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Exploring the Enigmatic Components of the Universe

*Samandeep Sharma

Department of Physics,

Goswami Ganesh Dutta Sanatan Dharma College, Sector 32, Chandigarh, India 160030.
EmailID: samandeep.sharma@ggdsd.ac.in

Abstract

A number of cosmological observations over the last decades have provided us compelling evidence that the ordinary hadronic matter constitutes only around 5 percent of the Universe. Rest 95% can be attributed to the two unknown forms of energy, viz. the Dark Matter and Dark Energy. Formulating a successful theory for the composition of these mysterious constituents as well as experimental detection of the proposed constituent particles continues to be one of the most outstanding problems in the present day high energy physics. In the present article, beginning with the experimental evidence for the existence of dark matter and dark energy, a brief overview of various theoretical speculations for their composition would be provided. Further, experimental status of some of the ongoing and future searches for dark matter and dark energy components would also be briefly discussed.

Keywords:Dark matter, dark energy, LHC, direct searches, WMAP.

1. INTRODUCTION

Ever since the dawn of civilization, man has been fascinated by the stars, planets and other "heavenly" objects, wondering what essentially the magnificent universe around us is made up of. More than eighty years ago, Edwin Hubble established the expansion of the universe with his pioneering observations of galaxies. Since then, galaxies have been the fundamental tools for understanding the structure and evolution of our universe. After decades of exhaustive and increasingly precise astrophysical observations, scientists today have evidence that what we have always thought of as the actual universe- the planets, stars, galaxies, all the matter in space- represents less than even a mere 5 percent of what's actually out there. The rest is something they call as 'dark matter' (23 percent) and approximately 73 percent is something even more mysterious, which they call as 'dark energy'. The present article aims to introduce the reader to the enigmatic concepts of dark matter and dark energy along with shedding some light on the exciting questions such as why do we need dark matter, what is it believed to be consisting of etc..

Let us first begin with by formally introducing both of these. Dark matter is a term used to describe matter that can be inferred to exist from its gravitational effects, but does not emit or absorb detectable amounts of light. On the other hand, the term 'dark energy' although seems to be linked to dark matter through the mass energy equivalence, is actually a counter force. A formal definition of the term 'dark energy'can be given as- a hypothetical form of energy that permeates all space and exerts a negative pressure, so as the universe expands, the pressure increases and causes the universe to expand at an ever-increasing rate.

We would like to narrate the story of dark matter and dark energy intwo parts. Firstly, we would discuss the experimental signals as a consequence of which we believe that these exist. Secondly, we would discuss some of the possibleexplanations as to what both of these mysterious entities are made up of.

2. MOTIVATION FOR DARK MATTER

We call something dark because it (almost) neither emits nor absorbs electromagnetic radiations. Historically the observational evidence for the existence of dark matter came from analyses of galactic dynamics and cosmic microwave radiation. The following discussions in this section show that the observed luminous objects can not have enough mass to support the observed gravitational effects.

• Galactic Rotation Curves:It was Swiss astronomer Fritz Zwicky in 1933 who, while studying clusters of galaxies, found that the mass in the galactic plane must be more than the material that could be seen. By applying Virial Theorem, i.e. the total kinetic energy should be the half of the total gravitational energy, Zwicky estimated the total mass of the cluster based on the motion of galaxies near its edge and compared it to the one based on the number of galaxies and total brightness of the cluster. He found that there was about

four hundred times more estimated mass than was visually observable. Further evidence for dark matter came from the measurements of rotations of spiral galaxies in 1950's and 1960's. By the virtue of virial theorem, astronomers expected the stars near the center of a galaxy, where the visible mass is concentrated, to move faster than the stars at the edge. However, what they actually observed was that the stars at the edge of the galaxy had nearly the same rotational velocity as the stars near the center. Both these observations implied that the galaxies and galactic clusters must contain an 'invisible' form of matter - "dark matter"- in a proportion substantially larger than the usual 'visible' matter, responsible for the observed gravitational effects. As astronomers focused their attention to dark matter, they began to collect additional evidence for its existence.
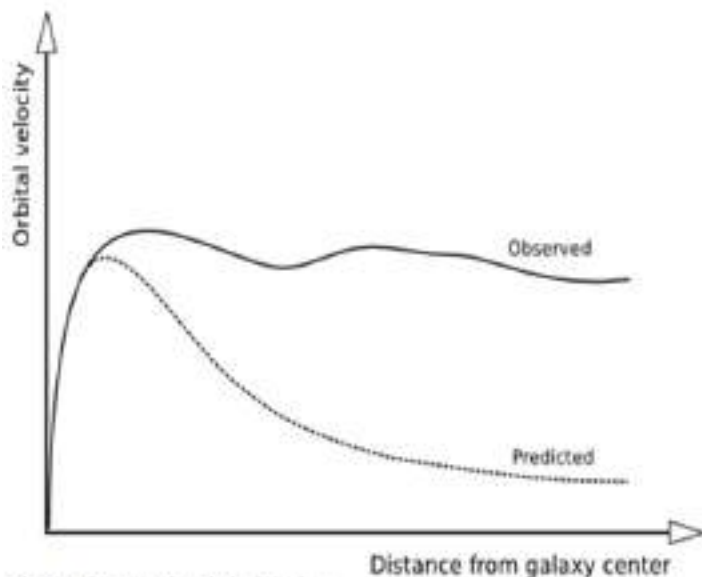

Fig.1 Rotation curve of a typical spiral galaxy

Fig.1 Rotation curve of a typical spiral galaxy

• Confinement of hot gas in the galaxies: Expecting to find pools of hot gas, which had previously gone undetected and which might account for the mass being attributed to the dark matter, some of the astronomers turned their attention to galactic clusters. The basic technique was to estimate the temperature and density of the gas from the energy and flux of the X rays using X ray telescopes, which would further enable the mass of the galactic cluster to be derived. The measurements of hot gas pressure in galactic clusters by X ray telescopes, such as Chandra X Ray Observatory by NASA, have shown that the amount of superheated gas is not enough to account for the discrepancies in mass and that the visible matter approximately constitutes only 12-15 percent of the mass of the cluster. Otherwise,

there won't be sufficient gravity in the cluster to prevent the hot gas from escaping.

• Gravitational lensing: It has been shown that the clusters and superclusters can distort space-time with their immense masses. Light rays emanating from a distant object behind a cluster pass through the distorted space-time, which causes the rays to bend and converge as they move towards an observer. Therefore, the cluster acts like a large gravitational lens. By measuring the angle of bending, the mass of the gravitational lens can be calculated - the greater the bend, the more massive the lens. Using this method, astronomers have confirmed that the galactic clusters indeed have high masses exceeding those measured by the luminous matter, thereby providing additional evidence for the existence of dark matter.

• Fluctuations in Cosmic Microwave Background Radiation: Cosmic Microwave Background Radiation (CMBR) can be considered as the radiation left over from an early stage in the development of universe. The analysis of CMBR reveals what the universe was like when it was only a few hundred thousands years old, long before galaxies and the clusters of galaxies were formed. The intensity of CMBR is very nearly the same in all directions however small variations of a fraction of a percent have been detected. These fluctuations (anisotropies) are due to clumps of matter that were either hotter or cooler than the average, representing the seeds of all future structures - the stars and galaxies of today. The rate at which these clumps would grow in a hot, expanding gas can be calculated from different admixtures of the normal visible matter, photons, protons, neutrons etc., and dark matter. Comparison of such calculations with the observations of CMBR by Planck mission team in 2013 have shown that the total mass energy of the known universe contains 4.9 percent ordinary matter, 26.8 percent dark matter and 68.3 percent dark energy. Thus, dark matter is estimated to constitute 84.5 percent of the total matter content in the universe, while dark matter plus dark energy constitute 95.1 percent of the total matter energy content of the universe.

3. EVIDENCE FOR DARK ENERGY IN UNIVERSE

In 1929, the astronomer Edwin Hubble had discovered that distant galaxies were moving away from us and the farther away they got, the faster they seem to be receding. This was a revolutionary idea which showed that the universe, which was once supposed to be stationary, is actually alive in time, like a movie. Rewinding the film of expansion, the universe would eventually reach

a state of infinite density and energy - "The Big-Bang". But the more perturbing question is - how would it end, what is the probable fate of the universe. The universe is full of matter and matter attracts other matter through gravity. Astronomers reasoned that the mutual attraction among all the matter may be slowing down the expansion of the universe. But what would be the ultimate outcome –

• Would the gravitational effect be so forceful that the universe would actually stretch a certain distance, stop and then reverse itself, like a ball tossed in air?

• Would the effect of gravity would be so slight that the universe would escape its grasp and never stop expanding, like a rocket leaving earth's atmosphere?

• Would the gravity ensure a rate of expansion neither too fast nor too slow, so that the universe would eventually come to a virtual standstill?

With an aim to measure the rate of expansion of the universe, two teams, one led by Saul Perlmutter at Lawrence Berkeley National Laboratory and the other by Brian Schmidt at Australian National University, closely analyzed a number of supernovas throughout the 1990's. In 1998, both the teams reported their observations whichsurprised the scientific community. They found that the light from the distant supernovas is inexplicably faint. The best explanation for this is that they are more distant than originally thought, which implies that the expansion of the universe is not slowing down, as expected, but accelerating. This discovery implied that the dominant force in the universe is not gravity, but something else. It was Michael Turner, a cosmologist at the University of Chicago, who coined the term Dark Energy for this "something".Dark energy is a thus a kind of repulsive gravity, actually pushing the universe apart. The effect of dark energy is small for objects of the size of galaxies and stars, but is critical for understanding the large-scale structure of the universe. Saul Perlmutter, Brian Schmidt along with Adam G. Riess, an American astrophysicist, bagged the 2011 Nobel Prize in Physics for this discovery of accelerating expansion of universe.Aseries of supernova surveys in the past decade have measured hundreds of distant supernovae and greatly strengthened the case for cosmic acceleration and by implication, dark energy.

Apart from the Supernovae, there are many other cosmological observations which stand in need of dark energy for their explanation, some of which are briefly discussed below.

• **X-ray emission from clusters of galaxies:**

The study of X-ray emission from clusters of galaxies has been proven to be a powerful technique for gathering evidence for the existence of dark energy. Broadly, it proceeds along two lines of approach. One method, called the "growth of structure" method, relies on observing how the number of galactic clusters changes with time. Data collected by NASA's Chandra X-ray observatory provides high quality estimates of cluster mass as a function of time which can then be compared with predictions from models of the expansion of the universe with and without dark energy. The results are in good agreement with the conclusions from the supernova data. Another approach uses Chandra data to determine the ratio of hot gas to dark matter in clusters. Computer simulations for clusters indicate that this ratio should be nearly constant with time. The only model for the expanding universe that reproduces this result is the one that contains dark energy in an amount consistent with the estimates from supernova studies.

• Cosmic microwave background radiation and largescale structure: Tiny temperature variations or fluctuations (at the part per million level) in the Cosmic microwave background radiation (CMBR) have been detected with the NASA's Wilkinson Microwave Anisotropy Probe (WMAP) and other telescopes. Highly accurate measurements of the fluctuations by WMAP indicate that the amount of dark energy required is consistent with the results of supernova and cluster studies. Observations of the CMBR by the Planck spacecraft have recently given a more accurate estimate of the composition of the universe - 68.3 percent of dark energy, 26.8 percent of dark matter and 4.9 percent of ordinary matter. This pattern remains imprinted on the distribution of matter, and shows up in the distribution of galaxies formed hundreds of millions of years later. The theory of large-scale structure, which governs the formation of structures in the universe (stars, quasars, galaxies and galaxy groups and clusters), also suggests that the density of matter in the universe is only 30 percent of the critical density, supplying yet another evidence for the existence of dark energy.

4.   OUR UNDERSTANDING OF DARK MATTER AND DARK ENERGY COMPOSITION

Discussion in the previous sections clearly brings about the fact that a major chunk of our Universe is made up of these mysterious forms, viz. Dark matter and Dark energy. In this section, we would briefly discuss ourunderstanding of the what these two can be made up of.

4.1 DARK MATTER

Some astronomers believed that the missing matter could simply be made up of the regular baryonic matter (the protons and neutrons), however more difficult to detect. Such dark matter candidates are referred to as Massive Compact Halo Objects (MACHOs), which are believed to be large objects residing in the halos of galaxies, but eluding detection because they have very low luminosities. Such objects include brown dwarfs, white dwarfs, neutron stars and even black holes. However, the theory of Big - Bang Nucleosynthesis as well as the experimental evidence from anisotropies in CMBR observed by NASA's Wilkinson Microwave Anisotropy Probe (WMAP) and Planck mission team have produced an upper bound (5 percent) on the total amount of baryonic matter in the universe. So far, we have probably contributed somewhat to the dark matter mystery, but there are not simply enough of them to account for all the dark matter in the universe, most of the dark matter is thus attributed by the non-baryonic stuff.

The non-baryonic dark matter candidates can broadly be grouped into two categories-
•   Hot Dark Matter (HDM)
•   Cold Dark Matter (CDM)

depending upon their respective masses and speeds. CDM is composed of substantially massive particles expected to be moving at sub relativistic speeds, whereas HDM consists of particles with zero or nearly zero mass which are expected to be moving nearly at the speed of light, when the pre-galactic clumps began to form. This classification has observational consequences for the size of clumps that can collapse in the expanding universe. HDM particles are expected to be moving so rapidly that clumps with mass of the order of that of a galaxy would quickly disperse. Only clouds with the mass of the order of thousands of galaxies, i.e., the size of galaxy clusters, can form. Individual galaxies could have been formed later as the large cluster size clouds fragmented, in a top-down process. In contrast, CDM can form clumps of mass of the order of that of a galaxy or less. Galaxies would be formed first and clusters would be formed later as the galaxies merge into groups and groups into clusters in a bottom-up process. HDM may include (massive) neutrinos, but the top-down formation scenario for galaxies has largely been ruled out by the observations of high red shift galaxies such as Hubble Ultradeep field. The observations with Chandra also show many examples of clusters being constructed by the merger of groups and sub clusters of galaxies. This and the other line of evidence that galaxies are older than the groups and clusters of galaxies strongly support the CDM alternative.

The leading candidates for CDM are particles called WIMPs (Weakly Interacting Massive Particles). WIMPs could include large number of exotic particles, such as,

• Neutralinos- Hypothetical particles that are similar to the neutrinos but are heavier and slower. In many models of beyond standard model particle physics, e.g. in the MSSM (the minimal supersymmetric standard model), the lightest supersymmetric particle is generally thought to be the lightest neutralino. Although neutralinos have not been discovered yet, they are a front runner in the WIMPs category.

• Axions- Neutral particles with mass less than a millionth of that of an electron. Axions have a specific type of self-interaction that makes them a suitable CDM candidate. Axions have a theoretical advantage that they solve the Strong CP Problem in Quantum Chromodynamics, but have not been detected yet.

• Photinos- Fermionic partner of photon, similar to photons but with spin 1/2, each with a mass ten to hundred times that of a proton, predicted by supersymmetry. Photinos are uncharged and, true to the WIMP signature, interact weakly with matter.

Till date, the experiments at the Large Hadron Collider (LHC) have failed to find any evidence for the existence of photino. Other possibilities that have been discussed in literature include sterile neutrinos and Kaluza-Klein excitations related to the extra dimensions in the universe.

4.2 DARK ENERGY

Comparison of the age of the universe deduced from the expansion rate of the universe with independent age estimates also provides an important check on the amount of dark energy driving the acceleration of the expansion. The ages of the oldest known stars constrain the age of the universe to be in the range 12 to 15 billion years, which is again consistent with estimates of the amount of dark matter and dark energy.

Apart from the above, the gravitational lensing technique (as discussed in the case of dark matter), based on bending of light from a background object due to the presence of galaxies and clusters of galaxies, also provides evidence for the presence of dark energy with an amount consistent with the other cosmological observations.

From the above discussion, it is apparent that the observational evidence for the existence of dark energy is extremely compelling. However, understanding the origin of this acceleration is one of the greatest unsolved

problems in contemporary science. Explanations for the presence of dark energy can broadly be categorized into three approaches

• Vacuum energy: The most straightforward explanation for dark energy is that it is a property of space. Albert Einstein was the first person to realize that the empty space has some amazing properties, e.g. it possesses its own energy - the "vacuum energy". Mathematically, it is equivalent to the addition of a constant term, the 'Cosmological Constant', in the equation that describes the expansion of the universe. Essentially, the cosmological constant corresponds to the value of the energy density of the vacuum of space, originally introduced by Einstein in 1917 to achieve a static universe, then dropped after Hubble's 1929 discovery that the universe is expanding. From 1929 until the early 1990's, when the presence of dark energy was experimentally confirmed, most of the cosmologists assumed the cosmological constant to be zero. While dark energy is poorly understood at a fundamental level, its main required properties are that it dilutes much more slowly than matter as the universe expands, and that it clusters much more weakly than matter, or not at all. The cosmological constant is the simplest possible form of dark energy since it is constant in both space and time. So far, various probes of dark energy are consistent with a constant value for the vacuum energy. With the development of quantum mechanics, attempts to deploy it for the explanation of the origin of vacuum energy commenced. It was realized that "empty space" is actually full of virtual particles which continually form and then disappear for extremely short time intervals. The effects of these "virtual particles" have been measured in the shift of energy level of hydrogen atoms and in particle masses. However, attempts to estimate the energy density associated with the quantum vacuum lead to an extremely absurd result that the amount of vacuum energy density should be approximately 10^{20} times more than observed. No satisfactory explanation for resolving this enormous discrepancy has been put forward till date. Thus, the physical basis for vacuum energy continues to be a complete mystery as yet. Advances in understanding the nature of elementary particles, perhaps simulated with the discoveries by LHC at CERN, may shed light on the vacuum energy in near future.

• Quintessence: Vacuum energy, or the cosmological constant is, as the name implies, constant in space and time. A more general approach assumes that the vacuum energy can vary over space and time due to the existence of a new force field which is called a scalar field, or quintessence. It is expected that this scalar field would affect the expansion of the universe in a manner opposite to that of matter and normal energy. This, however, gives rise to an interesting question - "why the cosmic acceleration began when it did". If cosmic acceleration began earlier in the universe, structures such as galaxies would never have had time to form and life, at least as we know it, would never have had a chance to exist. Many models of quintessence have a so called "tracker behaviour", which solves this problem. Such models assume that the scalar field energy density tracks (but is less than) the energy density of radiation and matter at very early times and then comes to dominate the energy density of the universe at later times. Many versions of scalar fields have been proposed, but as yet none has emerged as a favorite. Experimentally, no evidence of quintessence is yet available, but it has not been ruled out either. An important goal of future research is to distinguish between vacuum energy and scalar fields as dark energy candidates. The most promising way is to use different experimental methods described above to determine the exact relation between the density and pressure of the dark energy. This relationship is expressed as pressure = (w) × (density), where w is called the "equation of state parameter". For vacuum energy, the value of w is equal to -1, whereas for scalar fields, w can be less than or greater than -1, and it can vary with time. To date, all observations are consistent with w = -1, but other values, as well as variation with time, are also possible.

• Neutrino dark energy: In the past few years, numerous attempts have been made to study the possible connections between the neutrinos and the dark energy. There are at least two observations which motivate these studies: • The dark energy scale 10^{-3} eV is smaller than the energy scales in particle physics, but interestingly is comparable to the neutrino masses.

• In Quintessence-like models of dark energy, mass of the scalar field, m_Q is approximately 10^{-33} eV, which surprisingly is also connected to the neutrino masses via a seesaw formula

$$m_Q \, m_{2\nu} \, / \, M_{Pl},$$

with $M_{Pl} \approx 10^{19}$ GeV being the planck mass, the scale for quantum gravity.

On the basis of the arguments given above, it is quite interesting to make a speculation regarding the connection between the dark energy and neutrinos. If such connection exists in nature, then in terms of the language of the particle physics it requires the existence of new dynamics and new interactions between the neutrinos and the dark

energy sector. Qualitatively these models have made an interestingprediction, viz., neutrino masses are not constant, but vary during the evolution of the universe. The predictions on the variation of the neutrino masses can be tested with Short Gamma Ray Burst, CMB and much more interestingly and importantly in the experiments of neutrino oscillations. If the interactions between dark energy and the neutrinos indeed exist, they will open up some possibilities of detecting the dark energy non-gravitationally. Recently, some interacting dark energy models, where the dark energy sector is closely connected to the Higgs and the Top quark in the standard model of elementaryparticlephysics(SM), have also been proposed in literature. One has to wait for future experiments to learn more about the dark energy and hence confirm or rule out these models.

5. ARE DARK MATTER AND DARK ENERGY RELATED?

It is natural to conjecture the dark matter and dark energy as two different manifestations of the same physical quantity in view of the Einstein's famous mass-energy equivalence relationship. However, it needs to be emphasized here that as per the present cosmological evidence, the two do not seem to berelated to each other. Dark energy is the force responsible for the acceleration of the expansion of the universe at an everincreasing rate since the Big Bang. Dark matter, on the other hand, is the force that keep the universe together and explains how the cohesion of the stars, galaxies and even the galactic clusters is possible. The influence of dark energy is largely repulsive, whereas that of dark matter is attractive. Thus, dark matter and dark energy appear to be competing forces in our universe. The only thing they have in common is that both were forged in the 'Big-Bang' and both remain mysterious.

6. CONCLUSIONS

In conclusion, we would like to state that understanding the dark matter and dark energy is one of the biggest challenges to the presentday particle physics. Dark Matter is a mysterious form of matter which has been proven to constitute around 26% of the total mass energy of the Universe. As per our present knowledge, it is largely supposed to be consisting of non baryonic components-viz. WIMPs.

On the other hand, dark energy is even more mysterious and is related to the wellestablished phenomenon of acceleration of the expansion of the universe.At present, the simplest possible explanation, vacuum energy, is consistent with all existing data, but the theory provides no understanding of why it should have the requisite small value. An impressive array of experiments aiming to understand the origin of dark energy are underway or are planned, hoping to make a significant progress in the next fifteen years.

In conclusion, we would like to state that powered by robust instruments, bold ideas and profound mysteries, we are certainly in a revolutionary era of discovery to understand the universe and our place in it.We have to wait for more data to arrive at a conclusive theory of these mysterious constituents of Universe.

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Artificial Intelligence (AI): Prospectus and Challenges

*IfatRasheed **Dr.Gurinder Kaur Sodhi
*Research Scholar, Department of E&C, DBU, Punjab.
**Assistant Professor, Department of E&C, DBU, Punjab.
Contact: ifatrashid@gmail.com

Abstract

One of the most popular buzzwords in business, industry, and academia right now is artificial intelligence. It is a key lynchpin of a lot of the digital transformation happening now as businesses get ready to profit from the ever-increasing volume of data being generated and gathered. The abundance of data has increased research into its processing, analysis, and application. The emphasis was on teaching computers to do this in the most "smart" way possible because machines are significantly more suited to humans than this work. This growing interest in the field's study from academia, business, and the middle-ground open source community has produced innovations and advancements that have the potential to bring about significant change. It is playing a major part in the day-to-day operations of human societies, from healthcare to autonomous vehicles to predicting the results of judicial disputes to weather forecasting. The ability of building intelligent robots brings about some difficulties for the IT sector. A feeble attempt has been made to highlight the moral concerns surrounding artificial intelligence or "thinking machines" in this article.

Key words: Science and Technology; Artificial intelligence; Thinking Machines; Recent Developments.

Introduction:

In the field of computer science known as artificial intelligence, the development of intelligent machines that function and respond just like people is emphasised. It is now a crucial component of the technological sector. Programming computers with particular abilities, such as knowledge, reasoning, problem-solving, perception, learning, planning, and the ability to operate and move objects, is at the heart of artificial intelligence. One of the main focuses of artificial intelligence research is knowledge engineering. Only when they have a wealth of information about the outside world can machines frequently behave and react like humans. To perform knowledge engineering, artificial intelligence needs to have access to objects, categories, properties, and relations between them all. It is challenging and time-consuming to start up machines with logic, reasoning, and problem-solving abilities.

Another essential component of artificial intelligence is machine learning. While learning under proper supervision involves categorization and numerical regressions, learning without any supervision necessitates the capacity to spot patterns in streams of inputs. Regression focuses on obtaining a set of numerical input or output examples in order to discover functions that allow the generation of suitable outputs from respective inputs. Classification determines which category an object belongs to. Computational learning theory is a well-defined subfield of theoretical computer science that studies the mathematical analysis of machine learning algorithms and their performance.

Computer vision is the ability to analyse visual inputs with a few sub-problems such as facial, object, and gesture recognition. Machine perception deals with the ability to use sensory inputs to deduce the various aspects of the world. Another important area of artificial intelligence is robotics. Robots need intelligence to perform functions like object handling and navigation, as well as the related issues of mapping, motion planning, and localisation.

Artificial intelligence advancements in recent years:
Because of the emphasis on modelling human thought processes, all of these developments have been made possible. The area of study known as "machine learning" has produced the most fruitful results in recent years. The phrases "artificial intelligence" and "machine learning" are now sometimes used interchangeably because they are both so fundamental to modern artificial intelligence. The ideal approach to think of machine learning, however, is as the current state-of-the-art in the broader field of artificial intelligence, as this is an inaccurate use of terminology. The premise of machine learning is that, if machines can be programmed to think like us, they can learn to work by observing, classifying, and learning from its mistakes, just like we do. Instead of having to be taught how to do everything step-by-step.

Artificial neural networks were created as a result of applying neuroscience to IT system architecture, and while work in this field has advanced over the past 50 years, it has only recently become feasible for everyone, outside of those with access to the most expensive, specialised tools, to carry out this task on a daily basis. The data explosion that has been unleashed since traditional society combined with the digital world may be the single largest enabling factor. Computers today have access to a vast amount of data to aid in their learning and decision-making, ranging from the information we share on social media to machine data produced by connected industrial machines.

Artificial Intelligence Prospectus:

Apocalyptic science fiction like The Matrix or The Terminator is not the only source of concern for the future of humanity; respected scientists like Stephen Hawking have also raised concerns about the development of intelligence that is equal to or greater than our own but has the ability to operate at much higher speeds. Even if robots don't exterminate us or turn us into living batteries, a less dramatic but no less terrifying possibility is that automation of labour (both mental and physical) will result in significant societal change. These changes could be for the better or worse.

This natural worry prompted several digital behemoths, including Google, IBM, Microsoft, Facebook, and Amazon, to establish a cooperation in artificial intelligence a few years ago. The goal of this group is to establish standards for future research and the use of robots and artificial intelligence. It will also advocate for ethical applications of AI. Research in a variety of fields—from economics and law to technological subjects like verification, validity, security, and control—is motivated by the desire to keep the influence of artificial intelligence on society positive. If an AI system is in charge of your car, aeroplane, pacemaker, automated trading system, or power grid, it becomes even more crucial that it follows your instructions. While a laptop crash or hack may be little more than a minor inconvenience, this is not the case. Preventing a deadly arms race in lethal autonomous weapons is another immediate challenge. What would happen in the long run if the quest for strong artificial intelligence is successful and an artificial intelligence system outperforms humans in every cognitive task? I.J. Good noted in 1965 that creating more intelligent artificial intelligence systems is in and of itself a cognitive endeavour. Such a system might undergo recursive self-improvement, resulting in an intelligence explosion that would far surpass human intelligence. Strong artificial intelligence may be the biggest development in human history because it might help humanity end war, sickness, and hunger by creating ground-breaking new technologies. However, if we don't figure out a way to mesh AI aims with ours before it becomes superintelligence, it might also be the last, according to some researchers.

Some people doubt that powerful artificial intelligence will ever be developed, while others are adamant that the development of superintelligent artificial intelligence would always be advantageous. At FLI, we are aware of both of these possibilities as well as the possibility that an AI system could inadvertently or intentionally cause significant harm. We are certain that current research will enable us to better anticipate and prevent such potentially detrimental effects in the future, allowing us to take advantage of the advantages of artificial intelligence while avoiding pitfalls.

Artificial intelligence problems:

The majority of scientists concur that a superintelligent "Artificial Intelligence" is unlikely to display human emotions like love or hate, and that there is no reason to anticipate that Artificial Intelligence will purposefully turn good or malevolent. Instead, scientists believe two possibilities are most possible when evaluating how Artificial Intelligence might become a risk:

The artificial intelligence is set up to act in a terrible way: Systems with artificial intelligence that are programmed to kill are referred to as autonomous weapons. These weapons have the potential to easily result in massive casualties in the wrong hands. Furthermore, a race for artificial intelligence weapons could unintentionally end in a conflict between the two that causes large numbers of victims. These weapons would be built to be incredibly hard to simply "switch off," so humans may conceivably lose control of such a situation in order to avoid being foiled by the enemy. This risk is one that exists even with limited artificial intelligence, but it increases as AI and autonomy develop.

This can happen whenever we are unable to fully align the goals of Artificial Intelligence with ours, which is remarkably challenging. Despite the fact that the Artificial Intelligence is programmed to do something beneficial, it develops a destructive method for achieving its goal. If you order an intelligent, obedient car to bring you to the airport as quickly as possible, it might really do what you asked for, which would be to get you there while being followed by helicopters and covered

in vomit. If an ambitious geoengineering project is given to a superintelligent machine, it might cause havoc with our ecology as a side consequence and see human attempts to stop it as a danger that needs to be defeated. These instances show that competence, not malice, is the main worry regarding developing artificial intelligence. A super-intelligent AI will be very adept at achieving its objectives, and if those objectives conflict with ours, we have a problem. If you are in charge of a hydroelectric green energy project and there is an ant-hill in the area to be flooded, it is unfortunate for the ants. You are probably not a malicious ant-hater who steps on ants with purpose. Never putting humanity in the same situation as those ants is a major objective of AI safety research.

Safety Concerns:
Recent media reports and open letters from prominent scientists and technologists, including Stephen Hawking, Elon Musk, Steve Wozniak, Bill Gates, and many more, have raised worry about the dangers that artificial intelligence poses. Why are the headlines now referencing the topic?

Long considered science fiction, the eventual success of the search for powerful artificial intelligence was centuries or more away. But owing to recent advances, several AI milestones that scientists once thought were decades away have now been attained, leading many experts to take seriously the idea of superintelligence in our lifetimes. The majority of artificial intelligence researchers at the 2015 Puerto Rico Conference predicted that human-level artificial intelligence would exist by 2060, despite the fact that other experts still believe that this is centuries away. It is wise to start the necessary safety studies now because it could take decades to complete.

We have no reliable means of forecasting how Artificial Intelligence will act because it has the ability to become more intelligent than any human. We can't really base future technical advancements on the past because we've never made something that could intentionally or unintentionally outwit us. Perhaps our own evolution is the finest illustration of what we might encounter. Not because we are the biggest, quickest, or strongest, but because we are the smartest, people now rule the earth. Are we guaranteed to maintain control if we are no longer the smartest?

According to FLI, as long as we prevail in the contest between the expanding strength of technology and the wisdom with which we handle it, civilisation will flourish. FLI believes that in the case of artificial intelligence technology, advancing the latter by funding safety research is the best strategy to win the race rather than slowing the former.

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Recent Trends in ECG Data Compression Approaches

*Butta Singh, Himali Sarangal and Manjit Singh
Guru Nanak Dev University, Regional Campus, Jalandhar
Corresponding Author Email ID: bsl.khana@gmail.com

Abstract
ECG monitoring facilitates in providing accelerated health status of the concerned patient to the healthcare centre in case of the hostile cardiac behavior. For continuous monitoring of patient's health, the ECG signal is recorded for long time durations typically for several hours or few days. The storage of such massive volume of data requires large memory space. To combat with such a huge growth rate of memory requirement and data sparsity, many ECG compression and de-compression algorithm had already developed to represent the raw ECG in the processed format. In this paper, the review of approaches dealing with ECG data compression is presented. It also highlights the research challenges relevant to each domain.
Keywords: Electrocardiogram; ECG; Data Compression

Introduction
E-healthcare monitoring system enables an instantaneous analysis of patient physiological data. One of the best representatives of physiological signal is Electrocardiogram (ECG), which provides state of autonomic nervous system responsible for regulating cardiac activity [1]. In the modern era, cardiovascular diseases had emerged as one of the essential causes of mortality in both urban and rural areas [2], [3]. ECG monitoring facilitates in providing accelerated health status of the concerned patient to the healthcare centre in case of the hostile cardiac behaviour [4]. Cardiac monitoring using ECG signal is the best representative of heart's electrical functionality and had proven to be useful in the diagnosis of most of the heart diseases. Transmission of this compressed ECG via a communication channel introduces various security and privacy issues [5]. To counteract with these concerns, there is a need for implementation of efficient security protocols. To this effect, several algorithms have been developed in the past two to three decades [6].

For continuous monitoring of patient's health, the ECG signal is recorded for long time durations typically for several hours or few days. The storage of such massive volume of data requires large memory space, for example, a threechannel ECG signal sampled at a frequency of 1 kHz with 11 bits of resolution in three lead system of a particular patient, recorded for 24 h requires 928 MB of memory size per channel without any overhead. Such vast volume of data is expected to have intra and inter-beat correlation or inherent sparsity. ECG possesses the capability of reduction of redundant information through intra and interbeat correlation, which is the core cause of its data compression[7]. To combat with such a huge growth rate of memory requirement and data sparsity, many ECG compression and de-compression algorithm had already developed to represent the raw ECG in the processed format [8].

In general, compression methods can be classified as lossy and lossless [9]. A better value of Compression Ratio (CR) is achieved when lossy methods are used but at the cost of the reconstruction error. An efficient integrity of the reconstructed data is ensured using lossless ECG data compression methods, but with the compromised CR, typical 2-4 CR with 0% reconstruction error has been reported in the literature [10]. The performance of ECG data compressor is usually being measured by the CR at the desired reconstruction error. Generally, the reconstruction error is being calculated by the Percentage Root mean square Difference (PRD) at the receiver end, after the process of decompression. Many researchers have proposed ECG compression techniques by treating One Dimensional (1D) ECG signal as a Two Dimensional (2D) image and exploiting the inter and intra-beat correlations by encoder [11]–[13]. These techniques broadly consist of the steps: QRS detection, ECG segmentation, pre-processing, and transformation. The "cut and align beats approach and 2D Discrete Cosine Transform (DCT)" and "period normalization and truncated Singular Value Decomposition (SVD) algorithm" are available pre-processing techniques to get good compression results in ECG

[14], [15]. This pre-processing is also often associated with the use of state-of-the-art image encoders, like JPEG2000, H.264/AVC, etc.

2. RESEARCH CHALLENGES

In this section, the literature survey dealing with ECG data compression is presented. It also highlights the research challenges relevant to each domain.

2.1. ONE-DIMENSIONAL ECG DATA COMPRESSION TECHNIQUES

In ECG data compression techniques, the direct and the transformed domain are used to exploit the redundancy in the signal. Thresholding the transformed domain coefficients significantly reduces the data size without losing the significant information [23]. Many 1D and 2D domain based compression methods are reported in the literature. The direct data compression method analyzes and reduces data points in the time domain. Jalaleddine et al. [23] had surveyed various direct data ECG compression schemes which include Turning Point (TP), Amplitude Zone Time Epoch Coding (AZTEC), improved modified AZTEC technique, Co-ordinate Reduction Time Encoding System (CORTES), the delta algorithm and the Fan algorithm. Cox et al. [24] proposed AZTECH algorithm rhythm analysis the advantage of this method lies in its ability of high data reduction ratio but suffers from loss of data fidelity due to the presence of discontinuity that occurs in the reconstructed ECG waveform. Kumar et al. [25] developed improved modified AZTECH technique in which the statistical parameters of the signal to be compressed are computed, and they adjust themselves to the nature of the signal by recalculating the threshold value. The authors have concluded that using least square polynomial smoothing filter a significant reduction in PRD was obtained for a typical value of CR=2.76, the threshold value of 0.010, PRD value with and without smoothing filter were 4.54 and 6.56 respectively. Kumar et al. [26] had surveyed AZTEC, modified AZTEC, Fan, and scan along polygonal approximation techniques. The authors had also suggested some modifications in them, thereby making suitable for telemedicine purposes. In the modified version the CR value is high, and PRD value had gone considerably low for the same value of the threshold.

Recently, Mukhopadhyay et al. [27]–[29] proposed ASCII based encoding methods to be employed for compression due to its simplicity, which enables them to be used in portable and mobile data ECG data monitoring systems. The transformed method analyzes energy distribution by converting the time domain to some other domain.

Sur and Dandapat et al. [8] presented a prospective review of various ECG data compression methods like Fourier transform, Fourier descriptor, Karhunen–Loeve Transform (KLT), the Walsh transform, the DCT and the wavelet transform. To efficiently explore inter and intra beat correlations at the encoder, processing techniques for 2D ECG image were also discussed by the authors. In twodimensional ECG compression methods, the transformation is applied to the 2D representation of 1D ECG signals to improve the compression efficiency. Reddy et al. [30] devised Fourier descriptor based ECG data compression. The advantage of the proposed method was its capability to handle noisy records without any requirement of the postprocessing, which was duly justified by the value of on an average CR =7 and PRD=7, making it suitable for the morphological study. Batista et al. [31] developed an effective compression technique which was based on optimized quantization of DCT coefficients. The efficiency of the technique was verified on all 48 records of MIT-BIH arrhythmia database. The results of CR and PRD using the proposed technique for the 100th record were 10.2 and 3 respectively.

1.2. TWO-DIMENSIONAL ECG DATA COMPRESSION TECHNIQUES

Numerous researchers have reported ECG data compression procedures by formulating 2D arrays from ECG signals to better exploit the inter- and intra-beat correlations by the employed encoder [11], [12], [34]. 2D ECG compression method needs reliable and precise R-peak detection and segmentation for efficiently exploiting the intra-beat and inter-beat correlations. Since the length of each beat is different, an appropriate algorithm is needed to align the beats for maximizing the beat to beat correlation. The cut and align beats approach with 2D DCT [35] along with period normalization [36] are the existing pre-processing techniques that achieve decent ECG compression results.

Kumar et al. [37] reported a 2D ECG data compression algorithm based on singular value decomposition and wavelet difference reduction techniques. Eddie B. et al. [11] proposed a new lossy compression technique which focused on pre-processing by clamping minimum DC level of the period. After clamping, the process of complexity sorting was done through which an increase in the vertical smoothness of the image was achieved.

Different combinations of pre-processing methods were explored using JPEG2000 & H.264/AVC encoder.

In the analysis by Filho et al. [11], it was verified that this assumption does not hold for the large set of ECG signals of pathology subjects. One more pre-processing method consists of a QRS detector, period length normalization, Dc equalization, complexity sorting and image transformation as designed in [11].

3. DATABASE

The details pertaining to the selected ECG datasets are as follows

Standard MIT-BIH Arrhythmia database: The dataset contains 48 records of thirty minutes' duration having two-channel ambulatory ECG recordings [62]. The 11-bit resolutions over 10 mV ranges with the sampling frequency of 360 Hz per sample channel were recorded. NSR database NSR database : It includes 18 ECG datasets of subjects with no significant arrhythmias; they include 18 records aged 26 to 50 with sampling rate 128 Hz and gain of 200 with 0 base.

CUVT database CUVT database: It comprises 35 ECG records of who experienced ventricular flutter, ventricular tachycardia, and ventricular fibrillation. The ECG signals are sampled at 250 Hz and gain of 400 with 0 base.

CSE database: This library has 125 ECG data sets (MO1_001 to MO1_125). The signal from these sets is sampled at 500 Hz with a peak 5mV quantization and 10-bit resolution. Each data record contains 15-channels of ECG signals including conventional 12 leads and 3 frank leads.

PTB database PTB database: This database has 549 12 lead ECG records collected from 290 subjects (aged 17 to 87, average 57.2 years) Each subject is characterized by one to five ECG records. Each record contains 15 concurrently measured signals: the conventional 12 leads (I, II, III, aVR, aVL, aVF, V1, V2, V3, V4, V5, V6) organized with the 3 Frank ECG leads (Vx, Vy, Vz). The sampling frequency was 1000 Hz for each signal with a gain of 2000 and 0 base

4. CONCLUSION

The present work contributes and reviews in the area of ECG data compression mechanisms that can aid the telecardiology technology. The proposed approach can also satisfy the growing need for the processing of ECG signals directly in compressed and encrypted domains to ensure the patient's privacy protection

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GENERATIONS OF RENEWABLE ENERGY TECHNOLOGIES

*Vishav Singh , **Kiranjit Kaur

*M. Tech Student, Department of Electrical Engineering, Desh Bhagat University,
Mandi Gobindgarh, Punjab (147301)
**Assistant Professor, Department of Electrical Engineering, Desh Bhagat University,
Mandi Gobindgarh, Punjab, (147301)
Corresponding Author Email ID: vishavbandral1999@gmail.com, kiranjit10@deshbhagatuniversity.in

Abstract

In this Paper, green technologies and methods for the creation of renewable energy sources are reviewed. The potential for renewable energy sources to meet global energy and development needs is very high. This potential is particularly alluring in developing countries, since many regions have not yet made a firm commitment to fossil fuel dominance. The two billion people who live in rural areas and do not have access to the grid for power are notably helped by solar photovoltaic and solar thermal technologies. Because it utilises readily available agricultural waste locally, biomass energy is appealing. Other advanced technologies that are suitable for developing nations include wind energy and small hydropower resources.
Keywords:- Renewable Energy Resources, Green House Effect, Solar Energy, Generations of Technologies;

Introduction

How much of a resource should be harvested now vs in the future has been the central economic concern in the management of renewable natural resources. Time is often thought of as having passed over the economic operation or one representative management.

For instance, the economic challenge in ocean fisheries has been how much to harvest this year and how much to leave in the water to serve as a source of growth for the following season..The duration of time between harvests in a forest operation has been a topic of economic debate increases the earnings of a forest owner. Similar comparisons of deferred income flows be taken into account for renewable soil, water, or animal resources .efficient allocation..Nonrenewable energy sources have two major drawbacks: limited supply and pollution. The combustion of fossil fuels produces a large amount of carbon dioxide (CO_2), a greenhouse gas. This is most likely the primary cause of the recent rise in global temperatures. Nuclear power facilities, on the other hand, are not harmful to the environment, but the compounds formed as a result of nuclear reactions are radioactive for years and must be stored in specific chambers. Renewable energy sources, on the other hand, are unaffected by any of these issues. The following are the most important renewable energy sources:

*   Wind energy
*   Solar energy
*   Bioenergy
*   Hydro energy

Renewable energy sources do not pollute the environment to the same extent that non-renewable do, but they are also not fully clean. This primarily affects biomass energy, which has the same effect as fossil fuels in terms of CO_2 emissions when burned, but the carbon circle is at least closed in that case. [2]
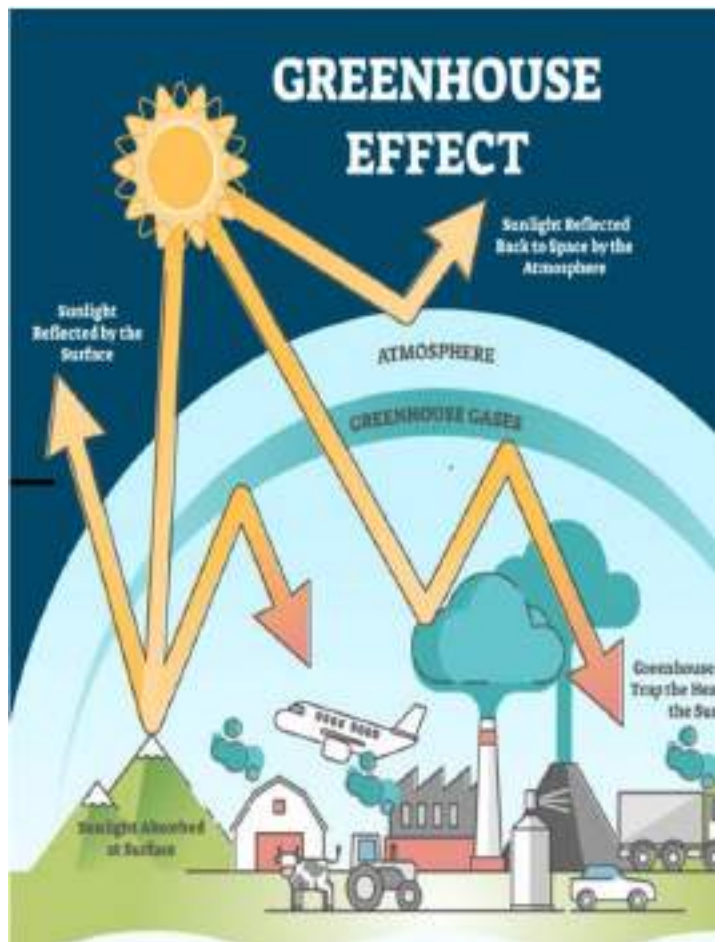

Fig. 1 Green House effect

The greenhouse effect is the way in which heat is trapped close to Earth's surface by "greenhouse gases." These heat-trapping gases can be thought of as a blanket wrapped around Earth, keeping the planet toastier than it would be without them. Greenhouse gases include carbon dioxide, methane, nitrous oxides, and water vapor. (Water vapor, which responds physically or chemically to changes in temperature, is called a "feedback.") Scientists have determined that carbon dioxide's warming effect helps stabilize Earth's atmosphere. Remove carbon dioxide, and the terrestrial greenhouse effect would collapse. Without carbon dioxide, Earth's surface would be some 33°C (59°F) cooler.

The expense and small volume of renewable energy sources (water energy excluded) are the two biggest issues, of newly acquired energy Renewable energy sources have enormous promise, but our current technological advancement prevents us from solely relying on them. The "Greenhouse Effect" is seen in this image. The earth reflects some of the sun's reflected radiation as greenhouse gases (CO_2, N_2O, CH_4, HFC, PFC, and SF_6), and this effect is responsible for Earth's temperatures. Due to the increasing concentration of CO_2 during the last century, greenhouse effects have been strengthening over the period[3]. As a result, the average temperature of the Earth rises globally. Ice melting, rising sea levels, agriculture impacts, and so on are all consequences of global warming. If the greenhouse effect did not exist, the earth's temperature would be approximately 30°C lower than it is now. Wood and biomass burning, deforestation, and fossil fuel combustion are all major producers of CO_2.

2. GENERATIONS OF RENEWABLE ENERGY TECHNOLOGIES

Renewable energy encompasses a wide range of sources and technologies at various levels of development. The International Energy Agency (IEA) has identified three generations of renewable energy technology over the years:

Hydropower, biomass combustion, geothermal power, and heat are examples of first-generation technologies that emerged around the end of the nineteenth century as a result of the industrial revolution. These technologies have a huge following. Second-generation technology includes solar heating and cooling, wind power, various types of biofuels, and solar photovoltaic. As a result of investments in research, development, and demonstration since the 1980s, they are now entering the market. Concerns about energy security following the oil crises of the 1970s prompted the initial investment, but these technologies' long-term appeal is due, at least in part, to environmental benefits. Many of the innovations are based on significant technological breakthroughs. Among the third-generation technologies still under development are advanced biomass gasification, biorefinery technologies, concentrated solar thermal power, hot-dry-rock geothermal power, and ocean energy. Nanotechnology breakthroughs have the potential to make a big impact.[4]

3. SOLAR HEATING

Solar heating systems are a well-known second-generation technology that consists of solar thermal collectors, a fluid system to transport the heat from the collector to the point of use, and a reservoir or tank to store the heat. Household hot water, swimming pools, and residential and commercial buildings may all benefit from these systems. The heat can also be used in industrial operations or as a source of energy for other applications, such as cooling.

4. BENEFITS OF RENEWABLE ENERGY

The following are some of the most significant advantages of renewable energy:

They are a renewable resource. It is one of the most significant advantages of alternative energy since renewable energy is always available for widespread usage and does not deplete like fossil fuels. The sun, wind, tides, and other natural forces will always be available for humans to use.

Municipal solid trash is being phased out. Alternative energy benefits include not only removing vast volumes of garbage now destroying the environment but also converting this junk into a benefit through waste to energy plants. These factories treat municipal waste, converting it to electricity and removing it from the environment.

Energy production on a small scale. Producing locally has several advantages in terms of alternative energy. This comprises decreasing transportation costs and benefits for local economies from the company putting up factories using alternative energy sources. It will no longer be necessary to import fossil fuels from other countries at exorbitant prices. There will be no need for foreign energy if there are several plants of alternative energy sources in the country.

Improved national security Alternative energy sources do not rely on foreign oil, which can be politically hostile to the United States at times. It also implies that

foreign countries do not have control over the market, which is potentially volatile. Foreign dependency is completely reduced with alternative energy sources.

It is more environmentally friendly. One of the most significant advantages of alternative energy is that it is far more environmentally friendly than present fossil fuel use. Alternative energy sources do not emit carbon dioxide, and their recovery causes little or no environmental damage. Fossil fuels, such as gas and oil, emit large amounts of greenhouse gases, which contribute significantly to global warming.[5]

A future that is healthier and cleaner. Alternative energy sources give solutions to the concerns of global warming, and they may repair some of the damage that has already been caused by the usage of fossil fuels. All of this contributes to making our planet a healthier and cleaner place to live for future generations. If we work together, we can Price stability has improved. Alternative energy has numerous advantages, including constant availability and sustainability, as well as being significantly less expensive and stable. For each area allocated to alternative energy sources, a mix of strategies is employed to keep energy costs from changing in the way that oil and gas prices do.

Fig. 2 Solar Plates

This helps to keep the pricing of alternative energy sources steady and prevents market instability.

5. DISADVANTAGES OF ALTERNATIVE ENERGY

Alternate energy sources have the following disadvantages:

No Constant Supply. The energy supply is dependent on nature and, thus, is not constant, e.g., solar energy. The same may be said about wind energy. Wind farms can only generate power in the countryside or other such regions where turbines can receive wind without being obstructed. The situation is better with hydroelectricity (or water energy) because once power is created at the dams, it can be extracted through wires and sent across long distances.[6]

Implementation Problems This is one of the main reasons why alternative energy isn't popular. Alternative energy sources have been used by many industries. They, on the other hand, withdraw as soon as they realize it would be too expensive.

It is costly to use. In terms of cost, fossil fuels are less expensive to utilize than alternative energy. Fossil fuels are easily available, maybe stored anywhere, and can be transferred using standard transportation methods. Solar electricity is expensive to utilize in everyday life. The cost per KWH might range from 20 to 25 cents. Dependant on Seasons. Biomass is generally produced from corn, wheat, barley, and similar crops all of which are seasonal. Thus biomass can only be produced only in certain seasons. Energy/Hydropower: Hydropower (water energy) often damages the surrounding environment. It has a well-known effect on fish. Many people consider hydropower plants to be ecological blight. Damming also reduces the amount of oxygen dissolved in the water. It would be erroneous to assert that alternative energy has no drawbacks.[7]

6. NON-TECHNICAL BARRIERS TO ACCEPTANCE

The main impediments to the broad commercialization of renewable energy technology are political rather than technical, and several studies have found a variety of non-technical hurdles to renewable energy use. The following are some of the most significant obstacles: Lack of government policy support, which includes the absence of policies and regulations that assist the deployment of renewable energy technology as well as the presence of rules and regulations that both impede and encourage renewable energy development. Subsidies for fossil fuels, a lack of consumer-based renewable energy incentives, government insurance for nuclear plant accidents, and complicated renewable energy zoning and approval processes are just a few examples.[8]

Consumer awareness and information transmission are lacking. Renewable energy technologies have a greater capital cost than traditional energy systems. Inadequate funding alternatives for renewable energy projects, including project developers, entrepreneurs, and consumers having insufficient access to reasonable finance. Failing to absorb all costs of conventional energy (e.g., consequences of air pollution, the danger of

supply interruption) and failure to internalize all benefits of renewable energy are examples of imperfect capital markets (e.g., cleaner air, energy security). Lack of necessary scientific, technical, and manufacturing skills required for renewable energy generation; lack of dependable installation, maintenance, and inspection service and the inability of the educational system to give adequate training in new technologies. Codes, standards, utility connections, and net-metering rules are all lacking.[9] Poor public perception of renewable energy system aesthetics. Lack of stake holder/community participation and co-operation in energy choices and renewable energy projects.

7. CONCLUSION

Evidence of worldwide renewable resource decline is apparent along both socioeconomic and ecological gradients. Statistics on ocean fishery depletion, forest land conversion, topsoil loss, desertification, species extinction, and freshwater diminution, overwhelmingly point to the consequences of human domination of the planet's resources. This data has most often been presented as smooth, continuous trends. However, perhaps most striking is recent research on catastrophic shifts in entire ecosystem types. An October 2001 article in Nature (Vol. 413, pp. 591-596) presents evidence of dramatic flips in state apparent in lake, coral reef, woodland, desert, and ocean systems resulting from continuous, incremental pressure. Optimal control theory, as presented in Section 2, has been the dominant 20th century paradigm behind the analysis of and policy advice in renewable resource systems. At the dawn of the 21st century and in the wake of worldwide renewable resource decline, policy-makers and resource economists alike are in search of a broader, more holistic view of complex and interdependent socio-ecological systems. Many have taken an approach of improving upon the old framework, as evident by the option value approach presented in Section 3. Others have looked beyond traditional disciplinary walls for entirely different perspectives on renewable resource management, for instance, the complex adaptive systems approach presented in Section 4. Neither discussion above is meant to be an exhaustive treatment of an economic nor natural science based approach to renewable resource systems, but rather highlights the key differences in foundation. Most dramatic is the seemingly polar extremes of the economist's focus on efficiency and the natural scientist's focus on resilience. At the heart of nearly all economic models of renewable resources is the goal of efficiency, where marginal benefits of the next resource put to economic use is exactly equal to its marginal cost of production and/or to society. This approach has been successful in generating maximum short-run returns to capital investment, however, has failed to consider the importance of scale and the consequences of unpredictable discontinuous change. Socio-ecological complexity is just simply too overwhelming to manage at the margin. A focus on resilience, in contrast, could help define the boundaries of the system in which economic actors can then go about the calculus of maximization.

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INVESTIGATION OF COMPARISON COTTONSEED METHYL ESTER BLENDS D80-B10-E10 AND D60-B20-E20 WITH DIESEL PROPERTIES

*Varinder Singh

Assistant Professor, Mechanical Engineering,
Desh Bhagat University, Mandi Gobindgarh, District Fatehgarh Sahib, Punjab- 147301

Abstract

Biodiesel is nontoxic and renewable fuel which used at place of diesel in CI engine without any major modification. Biodiesel had better lubrication property, less emission and clean burning as compare to diesel. In the present work, the Transesterification process was used for production of cotton seed oil methyl ester because yield and reaction type was less as compare to other biodiesel production process. Ethanol was used as oxygenated fuel that was mix in blend of cotton seed oil methyl ester and diesel. Because ethanol had high calorific value and high cetane no. ethanol would reduce the consumption of diesel, content of HC and CO in engine emission and ignition lag in CI engine.An experimental study was carried out compare the properties of blend D80-B10-E10 and D60-B20-E20 with diesel and pure biodiesel. The optimum blend was selected on the basis of properties. Results showed that the properties of blends were very near to pure diesel The properties were include density, viscosity, flash point and fire point, cloud point and pour point, carbon residue content and ash residue content and calorific value.

Keywords: ethanol, biodiesel, hydrocarbon, carbon monoxide, compression ignition.

Introduction

Diesel engines are widely used in transportation, agricultural appliances and construction machines owing to their high fuel efficiency and durability. However, the NOx and smoke emissions are the main exhaust emissions of diesel engines and there is a trade-off relationship between them [1].environmental policies, reduction in underground fossil fuel, escalating prices and increased demand for energy have triggered interest in more advanced and novel combustion technologies that use renewable and alternative fuels as energy sources. There is continuous pressure on emission control through periodically tightened regulations throughout the world. In this situation, there is an urgent need to promote use of alternative fuels as substitutes for diesel engine [2].Biodiesel is the name of a clean burning alternative fuel produced from domestic, renewable resources. It can be used in Compression Ignition engine without modification. The biodiesel combustion is better not only for people but also for earth's environment. Biodiesel contains no petroleum, but it can be blended at any level with petroleum diesel to create a biodiesel blend [3]. Generally the blend of biodiesel diesel mix is denoted by capital alphabet B followed by percentage of biodiesel in a mixture so if 20% biodiesel and 80% diesel is in a mixture on a volume basis then it is denoted as B20.in other word Biodiesel is simple to use, biodegradable, nontoxic, and essentially free of sulfur and aromatics. [4]

Need of biodiesel

Petroleum resources are not infinite so search for alternative is continuing all over the world. The demand of energy is fulfilled by the conventional energy resources like coal, petroleum and natural gas. Petroleum-based fuels are fewer reserves concentrated in some areas of the world. The scarcity of known petroleum reserves will make renewable energy resources like biodiesel more attractive [5].

- Biodiesel is Energy Independence
- Biodiesel has Smaller Trade Deficit
- Biodiesel important for Economic Growth
- Biodiesel is need for Cleaner Air
- Biodiesel is use to reduce Global Warming
- Due to High price of crude oil biodiesel is less costly

Transesterification

The majority of the methyl esters are produced using the base catalysed reaction because it is the most economic for several reasons [6]

1. low temperature and pressure
2. high yields and short reaction times
3. direct conversion process
4. simple in operation and environmentally eco-friendly

Transesterification can be defined as the process of reacting a triglyceride (oil) with an alcohol (e.g., methanol or ethanol) in the presence of a catalyst, such as so-

dium hydroxide or potassium hydroxide, to chemically break the molecule of the oil into methyl or ethyl esters. Glycerin, also known as glycerol, is the by-product of this reaction. The process is similar to hydrolysis, except than alcohol is used instead of water.

Critical quality parameters in the process are:
- Complete reaction
- Removal of glycerol
- Removal of catalyst
- Removal of alcohol
- Absence of free fatty acids
- Low sulphur content

Methanol is used as the alcohol for producing biodiesel because it is the least expensive alcohol, although other alcohols. Such as ethanol may yield a biodiesel fuel with better fuel properties but it is expensive. Often the resulting products are also called fatty acid methyl esters (FAME) instead of biodiesel. The amount of alcohol used can be reduced by conducting the reaction in steps, where part of the alcohol and catalyst are added at the start of each step, and the glycerol is removed at the end of each step. Free fatty acids in the oils or fats can be converted to alkyl esters with an acid catalyst also. This can be followed by a standard alkali-catalysedtransesterification to convert the triglycerides. Acid catalysts can be used for the transesterification of oils to alkyl esters, but they are much slower than alkali catalysts. [7]

Use of Catalyst in Transesterification
These are broadly divided into two types:
(a) Base catalyst
It is basically used for vegetable containing free fatty acid not more than 2%. KOH and NaOH are preferred as base catalyst. due to less cost.
(b) Acid catalyst
It is basically used for vegetable containing free fatty acid more than 2%. Sulfuric acid is preferred as acid catalyst. This procedure is carried out if the free fatty acid of the substrate is high. The conversion of free fatty acid to alcohol esters is relatively fast. Acid catalyst process needs excess alcohol and large amount of catalyst. Commonly used acid catalysts are Sulfuric acid and Phosphoric acid. Soap formed during this process is removed and the remaining oil is ready for base catalysis. Some oil is lost during this process. Acid catalyst can be used for direct esterification. Reaction is carried out for one and a half hour and allowed to settle for 24 hr.

Dual fuel diesel Engine
Conventional internal combustion engines operate on a mono fuel either liquid or gaseous. However, biogas run dual fuel diesel engines operate on both liquid and gaseous fuel simultaneously. Because the temperature attained at the end of the compression stroke inside the combustion chamber of CI engines is around 553 K. However, the auto ignition temperature of biogas is around 1087 K [8]. Therefore, simply compressing the biogas air mixture will not ignite the charge. Hence, a small amount of liquid fuel must be supplied which initially ignites and acts as an ignition source for biogas. The liquid fuel used is called the Pilot fuel. The gaseous fuel i.e. biogas. It is seen that in a dual fuel engine, the combustion starts in the same fashion to that of a CI engine. However, in the later part of combustion, the flame propagates in a manner similar to that of an SI engine. It is possible to achieve a substitution of diesel up to 85% by using biogas [9][11][14][18].

Primary fuel and its importance
The gaseous fuel that is use in dual fuel engine is called primary fuel. Biogas is called the primary fuel on which the engine mainly runs. Biogas run dual fuel diesel engines can be a panacea to the problem of acute power shortage particularly in rural areas in India. As is known to all, conventional diesel engine owns the benefit of much higher thermal efficiency than SI engine at the expense of high NOx and soot emissions. Hence, the utilization of biomass fuel in CI engines will improve the emissions and maintain high efficiency, which will promote the application of biomass fuel [10]. Moreover, gaseous fuels are considered good for internal combustion engines, because of their good mixing characteristics with air. The high self-ignition temperature enables them to operate with lean mixtures and higher compression ratios, resulting in an improvement in the thermal efficiency and reduction in emissions. Biogas is a good renewable gaseous fuel, and is produced by the anaerobic digestion of cow dung, non-edible seed cakes, animal waste, food waste, agricultural waste, municipal waste, sewage sludge etc[13].

Pilot fuel and its importance
The liquid fuel use in dual fuel engine is called pilot fuel. The blend of biodiesel- diesel –ethanol is called pilot fuel for dual fuel engine. The pilot fuel has a tremendous influence on the dual fuel combustion as it elicits the combustion process.[19] The combustion process of a biogas run dual fuel diesel engine is more complex than single fuel combustion. Prior to ignition

of pilot fuel, the biogas air mixture undergoes pre-ignition chemical reaction during the relatively longer compression stroke.[15] The pre-ignition reaction results in the formation of active radicals and partial combustion products that are believed to affect the ignition of the injected pilot fuel. cottonseed oil is the under-utilized non edible vegetable oil which is available in large quantity in rice cultivating countries and very little research has been done to utilize this oil as a replacement for mineral diesel. The direct injection of cotton seed oil cannot be done because of their high viscosity. So there is to reduce the viscosity of the cotton seed oil the transesterification is to be needed. First of all FFA content is calculated to know that which type of the catalyst is used either alkali or acid. After that optimum molar ratio methanol to oil is to be calculated [16].

Advantages of dual fuel engine
- No major modification of engine needed.
- Operation on diesel fuel alone is possible when biogas is not available.
- Any contribution of biogas from 0% to 85% can substitute a corresponding part of diesel fuel while performance remains as in 100% diesel fuel operation. Because of existence of a governor at most diesel engines automatic control of speed/power can be done by changing the amount of diesel fuel injection while the biogas flow remains uncontrolled. Diesel fuel substitutions by biogas are less substantial in this case [17].

Materials and Methods
Materials
Following materials are used:
1. Refined soya bean oil
2. Methanol (methyl alcohol)
3. Sodium hydroxide (NaOH) as catalyst
4. Ethanol (oxygenated fuel)

Refined soya bean oil purchase from local general store in Patiala. Methanol sodium hydroxide (NaOH) and ethanol were purchase from pooja science lab, Patiala, Punjab. The commercial diesel fuel was purchased from the nearer petrol pump. Table 1 shows apparatus used for biodiesel properties measurement.

Methodology to be adopted
1. Production of biodiesel.
2. Making the D80-B10-E10 and D60-B20-E20 blends.
3. Compare the properties of pure biodiesel and the blended biodiesel with pure diesel

Table 1 Apparatus for Biodiesel properties

Properties	Apparatus used
Density(kg/Lt)	Weighing balance
Kinematic viscosity(mm2/sec)	Redwood viscometer
Flash point and fire point(oC)	closed cup flash and fire point apparatus
Ash content (%)	Muffle furnace
Cloud point and pour point(oC)	Cloud and pour point apparatus
Carbon residue (%)	Carbon residue apparatus
Calorific value(kJ/kg or MJ/kg)	Bomb calorimeter

Density
Bio-diesel is slightly heavier than conventional diesel fuel and ethanol (specific gravity 0.88 compared to 0.84 for diesel fuel). This allows use of splash blending by adding bio-diesel on top of diesel fuel and ethanol for making bio-diesel blends. Table 2 show the properties of biodiesel.

Table 2. Density Propertie of biodiesel

Pure oil and Blends	Density (kg/Lt)
Diesel	815
Biodiesel	816
D60-B20-E20	820
D80-B10-E10	822

Viscosity of Biodiesel
It is an important property of a diesel. Improper viscosity leads to poor combustion, which results in loss of power and excessive exhaust smoke. Viscosity of Biodiesel is shown in Table 3.Diesel fuels with extremely low viscosities may not provide sufficient lubrication for the closely fit pumps and Injector plungers.Limits and method: kinematic viscosity is measured according to ASTM D-445 where it is limited to 1.9-6.0 mm2s-1

Table 3 viscosity of diesel, biodiesel and Blends

Pure oil and Blends	Viscosity (mm2sec-1)
Diesel	5.16
Biodiesel	2.5
D60-B20-E20	3.3
D80-B10-E10	3.26

Cloud and pour point

Cloud point is defined as the temperature at which a cloud or haze of wax crystal appears at the bottom of a test jar when chilled under prescribed conditions. Pour point is defined as the temperature at which the fuel ceases to flow. Both properties may indicate the tendency towards flow problems in the fuel line. Cloud and pour point temperature of biodiesel is shown in table 4.

Table 4 cloud and pour point of diesel, biodiesel and Blends

Pure oil and Blends	Cloud point (0C)	Pour point (0C)
diesel	3	2
Biodiesel	6	1
D60-B20-E20	5.5	0.5
D80-B10-E10	5.1	0.1

Flash and fire point

Flash point is defined as the lowest temperature at which the fuel gives off sufficient vapors and ignites for a moment. Fire point is an extension of flash point in a way that it reflects the condition at which vapour burns continuously for five seconds. Fire point is always higher than flash point by 5 to 80C. flash and fire point temperature of sample is shown in table 5.

Table 5 Flash and Fire point of diesel, biodiesel and Blends

Pure oil and Blends	Flash point(oC)	Fire point(oC)
diesel	65	70
Biodiesel	155	160
D60-B20-E20	82	87
D80-B10-E10	73	78

Calorific Value

Calorific value of a fuel is an important measure since it is the heat produced by the fuel within the engine that enables the engine to do the useful work. Calorific values of samples are shown in table 6.

Table 6 calorific value of diesel, biodiesel and Blends

Pure oil and Blends	DIESEL	Biodiesel	D60-B20 -E20	D80-B10 -E10
Calorific value (MJ/kg)	42.85MJ/Kg	39MJ/Kg	39.45MJ/Kg	41.15MJ/Kg

Conclusion

1. The results indicated that the blend of cotton seed biodiesel D60-B20-E20 had less calorific value than D80-B10-E10 and blend D80-B10-E10 had the calorific value 4.13% less than calorific value of diesel.

2. The cloud point ,flash point pour point and fire point temperature of blend D60-B20-E20 were more than the blend of D80-B10-E10

3. The viscosity of D80-B10-E10 was 58.28% less than diesel but more than blend D60-B20-E20.

4. In the end of study it is found that Blend D80-B10-E10 is best blend as compare to blend D60-B20-E20 for compression ignition engine at the place of pure diesel.

5. The Cloud point of blend D80-B10-E10 is 33.33% and D60-B20-E20 was 66.66%.

6. The pour point temp of blend D80-B10-E10 is 62.5% and D60-B20-E20 was 25% more than diesel.

7. The Calorific value blend D80-B10-E10 is 3.96% and D60-B20-E20 is 7.93%,

8. The Flash point blend D80-B10-E10 is 12.3% and D60-B20-E20 is 26.15% and

9. The fire point temp blend D80-B10-E10 is 11.42% and D60-B20-E20 is 24.28% less than diesel.

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PROPERTIES CHANGES BY ADDING EXPERIMENTAL WORK ON CONCRETE BY USING RICE HUSKASHANDMETAKAOLIN

*Jitender, **Shivani Thakur
*M. Tech Scholar,
**Assistant Profeossr, Civil Engineering Department,
Desh Bhagat University Mandi Gobindgarh -147301, Punjab

Abstract
This paper summarizes the comparison between properties of Rice Husk Ash (RHA) and Metakaolin when used as partial replacement for Ordinary Portland Cement (OPC) in concrete. OPC was replaced with these mineral admixtures at 2%, 4%,6% and 8% by weight. 0% replacement served as the control. Compressive Strength test was carried out on hardened 150mm concrete cubes after at 7 & 28 days curing in water. Compression strength test confirms its suitability as a partial replacement mineral admixture.
Keyword: RHA, Metakaolin, OPC(Ordinary Portland Cement), Aggregates, Water and Compressive Strength Test

Introduction

 Concrete is one of the substantially globally used material in the world. It's the mixture of cement, fine aggregate, coarse aggregate and water. The strength of concrete depends upon the constituents which are used in preparing this. The cost of constructional accoutrements increases day by day dueto huge demand of it.So the concrete engineers look towards the optional material that not only improves the strength of concrete but replaces the cement content which in turn reduces the cost of our construction work.The main advantage of incorporating the supplementary bonding material not only improves the strength but also help in preventing the pollution. It also improves the durability. Durability is linked to the physical, chemical and mineralogical characteristics of material and permeability.Several studies in the developing countries including Thailand, Pakistan and Brazil worked on the accoutrements like Rice Husk Ash and Metakaolin, these accoutrements not only enhance the characteristics of concrete but also contributes towards the green environment.

Rice Huskash

Rice hull ash is used in concrete construction as an alternative of cement. The incorporation of rice hull ash in concrete convert it into aneco-friendly supplementary cementitious material. The ensuing characteristics of the concrete are altered with the addition of rice hull

- The heat of hydration is reduced. This itself help in drying loss and smooth durabilityof the concrete mix.
- The reduction in the permeability of concrete structure. This will help in penetration of chloride ions, thus avoiding the spoilage of the concrete structure.
- There is a high increase in the chloride and sulfate attack resistance

Metakaolin

The reactivity of metakaolin is grounded on chemical composition and reactive surface. Largely reactive metakaolin has become available as a extensively reactive pozzolanic material in concrete. This type of material is not like other admixtures for example fly ash, blast furnace sediment, and silica smothers in terms of product because it's produced from high purity kaolin clay by calcinations at temperatures ranging from 700 to 800 o C. The average size of largely reactive metakaolin molecule, which is lower than cement molecules, is ranging from 1 to 2 and it's white in color which in return influences the color of the final product. Specific gravity of largely reactive metakaolin is 2.5

2.Aim Of Work And Literature
Aim

The aim of the study is to formulate ternary concrete and find out the effect of supplementary cementing material i.e., Rice hull ashRice hull ash and Metakaolin on strength parameter of ternary concrete.

The aim is achieved with the help of following objectives.

To design concrete blend by replacing cement with various proportions of Rice hull and Metakaolin

To determine the following strength parameters of various concrete samplesi) Slump Test ii) Compression Test iii) Split Tensile Test

To compare results of various blend designs and determine optimum blend design that can be used economically.

Literature Review

Ong et al. (2006) focused on the compressive strength performance of the blended concrete containing.different percentage of Metakaolin. They concluded that the cement is replaced accordingly with the percentage of 5 %, 10%, 15%, 20%, and 30% by weight. Concrete cubes are tested at the age of 1, 3, 7, and 28 days. In addition, the effect of calcination temperature to the strength performance is included in thestudy.Finally,thestrengthperformanceof Metakaolin-concreteiscomparedwiththeperformanceof concrete blended with silica fume and slag. The results show that the strength development of concrete blended with Metakaolin is enhanced. It was found that 10% replacement appears to be the optimum replacement where concrete exhibits enhanced compressive strength at all ages comparable to the performance of SF andGGBS.

Dinakar etal. (2013) studied the effect of Metakaolin Content on the characteristics of High Strength Concrete. This study presents the effect of incorporating Metakaolin (MK) on the mechanical and continuity characteristics of high strength concrete for a constant water/ binder ratio of0.3. MK blends with cement replacement of 5, 10 and 15 were designed for target strength and slump of 90 MPa and 100 ± 25 mm. From the results, it was observed that 10 relief position was the optimum position in terms of compressive strength. Beyond 10 replacement levels, the strength was dropped but remained higher than the control mix. Compressive strength of 106 MPa was achieved at 10 replacement.Splittingtensilestrengthandelasticmodulusvalueshavealsofollowedthesametrend.Indurabilitytests MKconcreteshaveexhibitedhighresistancecomparedto controlandtheresistanceincreasesastheMK percentage increases. This study has shown that the local MK has the implicit to produce high strength and high performanceconcretes..

Jayanti Rajput etal.(2013) have studied on the effect of RHA used as supplementing cementing material on the strength of mortar by partial replacement of OPC. Cement mortar paste were proportioned with varying dosages of RHA as partial replacement of OPC in the range of 5% to 30% by weight of cement. From the test results they concluded that This paper concluded that if roughly 10% of cement is replaced by equal quantity of RHA, there isn't any significant deprecation in the compressivestrength.

Dr. Abhay S. Wayal (2015) presents an overview of the work carried out on the use of RHA as partial replacement of cement in concrete and its effect on workability, compressive strength and chloride permeability of concrete. To produce environment friendly and durable concrete products incorporation of RHA as partial replacement of cement in concrete has gained importance. In the previous studies tests were carried on RHA concrete containing RHA as partial replacement in comparison with control concrete by varying replacement percentage. From the literature review it can be concluded that the workability of the fresh concrete mix decreases as the RHA replacement percentage in concrete increases. The required workability can be attained by good super plasticizer and proper mix design. The partial replacement of cement by RHA improves the compressive strength of hardened concrete whereas; the optimum replacement percentage varies in the studies. The chloride ion penetration of the concrete decreases as RHA percentage increases mainly due to pore refining capacity of RHA. From the above literatures the optimal replacement percentage was found to be ranging from 10% to 20%.

3. Material And Methodology
Cement

Cement is a dry fine substance made by calcining lime and complexion, mixed with water to form mortar or mixed with beach, clay and water to make concrete. It's a binder material. Once hardened, cement delivers sufficient strength to erect large artificial structures. Cement is sharp to essence and thus any essence in contact with cement should be erosion resistant. A normal type of cement that's used in the construction industry is also known as hydraulic cement because this fine substance is generally mixed with water before use. Cement should be applied over shells that have been gutted and are free of oil painting, dirt, grease or any other adulterant that affect relating with the endless structure. It's recommended to undercut all areas on which the cement is to be applied.

Cementhas the following advantages
• Provides durable, long- lasting repairs
• Sets and hardens fast, typically three twinkles after being mixed with water
• Cost-effective
• Very easy to use
• Can be used on perpendicular operations
• Doesn't erode or rust if erosion resistant material is used
• Doesn't shrink

Aggregates
Generally, aggregates engage 70 to 80% of the volume

of concrete and have an important influence on its properties. They're coarse material, deduced for the utmost part from natural gemstone (crushed gravestone, or natural gravels) and beach. In addition to their use as provident padding, aggregates generally give concrete with betterdimensional stability and wear resistance. In order to gain a good concrete quality,aggregates should be hard and strong, free of undesirable contaminations, and chemically stable.

FineAggregates

These are those which passes through IS sieve 4.75 mm.
* It should be strong and durable.
* It should not react with cement after mixing.
* Also, it should have a tough floor.
* It should not absorb greater than 5% of water.

CoarseAggregates

The aggregate which is retained over IS Sieve 4.75 mm is nominated as coarse aggregate. The coarse aggregates may be of following types-
* Crushed gravestone attained by crushing of clay or hard gravestone.

* Uncrushed gravel or gravestone performing from the natural decomposition of rocks.
* Incompletely crushed gravel attained as product of blending of over two types.

Water

Drinking water is good for making concrete. Water serves following purposes Water is used to prepare a plastic emulsion of the colorful constituents and to give plasticity to concrete. Water is also demanded for the hydration of the cementing accoutrements to set and harden during the period of curing.

Rice Husk Ash(RHA)

Rice milling generates a by- product known as husk. Rice hull ash is an seductive Pozzolona. Due to its low cost and high exertion it has a promising perspective in sustainable construction. The main element of the rice hull ash is silica, which is the element that governs the reactivity of the ash. The Rice Husk Ash is attained by burning the Rice Husk, attained from original manufactories, in stacks of 50 to 60 kg in open air. The entire procedure is shown below

* Before BurningRiceHusk   (B) After Burning Rice HuskAsh

Metakaolin

The key in producing metakaolin for use as a supplementary bonding material, or pozzolan is to achieve as near to complete dehydroxilization as possible without overheating. Successful processing results in a disordered, unformed state, which is largely pozzolanic. Thermal exposure beyond a defined point will affect in sintering and the conformation of mullite, which is

dead burnt and not reactive. In other words, kaolinite, to be optimally altered to a metakaolin state, requires that it's completely roasted but noway burnt..

4. Experimental Work

Thisdescribesthepropertiesofmaterialusedformakingconcretemixesdeterminedinlaboratory as per relevant codes of practice. Different materials used in tests were OPC, coarse aggregates, fine aggregates, rice husk ash

and Metakaolin. The description of various tests which were used in this study is given below:

Mixdesign

This describes the characteristics of material used for making concrete mixes determined in laboratory as per applicable codes of practice. Different material used in tests were OPC, coarse aggregates, fine aggregates, rice hull ash and Metakaolin. The description of different tests which were used in this study is given below

The concrete mix design was done by using IS 10262 for M-20 grade of concrete.

Design stipulations for proportioning

Gradedesignation	M20
Type of cementgrade	OPC 53 grade confirming to IS12269:1987
Maximum nominal sizeofAggregates	20 mm
Minimum cement contentkg/m3	320 kg/m3
Maximum water cementratio	0.55
Workability	75 mm (slump)
Exposurecondition	Mild
Degree ofsupervision	Good
Type ofaggregate	Crushed angular aggregate
Maximum cementcontent	450 kg/m3
Chemicaladmixture	Not
Sieveanalysis Coarseaggregate Fineaggregate	Coarse aggregate : Conforming to Table 2 of IS: 383 Fine aggregate : Conforming to Zone III of IS: 383

The mixture proportions used in laboratory for Experimentation are shown in table

Mix	%	w/c ratio	Water (Kg/m3)	Cement (Kg/m3)	Fine Aggregate (kg/m3)	Coarse Aggregate (Kg/m3)	RHA (Kg/m3)	Metakaolin (Kg/m3)
Control	-	0.50	186	372	562	1217	-	-
Rice Husk Ash	2	0.50	186	353.4	562	1217	18.6	-
	4	0.50	186	334.8	562	1217	37.2	-
	6	0.50	186	316.2	562	1217	55.8	-
	8	0.50	186	297.6	562	1217	74.4	-
Metakaolin	2	0.50	186	353.4	562	1217	-	18.6
	4	0.50	186	334.8	562	1217	-	37.2
	6	0.50	186	316.2	562	1217	-	55.8
	8	0.50	186	297.6	562	1217	-	74.4
Mixture of RHA and Metakaolin	2	0.50	186	353.4	562	1217	9.3	9.3
	4	0.50	186	334.8	562	1217	18.6	18.6
	6	0.50	186	316.2	562	1217	27.9	27.9
	8	0.50	186	297.6	562	1217	37.2	37.2

Results and Discussions

This presents a summary of the results obtained from laboratory tests that have been doneon the specimen. Tests were done on materials (cement, fine aggregates, coarse aggregates, RHA and METAKAOLIN), fresh and hardenedconcrete.

Compressive strength of control concrete in N/mm2
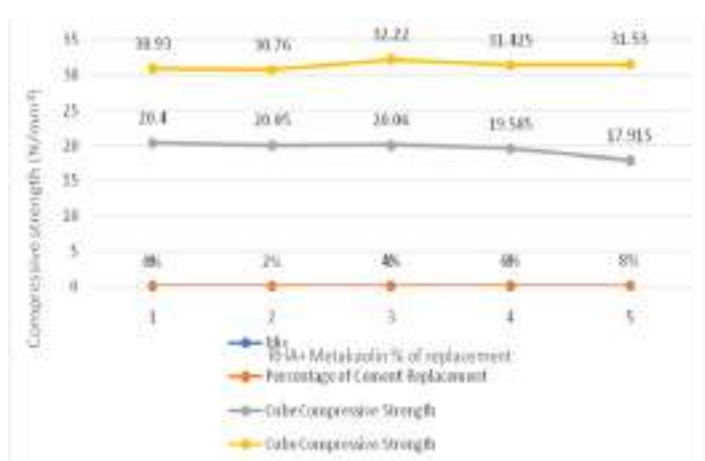
Grade of concrete	M20
7 Days	20.4
28 Days	30.93

Split tensile strength of control concrete in N/mm2

Grade of concrete	M20
7 Days	1.94
28 Days	2.71

Compressive strength of Mix (RHA+Metakaolin) concrete

Mix	Percentage of Cement Replacement	Cube Compressive Strength (N/mm2)	
		7 days	28 Days
CONTROL	0%	20.4	30.93
MIX (RHA+Me-takaolin)	2%	20.05	30.76
	4%	20.06	32.22
	6%	19.585	31.425
	8%	17.915	31.53

Split tensile strength of Mix (RHA+ Metakaolin) concrete

Mix	Percentage	Splitting Tensile Strength (N/mm2)	
		7 days	28 Days
M20	0%	1.94	2.71
MIX (RHA+WP-SA)	2%	2.185	3.025
	4%	2.045	2.82
	6%	1.925	2.61
	8%	1.625	2.395

Conclusions

The objective of this trial has been to estimate the possibility of successful replacement of cement with RHA, Metakaolin and MIX(RHA Metakaolin) in concrete. The conclusion drawn during the trials are as follows Thecompressivestrengthincreasesupto25%with8%replacementofcementbyMetakaolin. So,upto8%replacement itcanbeusedasasupplementarymaterialinM20gradeofConcrete.

• The split tensile strength increases up to 15% with 2% replacement of cement byMetakaolin.

• The above result shows that there is 8% increase in split tensile strength with 2 % RHA replacement. So,it ispossibletodesignM20gradeofconcreteincorporatingwithRHAcontent up to2%.

• As test results shows, the Mix (RHA + Metakaolin) can also be used as a replacement of cement.

• Controlmixwith4%RHAandMetakaolinshows5%increaseincompressivestrengthofM20 concrete.

• Controlmixwith2%RHAandMetakaolinshows30%increaseinsplittensilestrengthofM20 concrete.

• The study showed that the early strength of RHA, Metakaolin and Mix(RHA Metakaolin) concrete was found to be less and the strength increased with

age.

• The plasticity of RHA, Metakaolin and Mix(RHA Metakaolin) concrete has been found to drop with the increase in replacements.

• Based on the results of Split Tensile Strength test, it's accessible to state that there's substantial increase in Tensile Strength due to the addition of RHA, Metakaolin and Mix(RHA Metakaolin).

• Use of Metakaolin, Rice Husk Ash and Mix(RHA Metakaolin) in concrete can prove to be economical as it's non useful waste and free of cost.

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IN WSN AND IOT, A DETAILED ANALYSIS OF CURRENT ROUTING, CLUSTERING TRENDS, AND OVERLOOKED QOS ASPECTS IS PRESENTED.

*Maninder Jeet Kaur , **Jaspreet Kaur
*Research Scholar, Department of CSE, CT University,Ludhiana
**Assisstant Professor, Department of CSE, CT University,Ludhiana
1maninderkaur865@gmail.com, 2raijaspreet@gmail.com

Abstract
WSNs are currently serving as the IoT devices' skeleton. due to the small sensors and tiny batteries used in the Internet of Things. As a result, research into energy conservation and the life of N/w is ongoing. These are unquestionably crucial components, but there are a great number of other related QOS characteristics that could also have an impact on how well WSN algorithms designed for IoT devices work. All of these elements, including load, communication requirements for a single CH, fault tolerance, and consistent sensor placement, can be taken into mind when building an effective set of parameters to enhance the efficiency of IoT routing and clustering algorithms.
Keywords: Clustering, Routing, clustering, IoT , QOS factors etc

Introduction
In plain English, any average person is aware of the WSN truth that it is practically impossible to change the batteries in such small sensors after deployment. As a result, WSN researchers are continually discussing the importance of energy saving and effective utilisation. As the foundation for IoT devices, the WSN industry has now been interwoven in daily social life. The only reason IOT devices exist is because of smart sensors, which provide them sensing capabilities. Following a thorough review of the current WSN, it has been determined that three factors must be targeted in order to create an effective and efficient energy-aware network: node distribution, cluster head selection optimization, and advancements in routing methods. –

Related work
The main areas of concentration in the current WSN and IoT research race include enhancing clustering and routing by concentrating on two main quality factors: energy and N/w lifespan. This viewpoint analysis has been divided into two major groups depending on the targeted areas as a result of continuing with it. The following are a few instances:

Table 1: Analysis of latest WSN techniques for IOT

Sr. No Source	Author Name/ Implementation	Targeted Area	Proposed Algorithm	
1.	V. Pal, et al., (2012)/Scientific Research	This study proposes Smart CH Selection (SCHS), a simple and effective selection technique for CHs. This might be used with any clustering system that is distributed.	Cluster Head Selection	SCHS
2.	T. Kaur and D. Kumar, (2018)/ IEEE Sensors	This study proposes Smart CH Selection (SCHS), a simple and effective selection technique for CHs. This might be used with any clustering system that is distributed.	Cluster Head Selection	Particle swarm optimization (PSO) and UFC

3.	Behera, et al. (2019)/IEEE Journal	Developed a method for selecting cluster heads that involved rotating the cluster head location between nodes with greater energy levels than others.	Cluster Head Selection	R-Leach
4.	Murugaanandam and Ganapathy (2019)/ IEEE Access	The author proposed a strategy dubbed the 'Reliability Enhanced Preference Ordering Technique (RE-TOPSIS)' that combines fuzzy logic with a Multi-Criteria Decision-Making (MCDM) approach to pick CHs effectively and reliably.	Cluster Head Selection	'Reliability Enhanced Preference Ordering Technique (RE-TOPSIS)
5.	Hamidouche, et al. (2019)/ /IEEE Journal	The most recent heterogeneous network approach WOA and GWO are two algorithms that have been merged with the ICA.	Cluster Head Selection	GWO/WOA
6.	Battar and Kumar (2019)/ IEEE Conference	The PSO and firefly algorithms were offered as a way to maximise energy. This hybrid method may be able to preserve network strength, extending network life.	Cluster Head Selection	PSO/FireFly
7.	S. Anthony Jesudurai and A.Senthilkumar, (2019)/Elesiver	Cluster Selection that is More Energy Efficient The Head Selection Mechanism (IEECHS-WSN) was developed as a way to transfer data using a low-energy routing protocol. This approach is defined as the clustering of dual CHs and is employed in the data fusion system for data entropy.	Cluster Head Selection	IEECHS
8.	Nageswara Rao Malisetti and Vinay Kumar-Pamula (2020)/ Elesiver	A protocol for CH selection based on the quasi-opposition algorithm of butterfly optimization (QOBOA) was proposed, and it was compared to the original butterfly optimization as well as other contemporary methods in terms of network lifespan and energy efficiency.	Cluster Head Selection	QOBOA
9.	Pawan Singh Mehra, et al.(2020)/ Elesiver	With an FBECS, the distance from the sink and the density of the node adjacent were recommended. By considering each sensor node, the system ensured load balance by selecting the best candidate to act as cluster coordinator.	Cluster Head Selection	Fuzzy Balanced Cost Selection Algorithm (FBECS)
10.	Richa Sharma, et al. (2020)/ Springer	The eeTMFO / GA clustering technique was introduced in this paper as a safe and energy-conscious clustering approach. Five essential factors comprising direct fiduciary measures were used to assess this method.		
	Cluster Head Selection	Energy efficient, trusted moth flame optimization and genetic algorithm (eeTMFO / GA).		

11.	Baradaran and Navi, (2020)/ Elesiver	The author of this paper presented a method for producing high-quality clusters termed the HQCA. The cluster quality was assessed using the HQCA technique.	Clustering algorithms	High-Quality Clustering Algorithm (HQCA)
12.	M. T. Nguyen, et al. (2014)/IEEE Conference	Inter cluster multi-hop routing, or ICCS, was presented as an alternative to clustering in WSNs utilizing CS to reduce energy consumption even further. A greedy method is used to establish a routing tree between the CHs and the base station.	Routing In Clustered Networks	
	ICCS			
13.	Milica D. Jovanovic, et al. (2016)/ Elesiver	A simple intra-cluster MAC protocol known as STAR – TONE was suggested, which contained the proposed BM– BCD and provided an analytical model to quantify important protocol parameters.	Routing In Clustered Networks	Bitmap – Binary Countdown (BM-BCD)
14.	A. W. Ali, et al., (2016)/ International conference	In this study, the GCSTR approach was introduced as a way to extend the lifespan of the WSN.	Routing In Clustered Networks	Grid-Based Clustering with Spanning Tree Routing (GCSTR)
15.	Mukherjee, et al., (2017)/IEEE Access	The proposed approach displays the protocol for intra-cluster communication in the SEP-Vector Quantization mutual communications network (SEP-V).	Routing In Clustered Networks	
	SEP-V			
16.	S. K. Singh, et al. (2017)/IEEE Conference	To address communication issues with hot spots and intra-cluster, the author proposed an intra-cluster multi-hop approach in uneven clusters. The BS separates the network into three different types of fixed grids.	Routing In Clustered Networks	EUCA/EEUC
17.	Mukherjee, et al. (2019)/IEEE Access	To address the challenge of resource allocation in these sorts of networks, an ADAI methodology with a hierarchical resource allocation approach was devised. The APSO for intra-cluster resource allocation was also described by the author.	Routing In Clustered Networks	Adaptive Particle Swarm Optimization (APSO)

18.	Sixu, et al. (2020)/IEEE Conference	The fluffy-based multi-hop standard cluster routing was suggested in this work. During the cluster head elections, relative inter-cluster costs and relative intra-cluster costs were presented in a novel way.	Routing In Clustered Networks	NA
19.	Kalaivanan Karunanithy and Bhanumathi Velusamy (2020)/ Elesiver	A CTEEDG protocol was developed to improve the life and performance of WSNs. Based on the information gathered locally, the CTEEDG employed fuzzy logic to choose the CH.	Routing In Clustered Networks	Cluster-Tree Energy Efficient Data Recovery (CTEEDG)
20.	Khalid A. Darabkh, et al. (2020)/ Elesiver	To address the difficulty posed by IoT networks when incorporating energy-constrained devices, the author developed a novel protocol called Existence-Times optimizing based on Analytical Hierarchical Method and Genetic Clustering (LiM-AHP-G-C).	Routing In Clustered Networks	LiM-AHP-G-C

Conclusion

Researchers working in this subject now have more options thanks to the fusion of the IoT and WSN fields. The whole research shows that if we need more intelligent IoT devices, we also need more intelligent and energy-efficient sensors, as well as more effective N/W and routing algorithms. However, the data shows that while creating new algorithms, only energy, CH selection, and network longevity are taken into account. The study uncovers numerous factors that could be exploited in QOS to enhance the overall effectiveness of algorithms. Many issues that are much more important for IoT and WSN are still not getting enough attention. The domains of N/W security, data delivery rate, load balancing, delay due to traffic, and repeated information filtering concerns are all taken into consideration during the algorithm design in WSN for IOT. These background features can considerably boost the network's overall performance , therefore we now need to control research by taking them into account. Following are the three significant aspects of WSN that need to be consider with the above mentioned neglected QOS factors:

Node Distribution: The area covered under the sensing range is directly impacted by node distribution. It has been determined that there is a significant potential for communication gaps to be created when nodes are distributed randomly in the target field. The locations that are not covered by any sensor's sensing range are known as communication holes. Therefore, in order to maximize useful life, a smart node installation technique is always required.

Optimization Technique there are certain nodes in the sensing field that have more residual energy than the other nodes that are present in the field. The CH (Cluster Head) position is contested by these nodes with larger residual energies. In order to achieve the best throughput, it is crucial to choose the ideal node as a CH. The optimization technique must be developed carefully in order to provide the best solution for CH selection.

Routing Technique: A network needs effective routing strategies for the efficient data transfer rate to deliver the best communication in the network at a lower cost of energy after node deployment and the optimal CH selection. It can further increase the network's performance and life.

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COMPARISON OF OFDM OVER AWGN CHANNEL

*Deepti Malhotra **Gurinder Kaur Sodhi

*Department of Electronics and Communication Engineering Desh Bhagat University

deeptimalhotra1981@gmail.com

gsodhi@deshbhagatuniversity.in

Abstract

In this paper the comparison of DWT-OFDM and FFT-OFDM is presented. DWT-OFDM system model uses zero padding and vector transpose to transmit OFDM signal. Chaotic interleaving scheme for transmitting data efficiently over AWGN channel is described. This scheme is the simplest and most popular. The concept of chaotic Baker map is used in this approach. The proposed chaotic interleaving approach adds a degree of encryption to the transmitted data. The BER performance of the multiple copy chaotic interleavers Discrete Wavelet Transform OFDM (DWT-OFDM) and FFT-OFDM is compared. The simulation results show that multiple copy chaotic interleaver based DWT-OFDM system is better than the FFT-OFDM system.

Keywords: Orthogonal Frequency Division Multiplexing (OFDM), chaotic interleaving, DWT, FFT, BER.

Introduction

Orthogonal frequency division multiplexing (OFDM) is a Multi-Carrier Modulation (MCM) technology. OFDM modulation divides the entire frequency selective fading channel into many narrow band flat fading sub channels in which high-bit-rate data are transmitted in parallel and do not undergo IS1 due to the long symbol duration. Therefore, OFDM modulation has been chosen for many standards, including Digital Audio Broadcasting (DAB) and terrestrial TV in Europe, and wireless local area network (WLAN). Moreover, it is also an important technique for high data-rate transmission over mobile wireless channels. On the other hand, wavelet based modulation system satisfies the condition of orthogonality using orthogonal wavelet filter banks [2]. All the benefits of OFDM can be achieved by replacing the Fourier based OFDM with suitable wavelets. Wavelet based systems shows better immunity to impulse and narrowband noises than Fourier OFDM [3, 4].

Also, wavelet based OFDM doesn't require any CP, hence does not produce the ripples, reduces complexity, and no power wastage for redundancy. Also the equalizer performance is better in wavelet OFDM system as compared to conventional OFDM [6]. The transmitted signals of wavelet system consist of much lower side lobes and thus help in reducing the inter-carrier interference (ICI). An optimal beam-forming technique is also used to maximize signal quality of individual user.

2.Ofdm Transceiver
A.fft-Ofdm

The inverse transform block can either be IDWT/IFFT and forward transform block can be DWT/FFT. The data generator used here is a sine wave of bit stream d. It is processed using QPSK modulator to map the input data into symbols Xm. The more the levels of QPSK, the more complex the receiver which results in more bit errors as the system becomes more complex. The modulated symbols are transmitted through IFFT block to perform IFFT operation to generate N parallel data streams. Its output in discrete time domain is given by [5],

$$X_{k(n)} = 1/\sqrt{N} \sum_{i=0}^{N-1} Xm(i) \exp\left(j2\frac{\pi n i}{N}\right)$$

Cyclic prefix is added to the data before transmission, to mitigate the effect of ISI. CP is usually taken as 25% of the last part of the original OFDM symbol and then it is passed through AWGN channel with proper input power and SNR value set. At the receiver, the reverse operations are done to recover back the input data.

$$U_{m(i)} = \sum_{n=0}^{N-1} Uk(n) \exp\left(-j2\frac{\pi n i}{N}\right)$$

The output of the FFT in frequency domain is given by [7],

B.DWT-OFDM

For reliable and high speed communication over wire-

less links, an efficient modulation scheme, like a Discrete Wavelet Transform (DWT) modulation technique, is required. It provides better symbol rate and increases spectral efficiency. In the DWT-OFDM, the IDWT and DWT take place of the IFFT and the FFT [8].
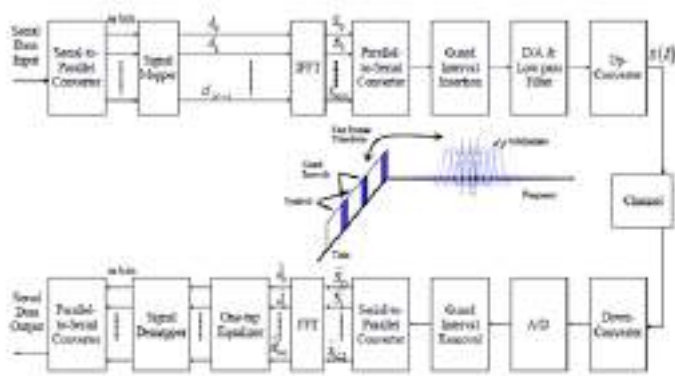

Fig. 1: OFDM transceiver

1.   CHAOTIC BAKER MAP

Errors in burst form are difficult to detect and correct in a wireless communication channel. So several interleaving schemes are used in mobile communication systems. The block interleaving is the simplest and most popular scheme, but this scheme is not efficient with 2-D error bursts of data symbols [1].

As a result, there is a need for advanced interleaver for such systems. The discretized version of 2-D chaotic Baker map is a good choice for this purpose. In the system model, the signal samples can be arranged into a matrix concatenation form and then randomized with the help of the Baker map [5]. The chaotic baker map generates a permuted version of square matrix. This Baker map transfers each element in a square matrix into a new position according to the map. Let B (n1…. nk) represents the discretized map, where the vector n1…….nk denotes the secret key Skey.The key is chosen in such a way that each integer ni divides N and n1 + n2 + ……nk =M.

Chaotic interleaving of an N×N square matrix can be summarized as follows:

1. An M x M square matrix is divided into k vertical rectangles of height M and width ni.

2. These vertical rectangles are stretched in the horizontal direction and contracted vertically to obtain a ni x M horizontal rectangle.

3. These rectangles peer stacked as shown in Fig. 2a, where the left one is put at the bottom and the right one at the top.

4. Each vertical rectangle ni x M is divided into ni boxes of dimensions (M/ni) x ni containing exactly N points.

5. Each of these boxes is mapped column by column into a row of data items as shown in Fig.2.

Fig.2 shows an example of chaotic interleaving of an (8×8) square matrix. The secret key, Skey = (n1, n2, n3) = (2, 4, 2).

The block diagram of the (FFT/DWT)-OFDM with chaotic interleaving is shown in Fig. 3. an interleaving stage is added in the previous block.

At the receiver, the reverse process is applied. Since the data is processed to the chaotic de-interleaving, the receiver is assumed to have an ideal knowledge of the secret key of the chaotic map.
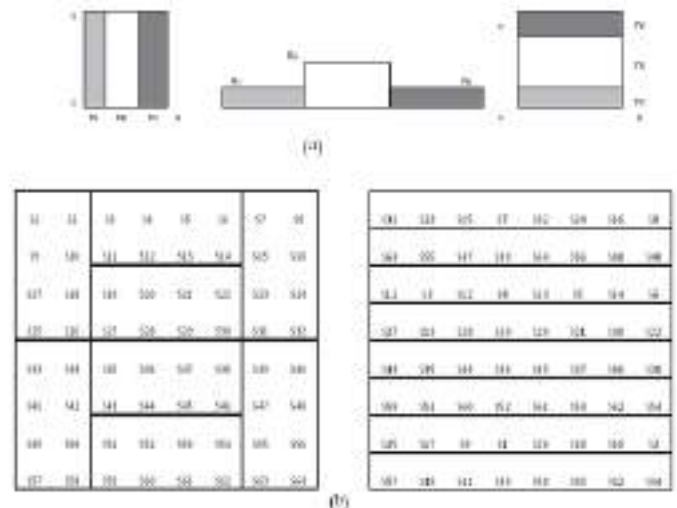

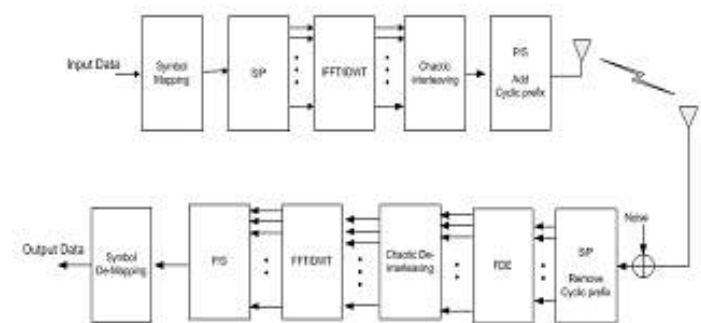Fig 2: Chaotic interleaving. (a) Discretized Baker map. (b) Randomization of an 8 × 8 block [1].

Fig. 3: Block diagram of the OFDM chaotic system model [1].

3. PROPOSED SYSTEM MODEL

In this paper we are using chaotic interleaving which provides better data encryption. Only one copy of burst data

is obtained using chaotic interleaving while in proposed DWT-OFDM system model we receive two copies of burst data.For this a block of matrix concatenation is used. With the help of these two copies it becomes easy to estimate about the exact copy of data. Due to this the system becomes somewhat complex but better as compared to DWT-OFDM with chaotic interleaving and FFT-OFDM system for short distances.The system performance is greatly enhanced using this method.

4. EFFECT OF CHANNEL

AWGN Channel Model

The transmitted signal is then applied to an AWGN channel model. The model allows for the Signal to Noise Ratio (SNR) variation. The additive white Gaussian noise (AWGN) will use for both modulation, basically, model is a channel whose sole effect is the addition of white Gaussian noise process to the transmitted signal. This channel is mathematically described by the relation:

$r(t) = S(t) + n(t);$

Where S (t) is the transmitted signal and n (t) is a sample waveform of a zero-mean white Gaussian noise process with power spectral density of No/2; and r (t) is the received waveform. [4]

V.SIMULATION RESULTS

In this section, simulations are performed to test and evaluate the proposed DWT system and to compare it with chaotic DWT and FFT. Two types of OFDM systems were simulated; FFT-OFDM and DWT-OFDM with and without chaotic interleaver using MATLAB and the table shows the Bit Error Rate for the systems. The effect of chaotic interleaving over DWT-OFDM is studied in AWGN channel. The system model and the table showing bit error rate are shown in Fig. 4 & 5. From the results, it is clear that proposed DWT-OFDM system is better than the chaotic DWT-OFDM and FFT-OFDM in terms of BER, specially, over short distance fading channels.
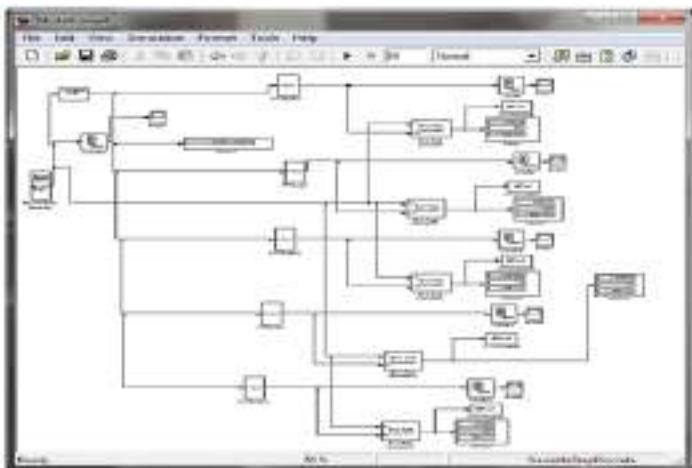

Fig. 4: Codec design of DWT-OFDM system [8]

DWT & FFT DESIGN	NO. OF ERRORS DETECTED	TOTAL NO. OF SYMBOLS COMPARED	ERROR RATE
FFT-OFDM	77	1.158e+0.004	0.006649
PROPOSED DWT	16	1.158e+0.004	0.001382
DWT-OFDM	921	1.158e+0.004	0.07953

Fig. 5: Comparison of error rate of different systems

VI. Conclusion

An efficient multiple copy chaotic interleaving scheme with orthogonal frequency division multiplexing (OFDM) has been presented for wireless data transmission. Matrix concatenation is used in proposed DWT-OFDM system. This approach helps in reducing multipath fading. This scheme has been applied on FFT-OFDM and DWT-OFDM.

From the simulink model and the table, it has been shown that multiple chaotic interleaving enhances the performance of DWT-OFDM system as compared to FFT-OFDM system.

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FIBER BRAGG GRATING BASED AN OPTIMAL OADM FOR PERFORMANCE ENHANCEMENT IN DWDM USING ARTIFICIAL NEURAL NETWORK

Parveen Bajaj

Department of Electronics & Communication Engineering, Desh Bhagat University, Punjab, India
E-mail: erpareen@rediffmail.com

Abstract

IDense Wavelength Division Multiplexing (DWDM) system offers a persistently aggregate demand for transmission capacity to promote their networks periodically to high data rates or large number of wavelengths. This paper proposed a new method for performance enhancement of Optical Add or Drop Multiplexer (OADM) with the DWDM based on the artificial intelligence.)The training and testing of the FF-NN is implemented in MATLAB platform by interfacing the results from OptiSystem. In addition, the performance of the proposed method is also analyzed in terms of Transmitted & Received Signal Power and compared with the conventional DWDM OADM with multiple filters.

Applications/improvements: The proposed method offers a viable solution to increase the performance of OADM with the DWDM. The improvement includes the use of hybrid algorithms, to further increase the performance.

Keywords: Fiber Bragg Grating, Optical Multiplexer, Dense Wavelength Division Multiplexing, Feed Forward Artificial Neural Network, Performance Enhancement, Signal Power.

Introduction

Optical networks have to face some technical challenges which are very important in case of increasing traffic. (1).The optical communication network employs different techniques for the efficient routing of information via the optical signals among number of users among those Wavelength Division Multiplexing (WDM) is the most famous approach for optical transmission systems. (2).With the use of WDM network the signals with moderate and high data rates can be transmitted over a single fiber together at different wavelengths (3). Total bandwidth of the system also increases without increasing the speed of clock (4).

The problem of increasing communication channels solved easily without requirement of new cables or by using limited cables by DWDM technique making this system very attractive not only for communication purposes (5). By using DWDM technique, 132 colors or wavelength can be combined or multiplexed through single mode fiber (6).DWDM employs semiconductor optical amplifier (SOA) in conjunction with an arrayed waveguide grating (AWG) based multiplexing and de-multiplexing scheme and it improves the overall power budget(7). Even though the DWDM network may be suspected to some impairment related to the system level they can be tackled with the help of some special type of modulators (8).

Now- a- days SONET has been displaced by DWDM technique and primarily chosen by fast growing telecom & metro networks (9). OADM plays a vital role in empowering more connectivity and adaptability in DWDM systems (10). A group of researchers implemented a new technique called terabit interferometric drop, add and extract multiplexer (11). Lot of techniques was employed, out of which the Fiber Bragg Grating (FBG) is the most attractive one(12).

FBG can be used as a wavelength multiplexer/de-multiplexer in OADM for adding / dropping of number of wavelengths (13). That specific wavelength may be passed through various optical elements like optical cross-connects or optical add-drop multiplexer along with any other particular route (14).The wavelength that has to be leaving or entering into the network will be controlled by the FBG based on its nature of the reflectivity (15).The reflection spectrum of the FBG can also be optimized using the Harmony Search Algorithm for achieving maximum reflectivity (16). Another one method optimizes the reflection spectrum of FBG by considering different phase shifts of the grating (17).

In this paper we have developed an artificial intelligence based OADM which is based on the parameters obtained from the simulation of the DWDM network in OptiSystem software. In section 2, related work has been discussed. The motivation for considering the present work and proposed methodology is given in section 3. The simulation results and the comparison of the proposed method with other existing technologies for improving performance of the OADM is presented and discussed in section 4. Finally, section 5 concludes the paper.

2. Related Works

Duan Liu et.al(19) have proposed a improved DE algorithm for identifying the Bragg wavelengths of fiber Bragg gratins when the wavelength moves connected with one completely sensor overlaps the other. His system beats the restrictions of the customary CPD .

Lazzeri et.al (20) have proposed the design of OADM hub which demonstrated that the hub has the capacity to work as a "language translator".

Jung-Chieh Chen et.al (21) have proposed the method for solving the problem of low-dispersion FBG filter. This problem can't be solved by using traditional methods.So Optimization (CEO) method has been used.

Jing Chen et.al(22) have proposed an effective optimization method based on a self-adaptive differential evolution (DE) algorithm to design fiber Bragg grating (FBG) filters with high-channel-count. They have numerically presented a 1037-channel 50-GHz spaced FBG filter to cover the whole bands.

A scheme based on Pareto-based multi-objective optimization technology was proposed by Hao Jiang et al.(23) The cross-entropy optimization (CEO) method was proposed by Jung-Chieh Chen et al.(24) in searching down the optimal index modulation profiles, An improved index modulation profile was created in this method. A proof of idea Few-mode fiber (FMF) compatible OADM was demonstrated by Xi Chen et al. (25) which empowers add/drop functionality for MDM super channels.

Pincemin et.al (26) has demonstrated phenomena of optical switching over a 100Gbps multiband optical frequency division multiplexing (MB-OFDM) based on a experimental setup. Through this demo, the authors have opened a different way to optically meshed networks with flexibility of high degree. Consequently bandwidth of optical fiber managed properly.

3.Optical Add or Drop Multiplexer With Feed Forward Neural Network

The method consists of three phases:
1. Initial data generation
2. Training the ANN
3. Testing the ANN

The block diagram of the proposed work is below in figure 1. In the testing phase shown the incoming optic signal at the entrance of OADM is processed by the trained neural network and then the signal is either dropped from the fiber or passed through the fiber without any hindrance.

3.1. DWDM network simulation with OptiSystem

Number of closely spaced signals can be transmitted through Dense Wavelength Division Multiplexing (DWDM) as compared to wavelength division multiplexing (WDM). There are various simulation tools are available for simulating
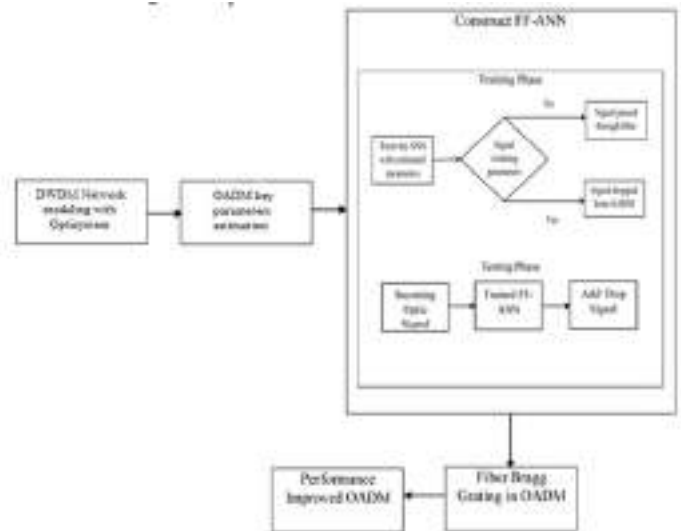

Figure 1: Functional Block diagram of the proposed method

the optical networks among them OptiSystem is found to be an efficient one
for the simulation of all kind of optical networks.

OptiSystem [27] software is used for the simulation and design of various optical communication systems and especially it is designed for the higher propagation schemes
such as OFDM (Orthogonal Frequency Division Multiplexing), PM-QPSK (Polarization Multiplexed Quadrature Phase Shift Keying) and D (Q) PSK (Differential Quaternary Phase Shift Keying). OptiSystem works by interconnecting different blocks of different optical components. The parameters used for the simulation are given as input such as data rate, symbol rate, carrying capacity of the fiber, length of the fiber.

3.2. Parameters Estimation

The parameters used for constructing the ANN are obtained from the performance analysis of the DWDM network in the simulation. The parameters considered in the formation of ANN based OADM are BER for each channel, OSNR, jitter measured from the eye diagram and chromatic dispersion calculated from the spectra of the signal [28]. The detailed description about these parameters is as follows.
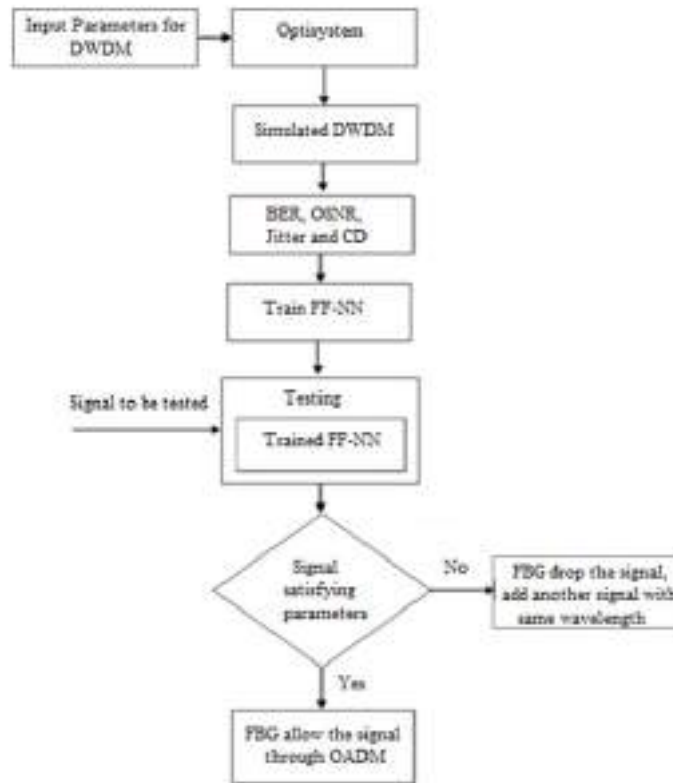
Figure 4: Processes associated with the proposed method for optimizing OADM in the DWDM network

4. Results and Discussion

In this paper we have proposed a system for adding or dropping the optical channels with in the fiber by developing the artificial neural network based Optical Add/Drop Multiplexer using feed forward type of neural network. The DWDM network is initially modeled with the OptiSystem software tool with different number of channels (Nc=32, 64,100) each with different data rates of 5 Gbps, 10 Gbps, 20 Gbps and with different channel spacing (Csp) of 30 GHz, 40 GHz and 50 GHz. The initial parameter setting for the Optisystem design is given in table 1. The wavelength of the channel used is 1550 nm and a fixed fiber length of 80km by considering the source of CW laser with frequency of 193.1 THz. For the purpose of optical transmission within the network the NRZ type of modulation is considered with Mach-Zehnder modulator. Then the parameters obtained from the simulation are used in the training and testing of the ANN such as BER, OSNR, Jitter and Chromatic Dispersion by interfacing the OptiSystem simulation results to MATLAB with the system configuration of Intel core i3 processor, 4GB RAM and Windows 8 Operating system.

Table 1: Parameter Setting for OptiSystem

Parameter	Value
Data rate	5 Gbps
	10 Gbps
	20 Gbps
Number of channels(N. ch)	32
	64
	100
Channel spacing	30 GHz
	40 GHz
	50 GHz

The parameters obtained after simulating the DWDM network in the software tool of OptiSystem is given in the following table 2. With these simulation results next the FF-NN will be trained for the addition or dropping of the optical channel based on the threshold value of the outcome FF-ANN. In this paper, we set the threshold as 0.32×10^{-10}

Parameters			BER	OSNR	Jitter	Chromatic Dispersion
Data Rate= 5 Gbps	Csp=30 GHz	Nc=32	10-8	25.35	0.5	1.2
		Nc=64	10-8	28.17	0.5	1.2
		Nc=100	10-8	31.35	0.5	1.2
	Csp=40 GHz	Nc=32	10-9	34.98	0.5	1.6
		Nc=64	10-9	40.07	0.2	1.6
		Nc=100	10-9	47.06	0.5	1.2
	Csp=50 GHz	Nc=32	10-11	41.05	0.2	1.2
		Nc=64	10-11	43.05	0.5	1.4
		Nc=100	10-11	44.65	0.5	1.6
Data Rate= 10 Gbps	Csp=30 GHz	Nc=32	10-11	16.89	0.2	-22.8
		Nc=64	10-11	19.53	0.2	-22.8
		Nc=100	10-11	22.69	0.5	-22.8
	Csp=40 GHz	Nc=32	10-11	25.57	0.5	-22.8
		Nc=64	10-11	38.86	0.2	-22.6
		Nc=100	10-11	36.58	0.5	-22.4
	Csp=50 GHz	Nc=32	10-11	37.22	0.5	-22.8
		Nc=64	10-11	34.54	0.2	-22.8
		Nc=100	10-11	36.54	0.5	-22.4
Data Rate=20 Gbps	Csp=30 GHz	Nc=32	10-11	16.89	0.5	-30.8
		Nc=64	10-12	19.53	0.5	-30.8
		Nc=100	10-11	22.69	0.6	-30.8
	Csp=40 GHz	Nc=32	10-11	25.57	0.2	-30.8
		Nc=64	10-11	30.86	0.3	-30.4
		Nc=100	10-11	33.58	0.2	-30.7
	Csp=50 GHz	Nc=32	10-12	37.22	0.2	-30.7
		Nc=64	10-12	39.54	0.2	-30.7
		Nc=100	10-12	49.54	0.2	-30.8

Table 2: Measurements obtained from the simulation of DWDM network using OptiSystem

The FF-NN is trained and tested in the MATLAB platform from the parameters as given in the table 1. The neural network is trained by 70 signals with different number of channels and with different data rates from the table 1 as well as it is tested with 30 signals. The following table 3 gives the results from the classification of the signals to be added or dropped as determined by the FF-NN.

Parameters	Signal Classification using FF-NN
Signals identified as valid (True Positive)	27
Signals correctly identified as not valid (True Negative)	1
Signals incorrectly identified as valid (False Positive)	2
Signals incorrectly identified as not valid (False Negative)	0
True Positive Rate $\dfrac{TP + TN}{Total\ number\ of\ signals}$	89. 84%
False Positive Rate $\dfrac{Sum\ of\ TP}{TP + FP}$	49%
Accuracy =	97. 28%
Positive Predictive value=	97. 05%

Table 3: Signal Classification performance by FF-NN

The table 3 shows that the signal classification results obtained from the FF-NN is given. The performance obtained by the classifier is acceptable. To validate the proposed method, it is compared with the conventional method in [34] which used integrated dense wavelength division multiplexing and Optical-OFDM system with OADM including the fiber nonlinearity effect and analyzed its performance. The comparisons results are shown in terms transmitted signal power are given in the following table 4 and 5.
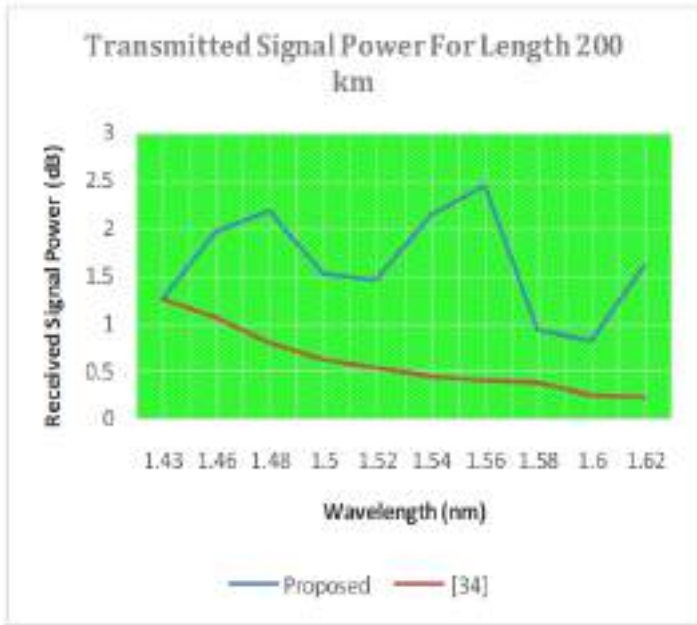
WAVELENGTH (μm)		Transmitted Signal Power (dB)			
		Proposed		Method in [34]	
		200 km	300 km	200 km	300 km
1.	1.44	1.2703	1.2869	1.2501	0.8314
2.	1.45	1.9652	2.1256	1.0524	0.7148
3.	1.47	2.1821	2.3867	0.8011	0.5412
4.	1.49	1.5143	1.8311	0.6247	0.4143
5.	1.51	1.4487	1.7442	0.5217	0.3541
6.	1.53	2.1355	2.5155	0.4304	0.3082
7.	1.55	2.4444	2.8854	0.4070	0.2590
8.	1.57	0.9357	0.6562	0.3845	0.2199
9.	1.59	0.8233	1.5565	0.2345	0.2116
10.	1.61	1.6222	1.6475	0.2227	0.1823

Table 4: Comparison of Transmitted signal power of the proposed method and the existing method
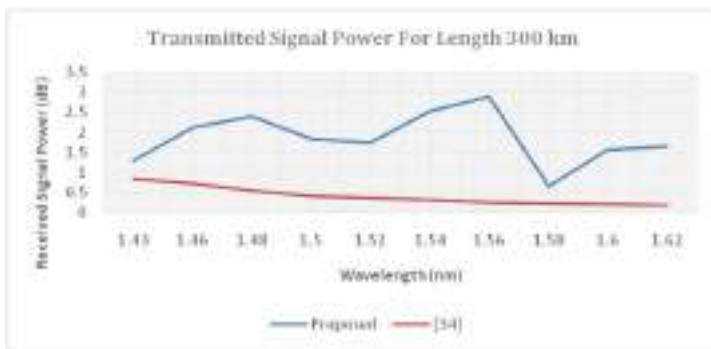
The received signal power at the received side after optimizing the OADM with the proposed method and the one with existing method (34) is given in table 5. The comparison chart is shown in figure 5, 6, 7 and 8 for different fiber length based on the comparison with wavelength and signal power. From the table 3, 4 and 5 it is obvious that our proposed method based on artificial intelligence technique achieved better perlformance than the conventional method with other existing methods.

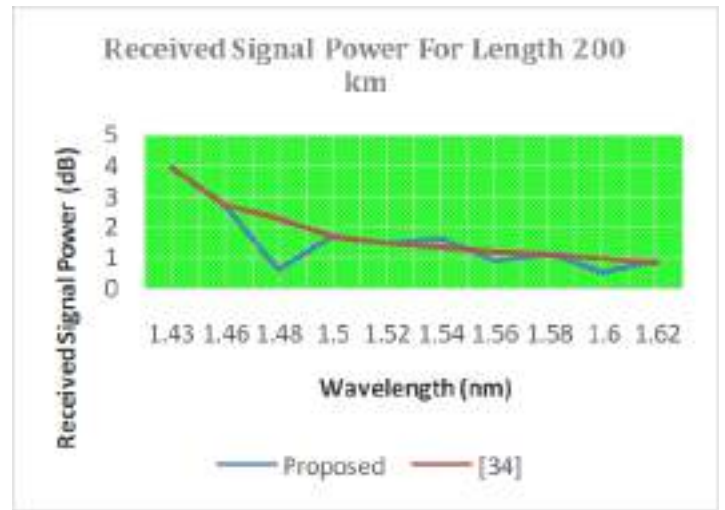| WAVELENGTH (µm)		Received Signal Power			
		Proposed		Method in [34]	
		200 km	300 km	200 km	300 km
1.	1.43	3.9487	5.4835	3.9978	4.6512
2.	1.46	2.6887	3.7681	2.7614	3.2512
3.	1.48	0.5747	2.2708	2.2781	2.6514
4.	1.50	1.7001	1.4276	1.7584	2.1451
5.	1.52	1.4386	2.5657	1.5072	1.6547
6.	1.54	1.6188	1.4218	1.3784	1.3142
7.	1.56	0.8564	2.3332	1.2004	1.2471
8.	1.58	1.1247	1.8663	1.1124	1.1112
9.	1.60	0.5113	1.1509	0.9751	1.0047
10.	1.62	0.8645	2.6715	0.8415	0.3458

Table 5: Comparison of Received Signal power of the proposed method and the existing method

Figure 5: Transmitted Signal Power for Length 200 km

Figure 6: Transmitted Signal Power for Length 300 km

Figure 7: Received Signal Power for Length 200 km

Figure 8: Received Signal Power for Length 300 km

Conclusion

Optical Add or Drop Multiplexers are used in DWDM networks for adding or dropping the signals based on the network requirements, hence this paper is proposed for a performance improved optimized OADM in the DWDM network based on the ANN. The ANN used here is the Feed Forward Neural Network and which is trained and tested with the parameters such as BER, OSNR, Jitter and chromatic dispersion obtained from the simulation of DWDM network in the optical network simulation tool known as OptiSystem. The training and testing of the neural network is carried out in the MATLAB platform based on this FBG will add/drop or allow the signal to pass and the results with the proposed method shows that better classification results are produced on comparing with the method using the SVM network. The experimental result shows that the proposed method achieves the accuracy of 97.28% on classifying the signals to be dropped from the fiber or passed through it without any interruption regarding its ability to make the transmission with minimum error. The performance of the proposed method in terms of Transmitted & Received Signal Power is also analyzed and compared with the conventional DWDM OADM with multiple filters. The proposed method is the one for classifying the signals for the OADM in DWDM network through artificial intelligence based techniques with this initiative the performance of the OADM in the DWDM network can be increased further through optimizing the performance of the classifier by any other optimization technique.

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Faculty of Engineering & Applied Sciences
Desh Bhagat University,
Mandi Gobindgarh, Punjab