query function and the collected patterns are labeled by the supervisor. Research work has been found in the literature to explore the impact of semi-

supervision using neural networks for improving the performance of change detection algorithms.As per the knowledge of the authors, no such application exists in change detection domain in the direction of active learning. This motivated us to explore the capacity of neural networks embedded with active learning framework to improve the performance of change detection process. The concept of active learning mainly involves query-based algorithm development. Here, the learner repeatedly creates some informative queries during learning. There is a human annotator who gives the answer to some of the queries and the learner refines its knowledge based on these answers. Using its present state of knowledge, the learner may again query about some more samples. The learner can query about a sample at a time (i.e., stream-based selective sampling) or a pool of samples at a time (i.e., pool-based sampling). Diversity in the field of active learning mainly lies in designing a variety of query functions. Uncertainty sampling is a well-known and straight forward query strategy in active learning. It is commonly used for probabilistic learning models. Here, the learner can originate a query about the sample for which it is most confused about the label. Another interesting approach is query-by committee strategy. Here, the learner makes a query about the samples for which the committee members have extremely disagreed upon the labeling. Apart from these well-known approaches, some decision-theoretic approaches also exist in the literature. Applications of active learning are found mostly in the area of natural language processing and remote sensing. In the proposed method, a binary change detection technique is evolved using the two variants of radial basis function (RBF) neural networks and multilayer perceptron (MLP) under active learning platform. Here, two approaches of query selection are used: uncertainty sampling and query-by committee. In the first approach, training of the network is initially carried out with a few randomly collected labeled patterns. After convergence of the training, rest of the patterns are tested with the network (trained) to estimate the support values in both the classes. Then, a pool of patterns are obtained from these patterns using the uncertainty sampling-based query strategy. Here, the patterns for which the estimated support values are nearer to 0.5 are treated as the "most confusing" patterns to the learner. Now, there is an active participation of the supervisor who has a knowledge about the labels of some of these confusing patterns. In turn, the supervisor helps to grow the set of labeled patterns using the query of the learner. The network is trained again with the new set of labeled patterns. In this way, the group of the "most informative" labeled patterns can be obtained. Here, two variants of RBF neural networks [i.e., simple RBF neural network and elliptical basis function(EBF) neural network] and MLP are individually used for investigation. In the second approach, instead of using a single neural network under active learning framework, a committee has been created using different neural networks. In the present experimentation, two neural networks (i.e., MLP and EBF) are used as committee members. At the onset, these are individually trained with a few randomly collected labeled patterns. After convergence, the rest of the patterns are tested using both the (trained) networks to predict the support values in both the classes (changed and unchanged). Then the patterns for which the neural networks disagree about the class assignment (in terms of maximum estimated support value) are treated as the "most confusing" patterns. In turn, the "most confusing" patterns are labeled by human annotator and are included into the previous set of the labeled patterns [3]. The ensemble network is trained iteratively by using the new set of labeled patterns until it reaches a prespecified step size. Finally, for each of the patterns, the outcome (i.e., the support values in both the classes) of both the neural networks are fused using "average" combination rule.To assess the effectiveness of the proposed method, experiments are carried out on multi-temporal and multi-spectral images. Here, a comparative analysis has been carried out between the performances of different neural networks (i.e., MLP, RBF, EBF, and ensemble of MLP and EBF) under two different active learning strategies. The results obtained using the proposed active learning techniques are also compared with those of the supervised RBF and MLP (i.e., trained using the labeled patterns collected by the random sampling method) and the semi-supervised change detection technique using MLP. By analyzing the results, it has been found that the proposed techniques are better suited for change detection when only a few labeled patterns are available.

2. Proposed Algorithm

In the proposed technique, two different active learning approaches are incorporated with the training of neural networks and used for the improvement of change detection. Here, a few labeled patterns are required to

start the initial training. These labeled patterns can be collected in many ways. In the proposed method, for experimental purpose, an equal amount of labeled patterns, from both the classes (changed and unchanged), are picked up randomly from the ground truth. For the labeled patterns, the target values are assigned to either [1,0] or [0,1] depending on their class labels.

2.1 Uncertainty Sampling-Based Active Learning for Change Detection

As already mentioned, in the present work, three different neural networks, namely RBF neural networks, EBF neural networks, and MLP are used individually for change detection under uncertainty sampling-based query framework. Details of the proposed active learning-based change detection technique are given below.

2.1.1 Initial Training and Support Value Estimation:

The neural network is initially trained with a few randomly collected labeled patterns. After convergence of training of the network, each of the remaining patterns (excluding the present labeled patterns) is passed through the network (trained) to predict the output values (or, the support values) for both the classes. Let, ur(m,n) =[ur1(m,n),ur2(m,n)] be the two degrees of support, estimated by the neural network, where ur1(m,n) and ur2(m,n) are the support values (i.e., the output values) of the (m,n)th pattern in the unchanged and changed classes, respectively. A pattern is more likely to belong to the class for which its support value is higher. For each of the (m,n)th patterns, we normalize each component of the support value ur(m,n).

2.1.2 Labeled Pattern Collection:

In the proposed work, the learner network repeatedly poses query about some of the patterns. Here, the query function is designed using the concept of uncertainty sampling [10]. The patterns for which the estimated support values are within an range of 0.5 are treated as the "most informative" patterns for training. Here, is a small positive quantity which has been set depending on the data set. It is obvious that the network is highly confused about the label assignment for these patterns, and there is a role of the supervisor. The supervisor now assigns the label to some of the selected patterns. For experimental purpose, in the present work, the collected patterns are labeled using the ground truth information. These selected patterns are included in the set of labeled patterns.

2.1.3 Iterative Training of the Neural Network:

After the selection of "most informative" labeled patterns, learning of the network is carried out again using the present set of labeled patterns. After convergence of the training, the network again generates some more queries using its present state of knowledge. Training of the network and collection of the labeled patterns are iteratively carried out until the number of training steps exceeds a prespecified step size. Out of all the selected confusing patterns in each training step, the number of patterns which are labeled by the supervisor is kept fixed at a prespecified batch size.

2.2 Query-by-Committee-Based Active Learning for Change Detection

In the present work, we have also demonstrated an application of ensemble of neural networks (i.e., MLP and EBF) under the query-by-committee active learning strategy in the field of change detection. Description of the proposed technique is given as follows:

2.2.1 Initial Training

At the beginning, the individual neural networks are trained using a few labeled patterns only. At convergence, the rest of the patterns are passed through both the (trained) network to estimate the support values in both the classes (changed and unchanged). Let $_{ur}{}^{i}(mn)=[\mu^{i}(mn)\,_{ur}{}^{i}(mn)]$ be the two degrees of support, estimated by the ith neural network, where $_{ur}{}^{i}(mn)$ and $\mu^{i}(mn)$ are the support values of the (m,n)th pattern in the unchanged and changed classes, respectively.

2.2.2 Labeled Patterns Collection:

As already mentioned, in the present investigation, two neural networks are used. Here, the patterns, for which two neural networks disagree about the class label estimation, are considered as "most confusing" ones. This means that for the "most confusing" pattern, two different neural networks estimate the maximum support value in two different classes. Now, a human annotator gives label to some (with prespecified batch size) of the "most confusing patterns" and these newly labeled patterns are incorporated into the set of labeled patterns.

2.2.3 Iterative Training:

Then the ensemble network is trained again with the present set of labeled patterns. After convergence, some of the informative labeled patterns are collected using the disagreement between the neural networks in ensemble. The collection of labeled patterns and training of the ensemble network are continued iteratively until it reaches a prespecified step size. Finally, the outcome (i.e., the support value in both classes) of different neural networks is fused using the average combination rule.

2.3 Generation of Input Patterns

As already mentioned in Section I, to carry out change detection process, image comparison is performed, pixel-by pixel, to generate a difference image (DI) which is used for further analysis. $DI = \{l_{mn} 1 \le m \le p 1 \le n \le q\}$ is produced by change vector analysis (CVA) technique from two co-registered and radiometrically corrected spectral band images and of size of the same geographical area at different times and . From DI, the input pattern for a particular pixel position is generated by considering the gray value of the said pixel and those of its neighboring ones to exploit (spatial) contextual information from the neighbors. In the present methodology, the second-order neighborhood system is used. Here, each input pattern consists of two features: (1) Gray value of its own and (2) Average of the gray values of its neighboring pixels including its own. The y-dimensional input pattern of the (m,n)th pixel position of DI is denoted by

. $X_{mn} = [x_{mn,1}, x_{mn,2}, \ldots\ldots, x_{mn,y}]$ Here, the number of features(i.e.,) of the input patterns is chosen experimentally and a mapping algorithm is used to normalize the feature values of the input pattern in [0, 1].

3. K-Means Algorithm

The next step is to take each point belonging to a given data set and associate it to the nearest center. When no point is pending, the first step is completed and an early group age is done. At this point we need to re-calculate k new centroids as barycenter of the clusters resulting from the previous step. After we have these k new centroids, a new binding has to be done between the same data set points and the nearest new center. A loop has been generated. As a result of this loop we may notice that the k centers change their location step by step until no more changes are done or in other words centers do not move any more. This in-built kmeans () function in R helps in executing the k-means clustering algorithm for our Difference image data set. The image produced from the algorithm is presented in Fig 2.

4. Conclusions

In this project, neural networks under an active learning frame work are used for change detection of remotely sensed images. By a comparative analysis, it has been concluded that the proposed active learning approaches have an edge over the semi-supervised method and a random sampling approach for the problem of change detection when a few labeled patterns are available. In future, we will try to find out the best active learning strategy that can be naturally embedded in the neural network framework. We found the difference image of the changed area using the unsupervised clustering algorithms

5. Acknowledgment

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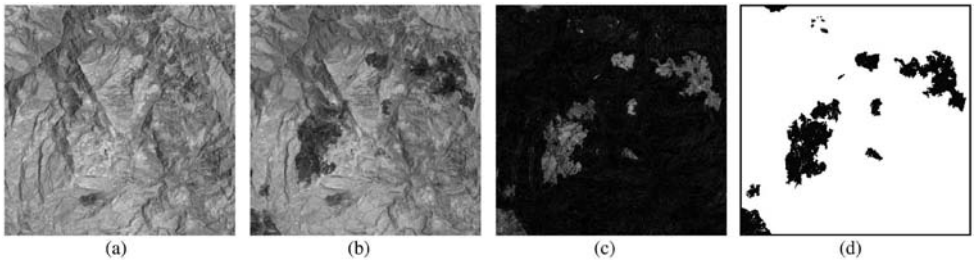

Fig. 2. Images of Mexico area: (a) band 4 image acquired in April , (b) band 4 image acquired in May (c) corresponding DI generated by CVA technique, and (d) a reference map of the changed area.

Tips and tricks of C programming

1.
```
main()
{
  char arr[] = "silicon";
  printf("%d", sizeof(arr));
  getchar();
}
```
Ans:- 8
The string “silicon” has 7 characters, but the size is 8 because compiler includes a single '\0' (string terminator) when char array size is not explicitly mentioned.

2.
```
main()
{
  int x=9, y = 5, z = 5;
  x = y==z;
  printf("%d", x);
}
```

Ans:-
The importance of the question lies in the statement x = y==z. The operator == is executed before = because precedence of comparison operators (<=, >= and ==) is higher than assignment operator =.The result of a comparison operator is either 0 or 1 based on the comparison result. Since y is equal to z, value of the expression y == z becomes 1 and the value is assigned to x via the assignment operator.

3.
```
main()
{
   printf("%%");
}
```
Ans:- %
Because to print a special character we need to use one more %

4.
```
main(){
    unsigned char c=290;
    printf("%d",c);
}
```
Ans:- 34
290 is beyond the range of unsigned char. Its corresponding cyclic value is: 34.

5.
```
main(){
    int a=0;
    a=5||2|1;
    printf("%d",a);
}
```
Ans:- 1
Consider the expression which will be treated as and evaluated like this.
5||2|1 => 5||(2|1)==>5||3 =>1

6.
```
main (){
    static char a;
    static long b;
    int c;
    printf("%d,%d,%d",a,b,c);   }
```
Ans:- 0,0,Garbage Value
Static variable always initialize with 0, and other one by garbage value.

7.
```
main() {
    int a, b = 10;
    a = -b--;
    printf("a = %d, b = %d", a, b);
}
```
Output: a = -10, b = 9

The statement 'a = -b--;' compiles correctly. Unary minus and unary decrement have save precedence and right to left associativity. Therefore '-b--'is treated as -(b--) which is valid. So -10 will be assigned to 'a', and 'b' will become 9.

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PhD Synopsis: A Framework for Specifying and Monitoring Service Level Agreement for Web Service Based Systems

In recent years, Service-Oriented Architecture (SOA) has become one of the leading paradigms in software design. Among the key advantages of SOA is service composition, the ability to create new services by composing the functionality of pre-existing ones. This has led to a range of Web Service Based Systems, which have revolutionaries the way afflictions are being developed over the Internet. Web Service Based Systems (WSBS) are essentially distributed in nature and in most cases facilitated through third party service providers. Which tend to be dynamic i.e. continuously evolving set of available services, volatile execution context, frequent revision of business policies, regulations and goals, etc. Since dynamic changes of the execution environment can invalidate service composition predefined within a service-based system, the quality of services (QoS) of composed services in this case may change dramatically. With these inconsistent natures of WSBS, to make it acceptable in service consumer market a mechanism is needed to create trust in the QoS promises made by service providers at negotiation time. No surprise, QoS aware service selection for composition, adaptation, and provisioning-time Service Level Agreement (SLA) monitoring has been an active area of research in service computing.

A Service-Level Agreement (SLA) is a contract between a Web Service provider and Web Service consumer that specifies a mutually agreed level of service quality, functional properties of a Web Service, and business assumptions. Many-a-times it is necessary to monitor the execution of services to ensure the fulfilment of certain agreed upon terms and conditions, thus leading to SLA monitoring as an important research agenda. Most of the existing SLA monitoring frameworks are composition platform dependent and perform at the composition/service layer by ignoring the impact of business layer and/or infrastructure layer. Recently, cross layer SLA monitoring has emerged as a promising and challenging research problem.

Further, since SLAs are made at negotiation time it is difficult to fulfil those at run-time due to the volatile/dynamic nature of WSBS. To make service based system more acceptable and adaptable, a new framework is needed that is capable of making SLA aware service selection for composition and automatically perform all SLA monitoring task at run time, from monitor generation to monitoring.

In this work, we introduce a new approach for SLA aware dynamic composition with cross layer monitoring of WSBS at execution time in a nonintrusive manner. The main advantages of this framework are I)Dynamic QoS requirement oriented service selection for composition, II)Composition platform independent and cross layer automatic monitoring of service based system, III) SLA specification and monitoring and Iv)User friendly SLA specification and monitoring. WSBS monitoring process is an event based approach, which is independent of the service composition platform. The monitoring engine runs in parallel with the WSBS and allows for easy adaption of the business process. Monitoring requirements are specified by a temporal logic based language called Monitor Specification Language (MSL). An SLA description language called XMSL has been proposed based on XML and MSL for the specification of SLA. XMSL monitoring process is based on the WSBS monitoring approach.

Moreover, with the continuously evolving set of available services, volatile execution context, frequent revision of business policies, regulations and goals, QoS aware service selection for composition has become much more complex. The significant contributions of the dissertation are the investigation of the problem of platform independent WSBS and XMSL monitoring as well as dynamic QoS requirement aware service selection for composition. Furthermore, based on the service selection approach, a run time adaptation approach is proposed. Most part of the concepts developed in the thesis are implemented and evaluated to prove their practical applicability.

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Feature Extraction and Classification of Epileptic Seizures

Abstract: *Epilepsy is a chronic disorder that causes unprovoked, recurrent seizures. Electroencephalogram (EEG) signal is a modest measure of electric flow in a human brain. When a seizure happens during an EEG, the normal pattern of brain activity that is seen on the EEG r eading changes, and different brain activity can be seen In machine learning, pattern recognition and in image processing, feature extraction starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpr etations. Feature extraction is related to dimensionality reduction..This paper is focused on extracting features like Average, Standard Deviation, Median, Max & Min of the data set. Machine Learning Techniques and algorithms using Neural Networks have been used to further classify the feature extracted data sheet.*

Index Terms: EEG, Epilepsy, Wavelet transform, feature extraction, classification, Python, Tensor-Flow, Keras.

I. Introduction

In machine learning, pattern recognition and in image processing, **feature extraction** starts from an initial set of measured data and builds derived values (features) intended to be informative and non-redundant, facilitating the subsequent learning and generalization steps, and in some cases leading to better human interpretations. Feature extraction is related to dimensionality reduction.

Feature extraction involves reducing the amount of resources required to describe a large set of data. When performing analysis of complex data one of the major problems stems from the number of variables involved. Analysis with a large number of variables generally requires a large amount of memory and computation power, also it may cause a classification algorithm to overfit to training samples and generalize poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy.

Technically, a feature represents a distinguishing property, a recognizable measurement, and a functional component obtained from a section of a pattern. Extracted features are meant to minimize the loss of important information embedded in the signal. In addition, they also simplify the amount of resources needed to describe a huge set of data accurately. This is necessary to minimize the complexity of implementation, to reduce the cost of information processing, and to cancel the potential need to compress the information. More recently, a variety of methods have been widely used to extract the features from EEG signals, among these methods are time frequency distributions (TFD), fast fourier transform (FFT), eigenvector methods (EM), wavelet transform (WT), and auto regressive method (ARM), and so on. In general, the analysis of EEG signal has been the subject of several studies, because of its ability to yield an objective mode of recording brain stimulation which is widely used in brain-computer interface researches with application in medical diagnosis and rehabilitation engineering. The purposes of this paper, therefore, shall be discussing some conventional methods of EEG feature extraction methods, comparing their performances for specific task, and finally, recommending the most suitable method for feature extraction based on performance. This signal is decomposed using the Daubechis Wavelet function of order 2 up to 4 levels. Thus, it produces a series of wavelet coefficient like four detailed coefficients (D1, D2, D3, and D4) and an approximation signal (A4).

II. Data Description

EEG signals are extracted from sophisticated machines in highly secured and de-noised labs are prone to artifacts and several other type of non-separable noise. EEG signal when analyzed has a very low frequency in the range of hertz. These EEG signals can be classified based on their frequency bands. The classification is shown in Table.1 it also mentions the region of brain from where it is extracted.[1][2]

Table.1 Classification of EEG Signals Based On Their Frequency

Type	*Frequency*	*Location*
Delta	up to 4	Frontally in adults, posteriorly inchildren; high amplitude waves
Theta	4 – 8	Found in locations not related to taskat hand
Alpha	8 – 13	Posterior regions of head, both sides, higher in amplitude on non-dominantSide.
Beta	13 – 30	Both sides of Brain, symmetrical distribution, most evident frontally; low amplitude waves
Gamma	31 - 100	Somatosensory cortex

In the present work, we have collected data from a publicly available database we related to diagnosis of epilepsy. This resource provides two sets of EEG signals. Each set contains reading of hundred single channel EEG segment of 23.6 seconds duration each. These five sets ate described as follows. Data sets Z and O are considered from five healthy subjects using a standardized electrode placement system. Set Z contains signals from Subjects in and around downstate with eyes open. Set O also contains signals same as Z but once with the eyes closed. The datasets N, F and S are recorded from epileptic subjects through intracranial electrodes for interictal and ictal epileptic activities. Set F contains segments recorded within a certain zone during seizure free interval. Set N also contains Segments recorded during a seizure free interval from the hippocampal formation of the opposite hemisphere of the brain. Set S only contains segments that are recorded during seizure activity. All signals are recorded using the 128 channel amplifier system. Each set contains 100 single channel EEG data. In all there are 500 different single channel EEG data[3][4][5].

III. Feature Extraction

In pattern recognition, feature extraction is a special form of dimensionality reduction. When the input data to an algorithm is too large to be processed and it is suspected to be notoriously redundant (much data, but not much information) then the input data will be transformed into a reduced representation set of features (also named features vector). Transforming the input data into the set of features is called feature extraction. If the features extracted are carefully chosen it is expected that the features set will extract the relevant information from the input data in order to perform the desired task using this reduced representation instead of the full size input. Feature extraction involves simplifying the amount of resources required to describe a large set of data accurately. When performing analysis of complex data one of variables involved. The signal is decomposed using the Daubechis Wavelet function of order 2 up to 4 levels. Thus , it produces a series of wavelet coefficients like 4 detailed coefficients (C0,C1,C2,C3) and an approximation signal (C4).

Analysis with a large number of variables generally requires a large amount of memory and computation power or a classification algorithm which over fits the training sample and generalizes poorly to new samples. Feature extraction is a general term for methods of constructing combinations of the variables to get around these problems while still describing the data with sufficient accuracy [6][7][8].

IV. Classification

Machine learning is a method of data analysis that automates analytical model building. Using algorithms that iteratively learn from data, machine learning allows computers to find hidden insights without being explicitly programmed where to look. The simplest form of binary classification with loss as mean_squared_error with different types of activation functions at the input, hidden and output layer. After the execution of the python program, we will get loss for each iteration and an individual accuracy that will give us a graph between loss vs number of iterations.

All the classes and functions that are required such as Numpy, pandas, Sequential, Dense, KerasClassifier, cross_val_score, LabelEncoder, StratifiedKFold, StandardScaler and Pipeline were imported.

Next, the random number generator was initialized to ensure that the same results were obtained when executing this code. This is helpful for debugging.

Now the dataset is loaded using pandas and the columns are split into 25 input variables (X) and 1 output variable (Y). pandas is used to load the data because it easily handles strings (the output variable), whereas attempting to load the data directly using NumPy would be more difficult.

The output variable is string values. They must be converted into integer values 0 and 1. This is done using the LabelEncoder class from scikit-learn. This class will model the encoding required using the entire dataset via the fit() function, then apply the encoding to create a new output variable using the transform() function.

scikit-learn is used to evaluate the model using stratified k-fold cross validation. This is a resampling technique that provides an estimate of the performance of the model. It does this by splitting the data into k-parts, training the model on all parts except one which is held out as a test set to evaluate the performance of the model. This process is repeated k-times and the average score across all constructed models is used as a robust estimate of performance. It is stratified, meaning that it will look at the output values and attempt to balance the number of instances that belong to each class in the k-splits of the data.

To use Keras models with scikit-learn, the KerasClassifier wrapper must be used. This class takes a function that creates and returns our neural network model. It also takes arguments that it will pass along to the call to fit() such as the number of epochs and the batch size.

The function that creates our baseline model is defined. Our model will have a single fully connected hidden layer with the same number of neurons as input variables. This is a good default starting point when creating neural networks.

The weights are initialized using a small Gaussian random number. The Rectifier activation function is used. The output layer contains a single neuron in order to make predictions. It uses the sigmoid activation function in order to produce a probability output in the range of 0 to 1 that can easily and automatically be converted to crisp class values.

Finally, the logarithmic loss function is used (binary_crossentropy) during training, the preferred loss function for binary classification problems. The model also uses the efficient Adam optimization algorithm for gradient descent and accuracy metrics will be collected when the model is trained.

The number of training epochs are passed to the KerasClassifier, again using reasonable default values. Verbose output is also turned off given that the model will be created 10 times for the 10-fold cross validation being performed.

Similar to the simplest form of binary classification, we introduced this k-fold cross validation to the Binary classification after defining a baseline model for the neural network. And the loss as mean_squared_error with different types of activation functions at the input, hidden and output layer. After the execution of the python program, we will get loss for each iteration and an individual accuracy that will give us a graph between loss vs number of iterations.

Again with the introduction of this k-fold cross validation to the Binary classification after defining a baseline model for the neural network. And the loss as binary_crossentropy with different types of activation functions at the input, hidden and output layer. After the execution of the python program, we will get loss for each iteration and an individual accuracy that will give us a graph between loss vs number of iterations.

Now for multiclass classification of the datasheets, we used two types of functions to calculate loss. The classified results of the datasheets were divided into three classes A, B and C. The classes A , B and C are of non-epileptic, epileptic without seizures and epileptic with seizures respectively. Also the k-fold cross validation was introduced and with different activation functions the best accuracy was measured along with the losses at each iterations and the graph between loss and number of iterations was plotted to check if the above multi class classification has a smoother curve with 'mean_squared-_error' or 'binary_crossentropy'

V. Conclusion

The detection of epileptic seizure in EEG signal can be performed by classifying these signal collected from different patients in different situations. This classification can be accomplished by using different machine learning techniques. In this work, the functioning and efficiency of different classifiers like Binary classifier and Multiclass classifier have been compared. The basic structure of a MLPNN was used for the above and the parameters were varied which was an attempt to establish patterns based on their change. Different combination of activation functions were tried and compared. In case of binary classification three activations functions were included in three different layers namely input layer hidden layer and output layer. The relu, sigmoid, softmax and softplus were the various activation functions used. The highest accuracy of

98.51% was achieved when the number of neurons in the first and second layer were set to 40 and 8 respectively. K-fold cross validation was introduced to the Binary classification after defining a baseline model for the neural network and a baseline accuracy of 88% was obtained. In case of multiclass classification a combination of softmax and softplus yeiled the highest accuracy of 92%. A Graph between loss and no of iteration was plotted which converged after 350 iterations. No particular pattern was observed beyond this value of epochs which could be explained by the fact that neural networks are infinitely configurable.

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The first principle is that you must not fool yourself and you are the easiest person to fool.

If I could explain it to the average person, I wouldn't have been worth the Nobel Prize.

~ Richard Feynman

Have you ever dreamt of creating history by inventing and discovering things out of the box? Ever imagined theorems named after you widely discussed in lectures? Here is the profile one of the famous scientist who has made unprecedented contributions with his theories and discoveries for the world, precisely in the Electrical and Electronics Engineering discipline, Heinrich Hertz, the first ever person to set milestones in the field of Radio waves propagation and utilization. Heinrich Rudolf Hertz (February 22, 1857 - January 1, 1894) was a German physicist who was the first to satisfactorily demonstrate the existence of electromagnetic radiation waves by building an apparatus to produce and detect them. His discovery was a key step on the path to the use of radio waves in communications and broadcasting and the use of all the many invisible octaves of the electromagnetic spectrum to the service of humanity. Heinrich Rudolf Hertz was born in Hamburg, Germany, on February 22, 1857, the oldest of the five children of Gustav Ferdinand Hertz and Anna Elisabeth Pfefferkorn. In his youth, Hertz showed an advanced aptitude for mathematics, and took extra geometry lessons on Sundays. He more often than not ranked first in his class. He at first pursued a career in engineering construction. In 1875, Hertz spent a year in a construction department in Frankfort. He then attended the polytechnic in Dresden, and was particularly fond of the mathematical lectures given there, but also took a keen interest in history and philosophy. After only a semester in Dresden, he joined the military and spent one year on active duty. In 1877, he enrolled at the polytechnic in Munich, changing his major to physics. During this time, encouraged by his teachers, he studied the original works of famous physicists such as Isaac Newton, Gottfried Leibniz, Joseph Lagrange, and Pierre-Simon Laplace. Hertz obtained his Ph.D. in 1880, and continued to work in Helmholtz's laboratory until 1883. As an assistant to Helmholtz in Berlin, Hertz submitted memoirs on the evaporation of liquids, a new kind of hygrometer, and a graphical means of determining the properties of moist air. In 1883, Hertz accepted a post as a lecturer in theoretical physics at the University of Kiel. In 1885, he became a full professor at the University of Karlsruhe where he discovered electromagnetic waves. On July 31, of the same year he married Elizabeth Doll, the daughter of Max Doll, a lecturer in geometry. In 1886, Hertz began a series of experiments to clarify some of the theoretical predictions of Maxwell's electromagnetic theory. At this time, he discovered the utility of a spark gap, and realized that its regular effects would enable him to investigate the questions left unanswered when he turned down Helmholtz's research idea. The phenomenon of the photoelectric effect, became the topic of a famous paper by Albert Einstein which won him a Nobel Prize. In 1887, Hertz made observations of the photoelectric effect and of the production and reception of electromagnetic waves, which he published in the journal *Annalen der Physik*. He was an extremely modest man and once denying the request for publishing his portrait he said, "... Too much honor certainly does me harm in the eyes of reasonable men..." and four years after, following his death, his portrait was published.

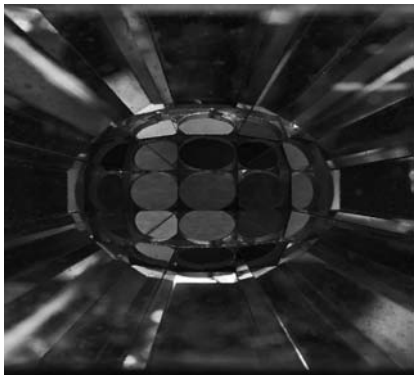
1. Hot Solar Cells

Even after decades solar panels were first developed, the slabs of silicon remain bulky, expensive, and inefficient covers a growing number of rooftops. Fundamental limitations prevent these conventional photovoltaic from absorbing more than a fraction of the energy in sunlight.

However a team of MIT scientist has built a different sort of solar energy device that uses intensive engineering and advances in materials science to capture far more of the sun's energy. The trick is to first turn sunlight into heat and then convert it back into light, but now focused within the spectrum that solar cells can use. While various researchers have been working for years on so-called solar thermo photovoltaic, this device is the first one to absorb more energy than its photovoltaic cell alone.

Standard silicon cell mainly capture the visual light from violet to red. That and another factors mean that they can never turn more than around 32 percent of the energy in sunlight into electricity. The device developed by MIT is still a crude prototype, operating at just 6.8 percent efficiency howeverwith various enhancements it could be roughly twice as efficient as conventional photovoltaic.

The key step in creating the device was the development of something called an absorber-emitter. It essentially acts as a light funnel above the solar cells. The absorbing layer is built from solid black carbon nanotubes that capture all the energy in sunlight and convert most of it into heat. As temperatures reach around 1,000 °C, the adjacent emitting layer radiates that energy back out as light, now mostly narrowed to bands that the photovoltaic cells can absorb. The emitter is made from a photonic crystal, a structure that can be designed at the Nano scale to control which wavelengths of light flow through it. Another critical advance was the addition of a highly specialized optical filter that transmits the tailored light while reflecting nearly all the unusable photons back. This “photon recycling” produces more heat, which generates more of the light that the solar cell can absorb, improving the efficiency of the system.

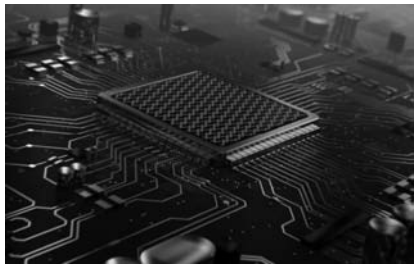


The researchers are also exploring ways to take advantage of strength of solar thermo photovoltaic. Because heat is easier to store than electricity, it should be possible to divert excess amounts generated by the device to a thermal storage system, which could then be used to produce electricity even when the sun isn't shining. If the researchers can incorporate a storage device and ratchet up efficiency levels, the system could one day deliver clean, cheap—and continuous—solar power.

2. Processor that enables optical deep learning

A new approach that uses light instead of electricity in deep learning computer systems based on artificial neural networks has been developed by a team of researchers at MIT. This discovery could vastly improve the speed and efficiency of certain deep learning computations. This optical chip, once tuned can carry out matrix multiplication with in principle zero energy almost instantly.

The new approach uses multiple light beams directed in such a way that their waves interact with each other, producing interference patterns that convey the result of the intended operation. The device is called a programmable nano photonic processor.



The advantage of using light to do matrix multiplication plays a big part in the speed up and power savings, because dense matrix multiplications are the most power hungry and time consuming part in AI algorithms.

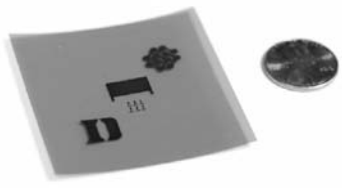
The programmable nano photonic processor uses an array of waveguides that are interconnected in a way

that can be modified as needed, programming that set of beams for a specific computation.

The processor, when set to implement a neural network that recognises four basic vowel sounds, they achieved a 77% accuracy level, compared to 90% for conventional systems, and the researchers believe there are no substantial obstacles to scaling up the system for greater accuracy.

According to the researchers, the nano photonic processor could have other applications as well, including signal processing for data transmission. This approach could do processing directly in the analogue domain. The system could also benefit data centres, security systems, self-driving cars and drones.

3. Printed sensor



An inexpensive printed sensor that can monitor the tread of car tyres in real time has been invented by electrical engineers at Duke University in collaboration with Fetch Automotive Design Group. If adopted, the device could increase safety, improve vehicle performance and reduce fuel consumption.

The design uses metallic carbon nanotubes on a flexible polyimide film that could track millimetre-scale changes in tread depth with 99% accuracy.

The core of the sensor is formed by placing two electrodes very close to each other. By applying an oscillating electrical voltage to one and grounding the other an electric field forms between the electrodes.

While most of this electric field passes directly between the two electrodes, some of the field arcs between them. When a material is placed on top of the electrodes, it interferes with this field. By measuring this interference through the electrical response of the grounded electrode, it is possible to determine the thickness of the material covering the sensor.

The sensors could be printed on most anything using an aerosol jet printer – even on the inside of the tyres themselves.

Other automotive applications for the printed sensors can be achieved by keeping tabs on the thickness of brake pads or the air pressure within tyres. This setup could be used with just about anything that isn't metallic or too thick.

4. Antenova Metal Mounted Antennas

The new family of antennas has been engineered to operate without de-tuning on metal surfaces – or where the product housing is mainly metal – a situation where it is normally extremely difficult for an antenna to operate.

There are very few antennas if any, that are as thin as the Zenon product, and that can be mounted on a metal surface.

The REFLECTOR antennas are formed of two layers, one electrically isolated from the other, so as to provide RF shielding to the second layer. This means that the antenna can be placed on any kind of material and it will radiate effectively in the direction pointing away from the base material. Antenova first introduced the REFLECTOR family of antennas at Embedded World, where the samples generated a huge amount of interest.

Zenon, part number SR4W030, is a high performance 2.4GHz antenna for Bluetooth, Wi-Fi, ZigBee and ISM. The antenna has an exceptionally low profile, measuring only 23mm x 16mm x 1.6mm. It is manufactured from rigid FR4 laminate and has a 1.13mm cable and IPEX MHF connector. The cable can be specified in two standard lengths, 100mm or 150mm.

Antenova's development team approaches antenna design with a concept that the company calls “design for integration” or DFI, where the final integration of the antenna into the customer's product is considered right from the start of the design process, and is a major factor shaping the design of the antenna.

Accordingly, Zenon has been designed for quick and easy integration into a customer's design. It is simply fixed in position with a peel-back self-adhesive strip, and can either be inserted into a new design or it can be retro-fitted into an existing design. No tuning or matching is required.

Tuhin
7th Sem, ECE

Pambanbridge: India's first sea bridge

In this world of widespread globalization, technological advancements and their remarkable innovations aid in reconstructing the globe to a shrunken small cocoon .Connectivity and travel diaries have as if taken leaps and bounds and countries have showcased their best engineering skills to bridge the world. India is too nevertheless one of the best hotspots of engineering marvels across the globe.

And such is an engineering marvel that evokes awe! Few can forget a train journey on the "***Pamban bridge***", connecting Rameswaramisland to the mainland. With 143 piers, spanning 2 km between the mainland and the island, it is the second longest sea bridge in India after the 2.3-km Bandra-Worli sea link on Mumbai's western coast. The Pambanbridge was the only link between Rameswaram and the mainland until 1988 when a road bridge, running parallel to it, was built. Earlier, it used to transport hundreds of pilgrims everyday to the temple in the island.

German engineer Scherzer designed the central part of the bridge that opens up to allow ferry movement. On an average, 10 to 15 boats and small ships pass beneath the bridge every month. As India's first sea bridge, it has also become a tourist attraction by itself as people watch in awe when the two leaves of the bridge open up to let ships to pass through. Efforts were taken for the construction of the bridge as early as the 1870s with the British administration planning to expand trade connectivity to Sri Lanka, then Ceylon. However, the construction of the rail bridge commenced only by 1911 and it was commissioned on February 24, 1914.

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