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GYANVESHAN

In Pursuit of Knowledge

The philosophy behind the name...

You may notice that "AN" is smaller than other letters in the title. It signifies something important. GYANVESHAN is a name built by combining two words – GYAN and ANVESHAN (with the common AN being merged into one) with GYAN meaning knowledge, and ANVESHAN meaning search or pursuit. That brings us to the tagline "In pursuit of knowledge".

Muthoot
Institute of Technology & Science

From Editor's Desk

Welcome to the sixth edition of our Technical Magazine *Gyanveshan!!* As in the previous editions, it provides you the perfect platform to unleash your thoughts, views, passion, and knowledge in creative, technical and non-technical writing.

After the third wave of Covid 19, our education system is back on track with offline classes and exams. Challenges and uncertainties that had disrupted our daily life in an unprecedented way are almost over. It is indeed at this pleasant situation, we are publishing the sixth edition of *Gyanveshan* which includes a bouquet of articles that reflects our agenda; 'information clubbed with inspiration'.

As you glance through the articles in this edition, you will realise that the sixth edition of *Gyanveshan* is also a sincere attempt towards the fulfillment of our goals, and the benchmarks we wish to set.

The editorial board wishes to convey our sincere thanks to the Executive Director, Principal and Vice Principal for their valuable suggestions and limitless support to make this happen. We are quite sure that *Gyanveshan* shall be a resourceful companion in your quest for knowledge!

Hope you enjoy this issue as much as we did making this for you. Happy Reading!!

Dr. Abhilash Antony
Faculty Chair, R&C Cell

GYANVESHAN, The Book of Articles - Vol 6, March 2022

"Winners see the challenges as opportunities to reinforce their values"

- Howard Schultz

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An Introduction to Generative Adversarial Networks (GAN)

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Abstract

Recently, Generative Adversarial Networks (GANs) have become a research focus of artificial intelligence. GANs comprise of a generator and a discriminator, both trained under the adversarial learning idea. The goal of GANs is to estimate the potential distribution of real data samples and generate new samples from that distribution. Hence it can be used to generate artificial data for training the neural network. They find wide application in image, video & speech processing. In this paper, we give a basic introduction to GANs and its applications.

Index terms – Generative Adversarial Networks, Medical imaging, Artificial Intelligence.

Introduction

The basic principle of GANs is inspired by two-player zero-sum game. They comprise of a generator and a discriminator that learn simultaneously. The generator captures the distribution of real samples, and generates new data samples. The discriminator is often a binary classifier. Both the generator and discriminator can adopt the structure of currently popular deep neural networks [1], [2]. The optimization process of GANs is a minimax game process, and the optimization goal is to reach Nash equilibrium [3], where the generator is considered to have captured the distribution of real samples.

Basic structure of GAN

The general structure of GAN is shown in Fig.1. The generator aims to learn the distribution of real data, while the discriminator aims to correctly determine whether the input data is from the real data or from the generator. Any differentiable function can be used as the generator and the discriminator. In order to win the game, the two participants need to continuously optimize themselves to improve the generation ability and the discrimination ability, respectively. The purpose of the optimization process is to find a Nash equilibrium between the two participants.

The generator model takes a fixed-length random vector as input and generates a sample in the domain. The vector is drawn from randomly from a Gaussian distribution, and the vector is used to seed the generative process. After training, points in this multidimensional vector space will correspond to points in the problem domain, forming a compressed representation of the data distribution. This vector space is referred to as a latent space, or a vector space comprised of latent variables [2]. Latent variables, or hidden variables, are those variables that are important for a domain but are not directly observable. In the case of GANs, the generator model applies meaning to points in a chosen latent space, such that new points drawn from the latent space can be provided to the generator model as input and used to generate new and different output examples.

The discriminator model takes an example from the domain as input (real or generated) and predicts a binary class label of real or fake (generated). The real example comes from the training dataset. The generated examples are output by the generator model.

The discriminator is a normal (and well understood) classification model. After the training process, the discriminator model is discarded as we are interested in the generator. Sometimes, the generator can be repurposed as it has learned to effectively extract features from examples in the problem domain. Some or all of the feature extraction layers can be used in transfer learning applications using the same or similar input data.

Combining a generator and discriminator, we can model a GAN as shown below (Fig.1).

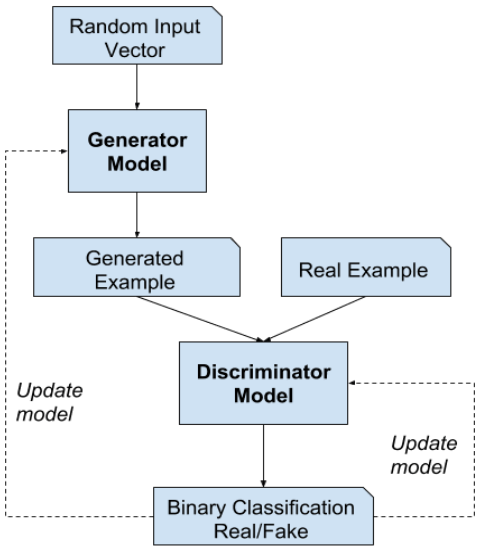

Figure 1: General model of GAN [2]

Application of GAN

GANs can generate image samples with the same distribution of real images. It can be used for image super-resolution. GANs can be used to generate artificial faces. Varied poses, expressions, genders,

skin colours, light exposure, and facial hair are observed from the generated samples (Fig. 2).

Figure 2: Faces generated using GAN [1]

In the field of autonomous vehicles GAN can be used to generate artificial driving scenarios to train the vehicle [1]. A variant of GAN called simGAN [1] can be used to generate images of the eye for eye detection application (Fig.3).

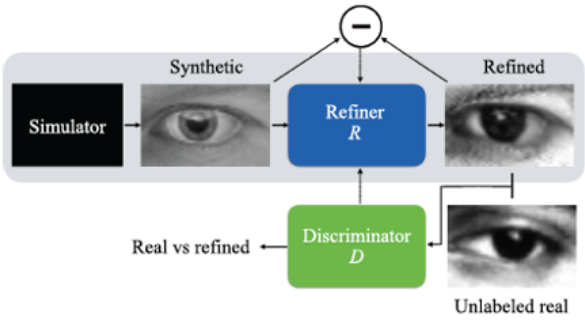

Figure 3: Framework of simGAN [1]

Image translation (Fig.4) is an area of computer vision where an image is converted to another image while preserving some of its properties. CycleGAN [1] is a form of GAN usually used for it. SeqGAN [4] is used to generate poems, speeches and music which SEGAN[1] is used for speech enhancement. Some researchers propose to synthesize images from text descriptions. MalGAN [5] is used to detect malware in computer networks.

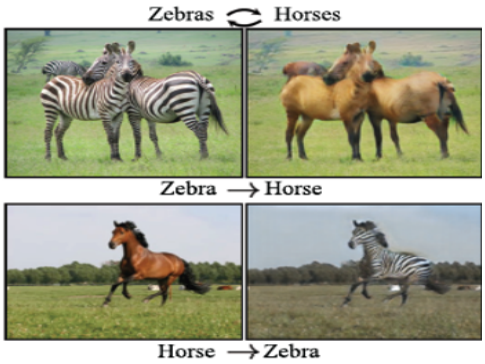

Figure 4: Image translation using cycleGAN [1]

Conclusion

In this paper, we survey the state of the art of GANs. The core idea of GANs originates from two-player zero-sum game in game theory. A GAN usually comprises of a generator and a discriminator, which are trained iteratively in an adversarial learning manner, approaching Nash equilibrium. As a powerful class of generative models, GANs do not estimate the distribution of data samples explicitly, but learn to generate new samples that conform to the same distribution as the real samples. They find wide application in the field of image, video and speech processing.

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An Overview of Superfluids and Superconductors

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Abstract

Peculiar properties are exhibited by superfluids and superconductors. This is identified as caused due to an underlying macroscopic quantum phenomenon known as Bose-Einstein condensation. The initial prediction of such a state of matter was put forward by Einstein in 1925. In recent times, a great deal of applications has emerged based on superfluidity and superconductivity. Consistent efforts continue for achieving superconductivity at temperatures nearing room temperature. Exotic properties exhibited by these systems are summarized in this article.

Index terms – superconductivity, superfluidity, Bose-Einstein condensation

Introduction

Among all phenomena that have aroused the curiosity of mankind, the peculiar properties exhibited by superfluids and superconductors are outstanding. Nowadays, this is identified as caused due to an underlying macroscopic quantum phenomenon known as Bose-Einstein condensation. The initial prediction of such a state of matter was put forward by Einstein in 1925. Later on, with the discovery of superfluid nature of helium below lambda point, London predicted this phenomenon to be the cause for superfluidity. Subsequently, an interpretation based on BCS theory centered the condensation of Cooper pairs as the cause for superconductivity. In addition to identifying condensation phenomenon in bulk systems, there were attempts to realize Bose-Einstein condensation using bottom-top approach. The first realization of such a condensate with alkali atoms such as rubidium and sodium in gaseous state was achieved in 1995. More recently, the approach has been extended to other boson systems such as exciton-polaritons and magnons.

Superfluid helium

Superfluid helium is one of the systems which exhibit Bose-Einstein condensate state. After the initial liquefaction of helium by Kamerlingh Onnes in 1908, thirty years lapsed before the superfluid nature of helium below lambda point (2.2 K) was discovered independently by Kapitsa in Moscow, along with Allen and Misener from Cambridge in 1938 [1]. From this discovery, it was found that at these very low temperatures, liquid helium ceases to have finite viscosity expected of a normal fluid. Accordingly, this property of helium II (superfluid helium) was coined as superfluidity. London, later interpreted this anomaly as due to the phase transition that occurs beyond lambda point to form a Bose-Einstein condensate state. This peculiar property of helium II arises due to the coherent nature of the superfluid state. Due to the intermixing of the normal fluid with the superfluid in helium II, a two fluid model was later developed by Tisza and Landau to interpret the properties of helium II.

Superconductors

Superconductivity is the peculiar property of certain materials by which its conductivity increases drastically at very low temperatures marked by negligible resistance at these temperatures [2]. Kamerlingh Onnes discovered this phenomenon for mercury at a temperature of 4.2 K in 1911. Later on, several elements such as tin and lead were shown to exhibit superconductivity at their respective critical temperatures. The microscopic theory of superconductivity was developed by Bardeen, Cooper, and Schrieffer, in 1957 [3]. This theory popularly known as the BCS theory considered the formation of quasi-particles called Cooper pairs, bound pairs of electrons having opposite spin, as the cause for superconductivity. These electron pairs are bound together by the attractive force mediated by lattice phonons and eventually withstand the Coulomb repulsion between them. Unlike in metals wherein interaction of electrons with the lattice atoms reduces their conductivity, the Cooper pairs seldom interact with these atoms, thereby offering tremendous conductivity resulting in superconductive behaviour.

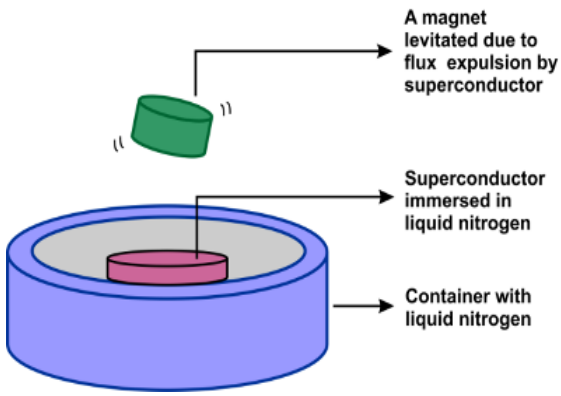

Figure 1: Meissner effect observed with superconductor wherein the magnetic flux expulsion by the superconductor (here immersed in liquid nitrogen) causes the magnet to hover above it.

In addition to low temperature superconductivity, high temperature superconductivity was observed in certain alloys and ceramics [4]. Novel materials are being discovered day in and day out, with the ultimate aim of achieving room temperature superconductivity.A room temperature superconductor

will have profound impact on electrical power transmission, magnetic levitation, etc. Meissner effect which can be used for realizing magnetic levitation is illustrated in Figure 1.

Atomic condensates

Atomic condensates are Bose-Einstein condensate formed with vapours of alkali atoms. This is usually achieved by bringing the atoms close together to enable the de Broglie waves of adjacent atoms to overlap, resulting in the phase transition to form an extended state [5]. To achieve this phase transition, various techniques such as laser cooling, magnetic trapping and evaporative cooling are applied in succession. In laser cooling technique, the velocity of atomic vapour from the oven is reduced by using laser beams, resulting in decrease in temperature of the vapour. As against the conventional refrigerator cooling method, this technique prevents the vapours from forming liquid phase due to interatomic interaction. This kind of approach is required to observe the Bose-Einstein condensate phase transition due to overlapping of de Broglie waves. This atomic vapour is further allowed to stay in a region using a magnetic trap. In the final stage, the temperature is further reduced to reach the phase transition temperature by allowing the fast moving atoms to leave the magnetic trap. This reduces the temperature of remaining atoms in the magnetic trap analogous to evaporative cooling of hot drinks such as tea or coffee.

Conclusion

Bose-Einstein condensation is a phase transition which occurs at ultra-low temperatures above absolute zero when atoms accumulate in the ground state devoid of interparticle interaction. This peculiar state was identified by London as the cause for superfluidity. Superconductivity is also caused due to Bose-Einstein phase transition. Bose-Einstein condensate state for alkali atoms was possible with laser cooling and trapping techniques. Recently, quasiparticles like exciton-polaritons and magnons are also shown to have undergone Bose-Einstein condensate phase transition. Efforts are underway to make room temperature superconductors with phase transition temperatures in ambient temperature ranges.

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Bioinformatics – The present and future

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Abstract

The technologies and techniques in every field is changing day by day. One of the interesting and high trending technologies now emerging is Bioinformatics. It is an exciting research area where the computer science uses its applications and tools to solve the problems of biology with an ease. Bioinformatics uses the systems for data storage, retrieval, manipulation, and distribution of data related to biological macromolecules such as DNA, RNA and proteins.

Index terms – Bioinformatics, Computational biology, Biological data analysis.

Introduction

The rapid rise in the biological data from sources like human genome projects and other sequencing projects across the world has led to increase in the need for analysing and interpreting of the these collected data. This brings to the importance of bioinformatics which can be explained as an interdisciplinary field of science which encompasses the inputs from computer science, physics, mathematics and biology to apply the tools for computation and analysis to efficiently capture and interpret the biological data. The use of bioinformatics has seen a tremendous growth ranging from genome sequence data, gene variation and prediction, prediction and detection of gene regulation networks to analysis of molecular pathways to understand gene-disease interactions. Bioinformatics finds its application heavily in the field of data management in modern biology and science[1]. The potential of bioinformatics in aiding the researchers in drug discovery and development is immense.

Recent advancements in Bioinformatics

Bioinformatics encompasses metabolic engineering data processing, data capacity and recovery, database structures, machine learning instrument and computerised reasoning. As a result, bioinformatics can be also explained as application of the computer novelty to administer the biological data accumulated. The bioinformaticians working in the field of DNA and protein sequencing across the work uses complex software programmes to retrieve, sort and analyse the data to come to predictions on different topics under the study and to store it for future use. The field of bioinformatics extends the engineers the opportunity to enhance engineering modelling, technical skill through its variety of requirements. The approaches like clustered regularly inspected short palindromic repeats has proved to be very efficient in solving biological problems in the world. The success of bioinformatics has accelerated many discoveries and solutions in the field of biotechnology and medicine. Bioinformatics is proved to be effective in understanding the root causes of cancer as well. Researchers has found that techniques in bioinformatics have helped in arranging the public domain genome data to support and recognise the role of genes in causing human cancer. In addition to that, bioinformatics has transformed the growth factor gene expression signature in mouse hepatocytes to predict the clinical outcome of the human cancer. Tools in bioinformatics has helped in identifying mutations from the resulting whole genome sequences. The tool known as integrative transcriptome has showed significant advancements in identifying the common molecular subclasses of human hepatocellular carcinoma.

Future directions of Bioinformatics

It is expected that in the coming years bioinformatics will help and guide the molecular biologists and researchers to build on the advantage of the advancements in the field of computational biology. The most successful research in the field of medicine is expected to be those that can combine the best results of laboratory bench, clinical practice and the sophisticated computational tools. The commercial possibilities of bioinformatics are considerable. In the recent past, the computer experts have often regarded as a part of the service environment, with the evolution of bio informatics, one can witness crucial management decisions on the drug discovery which were taken by the biologists moving to individuals that can excel in bioinformatics based on how that use the tools and knowledge to develop hypotheses and achieve their targets[2].

The emerging fields like information technology can be a great addition to bioinformatics as it helps to gather and utilize the biological information's to develop personal satisfaction of the people. The role of information technologists is to accumulate, depot an examine the organic hereditary data which would be help them to connect to quality-based medication issues and monitor its progress. Computational biology in bioinformatics will play a significant role in advancing the biomedical research and improvements, preventive pharmaceuticals, recognize sustainable information substances in DNA, RNA and protein arrangements and substance of genomes. The major fields that is expected to show

significant advances due to bioinformatics include molecular and personalised medicine, gene therapy, drug development, preventive medicine and forensic analysis. One of the major challenges of bioinformatics in the next decade will be improve the quality of the medicines available in the market and to develop more efficient antibiotics. the analytical and computational combination of bioinformatics makes it impossible to rule out the role of bioinformatics in the future. When it comes to the career opportunities, bioinformatic engineers has different professional choices in different divisions related to biomedical engineering, bio tech, pharmaceutical and bio-organisations.

Conclusion

Bioinformatics finds a vast range of applications in the field of biochemistry, pharmaceuticals, biotechnology, medicine, and bio-agriculture. The contribution that bio informatics can provide in the coming decades can be crucial as the world will need better technologies to rise to the needs of the people across the word, be it in medicine or in agriculture. This potentially opens huge career opportunities for bioinformatic engineers to contribute to the field of bioinformatics.

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Blue Brain

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Abstract

Blue Brain (BB) is the first attempt to reverse-engineer a human brain in order to understand the function of mammalian brain and dysfunction through super computer based reconstruction and simulation. BB aims to build comprehensive digital reconstruction of the brain which can be used to study the nature of the brain, which helps in understanding how human being process emotions, thoughts, and deeper insight into decision making power of the human brain.

Index terms – Blue Gene, EPFL, Nanobotes, Neurons, Sensory System, Blue Brain.

Introduction

The Blue Brain makes use of the Blue Gene super computer developed by IBM to carry out simulations. This was founded by Henry Markram at EPFL research institute that specializes in natural sciences and engineering. The aim is to upload a human brain into the computer, so that it can think and make decisions as human brain without the presence of human body. This virtual brain act as the man. So, even after the death of a person, we will not lose the knowledge, intelligence, emotions and memories of a person which can be used for various situations like to continue the pending work, to decide on something based on his/her area of expertise. The human brain is a complex system consisting of recursive connectors. It is more complex than any circuitry in the world. Human Brain is multi-level system with 100 billion neurons (nerve cell) and 100 trillion synapses[1].

A Virtual brain is an artificial brain. It can think like the natural brain, take decision based on past experience, and respond as natural brain can. It is possible to do so by super computers, with a huge amount of storage capacity, processing power and an interface between the human brain and this artificial brain. Through this interface, data is stored in the natural brain can be uploaded into the computer. So the brain and the knowledge, and the intelligence of anyone can be preserved and used for ever even after the death of the person.

Working of Natural Brain

The human ability to feel, interpret and even see is controlled, in computer-like calculations, by the magical nervous system. Yes, the nervous system is quite like a magic because we can't see it, but it is working through electric impulses through your body.

The human brain is a multi-level complex system with 100 billion neurons and 100 trillion synapses. Not even engineers have come close to making circuit boards and computers as delicate and precise as the nervous system[2]. To understand this system, one has to know following three simple functions:

Sensory input: When our eyes see something or when our hands touch a warm surface, the sensory cells, also known as Neurons, send a message straight to our brain. This is called sensory input because we are putting things into our brain by way of senses.

Integration: Integration is best known as the interpretation of things like taste, touch, and sense which is possible because of our sensory cells, known as neurons. Billions of neurons work together to understand the change around us.

Motor Output: Once our brain understands the change, either by touching, tasting or via any other medium, then our brain sends a message through neurons to effector cells, muscles or gland cells, which actually work to perform our requests and act upon our environment. The word motor output is easily remembered if one should think that our putting something out into the environment through the use of a motor, like a muscle which does the work for our body.

Idea of Brain Simulation

The working procedures of the natural and simulated brain is as below. This is a possible proposed solution. As per EPFL, development is still in progress.

Input: In the nervous system of our body, the neurons are responsible for transmitting information. The body receives the input by the sensory cells. These sensory cells produce electric impulses which are received by the neurons[3]. The neurons transfer these electric impulses to the brain.

Here neurons can be replaced by a silicon chip. So, the electric impulses from the sensory cells can be received through these artificial neurons and send to a supercomputer for the interpretation.

Interpretation: The electric impulses received by the brain from the neurons are interpreted in the brain. The interpretation in the brain is accomplished by the means of certain states of many neurons.

The interpretation of the electric impulses received by the artificial neuron can be done by means of a set of registers. The different values in these register will represent different states of the brain.

Output: Based on the states of the neurons the brain sends the electric impulses representing the responses which are further received by a sensory cell of our body to respond to neurons in the brain at that time.

Similarly, based on the states of the register, the output signal can be given to the artificial neurons in the body which will be received by the sensory cell.

Memory: Certain neurons in our brain, represent some states permanently. When required, this state is represented by our brain and we can remember the past things. To remember things we force the neurons to represent certain states of the brain permanently or for any interesting or serious matter, this happens implicitly.

In the similar way the required states of the registers can be stored permanently and when required this information can be retrieved and used.

Processing: When we think about something or make some calculation, logical and arithmetic calculations are done in our neural circuitry and are stored as states. Based on the new requests, states of certain neurons are changed to give the output.

In a similar way, the decision making can be done by the computer by performing arithmetic and logical calculations on the stored states and the new inputs.

Need of a virtual Brain

Today we are developed because of our intelligence. Intelligence is the inborn quality that cannot be created.

Some people have this quality, so that they can think up to such an extent where other cannot reach. Human society is always in need of such intelligence and such an intelligent brain to have with. But the intelligence is lost along with the body after the death. The virtual brain is a solution to it. The brain and intelligence will be alive even after the death. We often face difficulties in remembering things such as people names, their birthdays, and the spellings of words, proper grammar, important dates, history facts, and etcetera. In the busy life everyone wants to be relaxed. Can't we use any machine to assist for all these? Virtual brain may be a better solution for it. What will happen if we upload ourselves into computer, we were simply aware of a computer, or maybe, what will happen if we lived in a computer as a program?

Merits and Demerits

With the blue brain project the things can be remembered without any effort, decisions can be made without the presence of a person. Even after the death of a man his intelligence can be used. The activity of different animals can be understood. That means by interpretation of the electric impulses from the brain of the animals, their thinking can be understood easily [4]. It would allow the deaf to hear via direct nerve stimulation, and also be helpful for many psychological diseases[5].

Due to blue brain system human beings will become dependent on the computer systems. Technical knowledge may be misused by hackers; Computer viruses will pose an increasingly critical threat. The real threat, however, is the fear that people will have of new technologies[6]. That fear may culminate in a large resistance. Clear evidence of this type of fear is found today with respect to human cloning.

Conclusion

In conclusion, we will be able to transfer ourselves into computers at some point. Most arguments against this outcome are seemingly easy to circumvent. They are either simple minded, or simply require further time for technology to increase. The only serious threats raised are also overcome as we note the combination of biological and digital technologies. While the road ahead is long, already researches have been gaining great insights from their model. Using the Blue Gene supercomputers, up to 100 cortical columns, 1 million neurons, and 1 billion synapses can be simulated at once. This is roughly equivalent to the brain power of a honey bee. Humans, by contrast, have about 2 million columns in their cortices. Despite the sheer complexity of such an endeavour, it is predicted that the project will be capable of this by the year 2023.

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Chatbot and Artificial Intelligence

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Abstract

Chatbots have become like a necessity for businesses to gain recognition and customer satisfaction in today's competitive world. Companies can connect and interact with the clients in a personalised way via chatbots. Customer service like never can be achieved through chatbots which has resulted in increase of sales. As a result, chatbots can provide opportunities to improve brand engagement, help enterprises achieve business growth and make financial gains. Not only businesses but also customers are loving this technology. The hassles of waiting for long hours to get in touch with customer care executives get eliminated. Besides, chatbots can provide answers to customers even during non-operational hours. Due to chatbot's prompt replies and 24*7 availability, more than 65 percent of customers today prefer conversing with chatbots rather than humans. And therefore, chatbots have become a must-have for businesses to survive. This article gives a brief overview on relevance of chatbot, its working and its types.

Index terms – Chatbot, Virtual assistant, Natural Language Processing, Natural language understanding.

Introduction

A chatbot is a virtual assistant that can help customers by automating conversations and interact with them through messaging platforms. It is a software application which is used to conduct an online chat conversation through text or text-to-speech, instead of providing direct contact with a live human agent. Text-based chatbots are often deployed online on websites and social media platforms to provide customer support and outreach. Voice-based chatbots, on the other hand, are most typically used for call deflection and sorting or over-the-phone customer service. Chatbots are designed to convincingly simulate the way a human would behave as a conversational partner. To achieve this, chatbot systems typically require continuous tuning and testing.

Chatbots are used in dialog systems for various purposes including customer service, request routing, or information gathering[1]. While some chatbot applications use extensive word-classification processes, natural language processors, and sophisticated AI, others simply scan for general keywords and generate responses using common phrases obtained from an associated library or database.

Most chatbots are accessed on-line via website popups or through virtual assistants. They can be classified into usage categories that include: commerce (e-commerce via chat), education, entertainment, finance, health, news, and productivity. Among the most notable early chatbots are ELIZA (1966) and PARRY (1972).

How Do Chatbots Work?

Natural language processing (NLP) helps the chatbot to analyse the human language and generate the text. NLP is a branch of informatics, mathematical linguistics, machine learning, and artificial intelligence. NLP seamlessly bridges the communication gap between complex human language and coded machines. NLP helps businesses offer a compelling experience to customers. In the context of bots, NLP can be used to know what the user is actually trying to tell or ask. This way, brands can engage with their customers in a personal, more empathetic manner, which can ultimately make them stand unique among their competitors.

In order for the chatbot to understand the user's message, it needs to somehow convert the unstructured human language to structured data that computers can interpret. When a user sends a message to the chatbot, it needs to use algorithms to get meaning and context from every sentence to collect data from them. This process is called natural language understanding (NLU), and it's a subset of natural language processing. It consists of interpreting the user's message by extracting important and relevant details from it[3]. With the help of natural language understanding (NLU) and natural language generation (NLG), it provides the answer to the query given by the user. Working of chatbot is shown in figure 1[2].

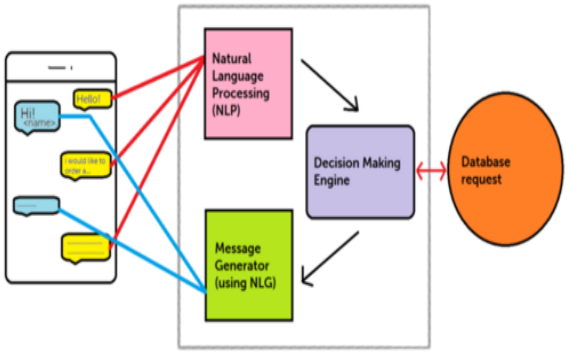

Figure 1: Working of a chatbot

Types of chatbots

The different types of chatbots are as follows[4]:

- **Standard logic tree**

These prompt-based chatbots let customers choose from a list of prompts then take them through a series of multiple-choice questions. The application will take them to the most helpful destination based on the answers. This type of chatbot is good for simple queries with a defined scope, as it limits customers to a certain number of inputs.

- Keyword recognition

This approach allows customers to submit their written inquiries. The chatbot identifies keywords from the query and directs customers to a corresponding solution. This type of chatbot can be used for a broader range of customer inquiries.

- Machine learning

This approach uses a machine learning engine to train itself to deliver an optimal response to a customer query. It learns based on past inquiries and evolves as inputs are analysed. A large amount of data is needed to train the system, and machine learning of the chatbot application is done in a black box with no insight into what is learned.

- Symbolic NLU

This approach leverages symbolic AI to provide a more conversational approach to customer service. It uses natural language technology to understand the intent of a customer query. It provides full visibility into the rules that machines use to gain knowledge, with human oversight to adjust the learning models.

Conclusion

Chatbots are increasingly present in businesses and often are used to automate tasks that do not require skill-based talents. With customer service taking place via messaging apps as well as phone calls, there are growing numbers of use-cases where chatbot deployment gives organizations a clear return on investment. Call centre workers may be particularly at risk from AI-driven chatbots. The NLP process is a core part of the chatbot architecture and process, since it is the foundation for translating the natural human language to structured data.

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Conventional and Smart Base Isolators for Seismic Protection

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Abstract

Earthquake is one of the most hazardous and dangerous natural phenomena which is uncontrollable in nature. To protect the manmade structures and the occupants from the disastrous seismic vibrations, some new techniques have been developed which partially absorbs the energy of seismic waves and thus eliminate them to reach directly into the structural components. Seismic isolation is a seismic design philosophy that aims to reduce the seismic demand on structures as opposed to increasing their capacity to endure forces. Base isolator is one of the most effective techniques in decreasing earthquake force that transmits to the building. The proper selection of the type of isolation system is crucial for the successful seismic decoupling of a particular structure. A variety of seismic isolators most commonly adopted as well as base isolators which are made smart by incorporating SMA wires and/or magnetorheological elastomers with adjustable stiffness are also discussed.

Index terms – Base isolators, Seismic Design, SMA wires, MR elastomers.

Introduction

Earthquakes shake the ground we live on, but they also cause ruptures within the earth, trigger landslides, and even turn soil to liquid. The destruction caused by an earthquake is highly unpredictable and sometimes beyond repair. A very vast population of the world is living in seismic prone areas risking their lives and properties including buildings and other manmade structures. The potential damages of earthquake include the loss of lives and damages to structures. The tremendous increase in the construction of Civil Engineering structures especially high-rise buildings necessitates an effective technology for reducing the damages caused by earthquake. Performance of building in a highly seismic prone area poses a great challenge for a Civil Engineer. Over these years, many attempts have been done to control or reduce the effect of earthquake and its subsequent damages on buildings, bridges, dams, pipelines, etc.

To protect the manmade structures and the occupants from the disastrous seismic vibrations, some new techniques have been developed which partially absorbs the energy of seismic waves and thus eliminate them to reach directly into the structural components. Those systems are called seismic control devices which include passive systems, active systems and hybrid systems.

Base Isolation in Buildings

Passive seismic control devices consist mainly of mechanical assemblies which are made up of different materials and designed to improve damping, stiffness, and strength of structures. Since the passive energy dissipation devices are not an integral part of the main structure, they can easily be replaced without compromising the structural integrity [1]. When these passive vibration isolators are accommodated at the base of the structure, it is termed as a base isolator. Base isolation is an innovative, new, evolving passive technology which is highly effective in mitigating the damages caused by earthquake. Nowadays, in the field of seismic research, the sector of base isolation has a very big interest. The term 'base' refers to the foundation of a structure and 'isolation' refers to the reduced interaction between the ground and the structure which is resting over the foundation.

Through base isolation, a horizontally flexible base separates or decouples the superstructure from the damaging ground motions and vibrations thus making the structural response accelerations less than the ground accelerations.

This isolation is attained by enlarging the flexibility of the structure by removing the fixity between the superstructure with the ground or foundation and by partially absorbing the energy of ground vibrations and by reducing the forces induced in the structure. The higher flexibility of base isolator increases the time period of the structure which is the most peculiar feature of seismic isolation [2]. That is, the natural frequency of the base isolator will be smaller than that of the fixed base structure and the seismic wave. The superstructure will remain elastic in nature with base isolation which may be designed for elastic behaviour avoiding a costly and complex ductile design thus achieving economy in construction.

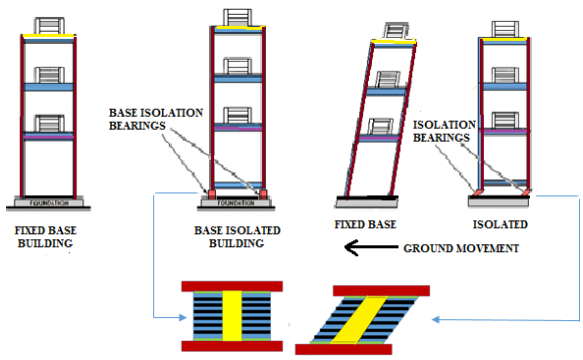

Figure 1: Fixed base and base isolated structure

Fig.1shows the pictorial representation of base isolation. A fixed-base building (built directly on the ground) will move with an earthquake's motion and can cause extensive damage as a result. But when it is isolated, the response of the building is modified such that the ground below is capable of moving without transmitting or transmitting minimal or no motion to the structure above.

Base isolation is very much useful when the utility of a structure is very much concerned and which should be functional instantly after a strong severe earthquake like a hospital building, structures related to defense activities, etc. It can be also critical for the case of structures whose contents are valuable or hazardous which should be protected from earthquake damages like in the case of buildings with historic importance or nuclear power plants etc. Base isolation may be necessarily required for structures with low or moderate strength like monuments. Base isolation is also said to have decreased the overall cost of building construction from the reduced ductility requirement and by the prevention of costly repair works after earthquake [3].

The proper selection of the type of isolation system is crucial for the successful seismic decoupling of a particular structure. The two core parameters of a seismic isolator which are used to evaluate the performance of an isolator are higher flexibility and energy dissipation capacity

Types of base isolators

There are a variety of seismic isolators but the most commonly adopted are Elastomeric High Damping Rubber Bearing (HDRB), Friction Pendulum Sliding Bearing (FPSB) [4] and Lead Core Rubber Bearing Base Isolators. A ''smart'' base isolation strategy effectively protect structures against extreme earthquakes without sacrificing performance during the more frequent, moderate seismic events. The proper selection of the isolation device is critical for the successful seismic isolation of a particular structure.

Magnetorheological Elastomeric Base Isolator

Conventional passive base isolators have to be provided with large seismic gaps due to their high horizontal flexibility and exhibits poor adaptability to varying ground excitations. Hence it becomes necessary to introduce "smartness", in the conventional base isolators and enhance their adaptability to varying spectra of input loads. As a new branch of rheological smart material, magnetorheological elastomer (MRE) can be controlled rapidly and reversibly by the application of magnetic field. MRE devices(fig.2) can provide tunable stiffness and damping without worrying about the leakage and settlement problems. The base isolators should have large vertical load carrying capacity and less horizontal stiffness, the laminated structure of the model enhances this and the coil provided externally provide the required magnetic field to the MR elastomer layers and by simply controlling the current in the coil the stiffness and damping of the system can be controlled thus providing real time adaptability[5].

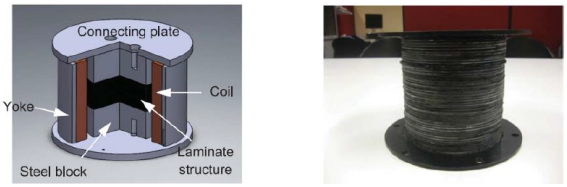

Figure 2: Magnetorheological Elastomeric Base Isolator

Smart Lead Core Rubber Bearing Base Isolator

Shape memory alloy equipped lead rubber bearings(fig.3) is an innovative concept which is to be extensively studied for its future use. An innovative smart material like shape memory alloy equipped in a base isolator further improves the performance of lead rubber bearing by reducing the frequency of replacement of bearing after strong earthquakes with their adjustable behaviour.

Even the configurations of SMA wires are not generalised now so as to use it in base isolation, around the periphery of lead rubber bearings, solid circular shape memory alloy bars are attached to the top and bottom mounting plates of conventional lead rubber bearing. The shape memory alloy equipped bearing is designated as Smart-LRB in which Nickel-Titanium alloy termed as Nitinol which is a widely known SMA is selected for identifying the material properties [6].

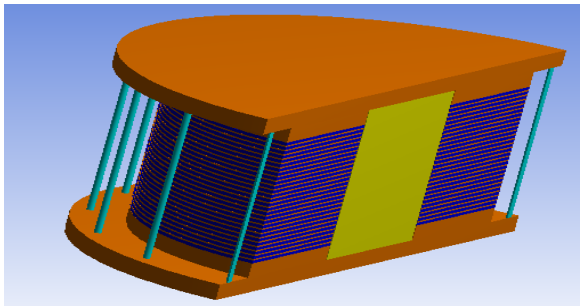

Figure 3: Smart Lead Core Rubber Bearing Base Isolator

Unbonded Fiber Reinforced Elastomeric Isolators and SMA Wires

Hybrid Seismic Base Isolation System using unbonded fiber reinforced elastomeric isolator (UFREI) is considered as one of the most promising devices for seismic base isolation of structures due to its low manufacturing cost and horizontal stiffness.

This low horizontal stiffness increases the structural period, shifting the structure into a period range of low seismic energy content [7]. Combination of UFREI and shape memory alloy (SMA) wires increases the energy dissipation capacity of the isolation system.

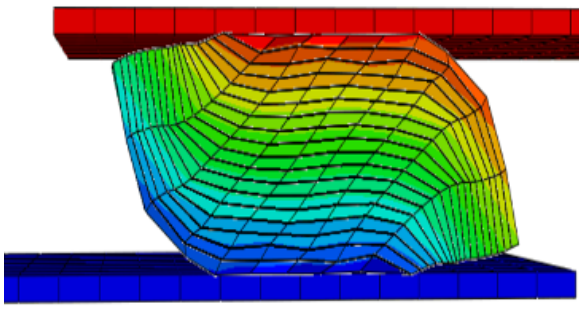

Figure 4 : Deformed configuration of Hybrid Seismic Base Isolator with UFREI &SMA

Conclusion

A base isolation system is a seismic protection mechanism in which the structure (superstructure) is isolated from the base (foundation or substructure). Some of the important base isolation systems used in buildings are discussed. Magnetorheological Elastomeric Base Isolator are smart base isolators which can bring real-time adaptability once it is fully developed. Shape memory alloy equipped lead rubber bearings is an innovative concept which is to be extensively studied for its future use. Combination of UFREI and shape memory alloy (SMA) wires increases the energy dissipation capacity of the isolation system.

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Effect of Electron Irradiation on the Optical Properties of Manganese Mercury Thiocynate (MMTC) and Manganese Mercury Thiocyanate Di Methyl Sulphoxide (MMTD) Crystals

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Abstract

MMTC (Manganese Mercury Thiocyanate) and MMTD(Manganese Mercury Thiocyanate Dimethyl sulfoxide) crystals were prepared from aqueous solution slow evaporation process. The pure MMTC and MMTD were exposed to 8 MeV electrons in the free air environment. The films were kept at a distance of 30 cm from the beam exit point where almost uniform electron beam distribution exists for an area of 8cm x 8cm. The dose rate was adjusted with a current of 20 mA and the accelerator was operated in pulsed mode at a repetition frequency of 50 Hz and the samples were exposed to a graded electron beam dose of 6kGy and 8 kGy. Electron beam irradiation is an efficient method where one adds fast energetic electrons into the virgin lattice and tries to change the microscopic atmosphere of the pure lattice .The expected changes due to this addition are studied and compared with that of pure crystals.

Index terms – NLO, Electron irradiation, Optical properties.

Introduction

Developing suitable materials for device fabrication is an important challenge in the area of material science research. Devices for specific applications need specific properties. It is possible to change the properties of the developed materials in a variety of ways. Doping is one of the methods to tune the materials in a desired manner. Another method is the electron beam irradiation. The electron irradiation replaces large number of lattice points of the host material and attains stable equilibrium with the host atoms. A concept called 'unit displacement energy, energy needed to knock an atom out of its position in the lattice enables us to relate the energy of the incoming beam and its microscopic effects produced inside the host material. Another effect is the so-called "thermal spike," i.e., rapid heating and quenching of a small volume of the material of the irradiated region. All these effect will contribute to properties of band gap, specific vibrational modes, electrical conductivity, dielectric constant etc. Changes in dielectric constant, optical band gap over electron beam irradiation with electron beam are reported for ferroelectric triglycine sulphate crystals. Studies in alloys reveal that changes in lattice parameters. Irradiation plays a major role in shaping the properties of the pure materials in addition to doping. Here the synthesised pure crystals of MMTC and MMTD are subjected to different dosage electron irradiation from an 8MeV electron irradiator. Immediately after irradiation characterization studies such as determination of band gap, changes in Urbach energy studies are done and the changes are reported.

Experimental Procedure

MMTC and MMTD crystals were prepared from aqueous solution and the mixture of water with dimethylsulfoxide respectively by slow evaporation process and the details are given.

The pure MMTC and MMTD were exposed to 8 MeV electrons in the free air environment. The films were kept at a distance of 30 cm from the beam exit point where almost uniform electron beam distribution exists for an area of 8cm x 8cm. The dose rate was adjusted with a current of 20 mA and the accelerator was operated in pulsed mode at a repetition frequency of 50 Hz and the samples were exposed to a graded electron beam dose of 6kGy and 8 kGy. The salient features of the Microtron accelerator are detailed elsewhere [1]. The delivered doses were measured using a current integrator calibrated against appropriate radiation dosimeters.

Electron beam irradiation is an efficient method where one adds fast energetic electrons into the virgin lattice and tries to change the microscopic atmosphere of the pure lattice. The expected changes due to this addition are in bandgap, specific vibrational modes, dielectric constant, conductivity etc.

UV-Vis-NIR Studies

UV-Vis spectrum of pure and irradiated MMTC and MMTD crystals are recorded using Varian Cary 5E spectrophotometer taken in the wavelength range of 190 -1100 nm and is shown in Fig.1. Cut off

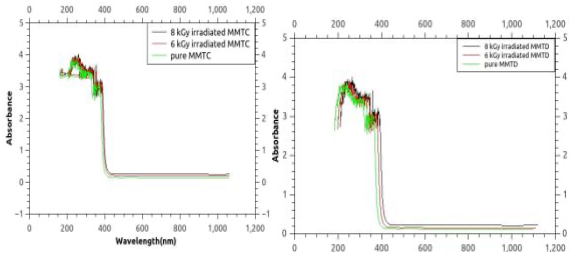

Figure 1: UV absorption curve of pure and irradiated MMTC &MMTD crystals

wavelength of the pure and 6 & 8 kGy irradiated MMTC crystal are 385nm, 389.7nm and 394nm respectively whereas for pure and 6kGy and 8 kGy irradiated MMTD are 384 nm, 395.3 nm and 409.7 nm respectively. The cutoff wavelength of the pure MMTC and MMTD is found to be increase with increase in the dosage of the electron irradiation [2]. This may be due to the enhancement in the number of charge carriers due to electron irradiation.

In order to determine the band gap of the pure and irradiated samples, a graph has been plotted between hν and $(\alpha h\nu)^2$ using the Tauc's relation and is shown in Fig.2 and it is clear that the band gap decreases with increasing the dosage of the electron irradiation due to the effect of guest electrons inside the pure crystal lattice by electron irradiation [3]. As the dosage of radiation was increased further the crystal structure can be distorted due to the penetration of the high velocity electrons.

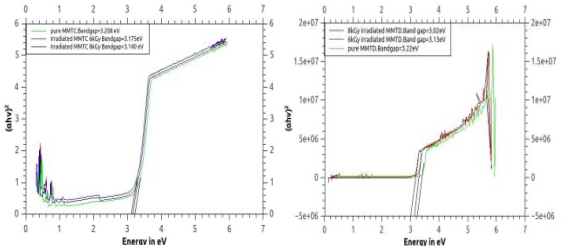

Figure 2: Tauc's plot of pure and irradiated MMTC and MMTD crystals

Determination of Urbach energy

There are disordered and localized states in band gap produced by amorphous materials which results an exponential absorption tail. An exponential empirical law was followed by this absorption edge. The exponential character of the absorption coefficient of the crystal near the fundamental absorption edge is expressed by the Urbach rule $\alpha = \alpha_0 \exp(h\nu/Eu)$, where α is the absorption coefficient, hν is the incident photon energy, and Eu is the Urbach energy. The Urbach energy was determined by drawing a graph between photon energy in eV and logarithm of the absorption coefficient [4]. Urbach plot of the pure, 6 kGy and 8 kGy MMTC and pure, 6 kGy and 8 kGy MMTD are shown in Fig.3. Urbach energy of the pure and irradiated samples is given in the Table 1 Urbach energy was found to be increase with increasing the dosage of the irradiation for both MMTC and MMTD. This may be due to the structural disorder by the irradiation in the grown samples. The linear region in the Urbach plot explain the disorder in the lattice caused by the irradiation.

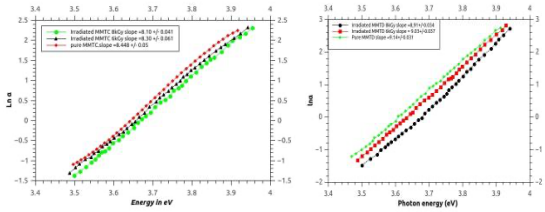

Figure 3: Urbach plot of the pure and irradiated MMTC & MMTD crystals

Table 1: Comparison of Band gap energy and Urbach energy of pure and irradiated MMTC and MMTD crystals

Name of Crystal	Band gap (eV)			Urbach Energy(eV)		
	Pure	6kGy	8 kGy	Pure	6kGy	8kGY
MMTC	3.208	3.175	3.140	0.1184	0.1205	0.1235
MMTD	3.220	3.130	3.020	0.1094	0.1107	0.1122

Conclusion

Good quality crystals of Manganese Mercury Thiocyanate (MMTC) and Manganese Mercury Thiocyanate Dimethyl sulphoxide (MMTD) samples were exposed to a graded electron beam dose of 6 and 8 kGy. Pure and irradiated samples were subjected to the optical, electrical and thermal investigations. The band gaps of irradiated crystals of MMTC and MMTD were found to be decreased with increasing the dosage of the irradiation whereas the Urbach energy found to be increasing.

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Effect of major processing parameters in additive manufacturing

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Abstract

Using conventional processing methods, modern metallic components are difficult to manufacture because of their complex configurations. In order to achieve this, Laser Melting process has been used. One of the unique Additive manufacturing techniques is selective laser melting (SLM) process, in which parts with complex shapes can be developed based on CAD Files. SLM involves multiple types of mass, heat, and momentum transfer that can be significantly affected by the operating temperature. The performance of SLM-processed components can be improved by controlling certain processing parameters.

Index terms – Additive manufacturing, Selective laser melting, Rayleigh–Bénard convection. Absorptivity and porosity.

Introduction

The role of additive manufacturing has been prevalent since last 30 years and is currently used in the manufacturing of various materials. Even though there are many kinds of machines, in fact, they are all similar in the way or other as they involve the production of three-dimensional shapes by combining different two-dimensional slices together. Mainly additive manufacturing has found its importance in "rapid prototyping" of metallic components using Electron Beam Machining (EBM) and Selective Laser Melting (SLM). Selective laser melting being able to create complex geometric shapes directly from computer-aided design (CAD) model is considered the most important manufacturing technology for large-scale industrial production. There are many studies involving a number of materials like Ni-based super alloys, Ti-based alloys, Al-based alloys, steels and various composites. It has been found that there are various concerns which had to be rectified. The major concerns involved were residual stress development, porosity and mechanical anisotropy. In concerns stated above, the porosity was found to be the common phenomena that are found in almost all metallic materials created by SLM and it is also the major reason which in fact can influence the build quality and strength of the final product. A.V.Gusarov also reported that the laser melting manufacturing process is sensitive to laser parameters such as the power, the laser beam diameter, scanning velocity of laser and thickness of the powder layer. However, some defects such as spatter, balling phenomenon, curling, cracks due to thermal stresses can happen in laser melting process because of its physicochemical complexity.

Rayleigh–Bénard convection effect during SLM

When the Gaussian laser beam is allowed to fall on the powder bed, localized melting of powder occurs in SLM; due to this the temperature gradient will be formed[1][2]. The temperature gradient mainly affects on the centre and edge of the molten pool. Concentration differences and temperature gradient at solid liquid interfaces of the molten pool causes surface tension difference which finally results in Rayleigh–Bénard convection flow. The Rayleigh–Bénard convection flow can be defined into two, the thermal Rayleigh–Bénard convection flow and the solutal flow. Based on the experimental studies by various researchers, the thermal Rayleigh–Bénard convection flow will lead to a clockwise flow pattern which is defined as source flow effect, whereas the solutal flow effect also known as converging flow moves the opposite direction; the source flow thermal Rayleigh–Bénard convection is weaker than the solutal flow effect. Rayleigh–Bénard convection effect plays a major role in laser melting process.

Temperature distribution during Rayleigh–Bénard convection clearly shows that the melt pool is wider and deeper in nature. The Rayleigh–Bénard convection flow influences the flow of the fluid in the powder bed and the distribution of temperature along the molten metal pool. The studies show that the flow of molten metal mainly depends on the thermal diffusion, surface tension gradient, temperature gradient and viscosity[3].

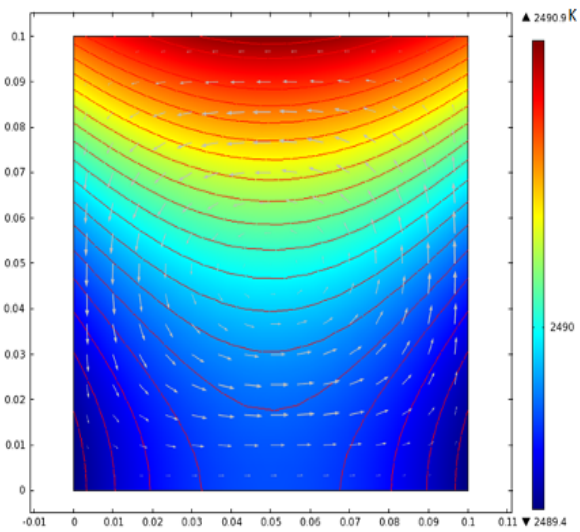

Figure 1: Temperature distribution during Rayleigh–Bénard convection

Absorptivity and porosity

Laser melting is a layer-by-layer process which includes scattering and absorption of laser radiation in the powder. To protect the underlying parts the powder is not compressed mechanically during the deposition of layer. So, the powder bed has porosity ranging from 40% to 60% which is a high porosity level. Through these pores multiple reflections occur and the laser radiation penetrates into several particle diameters which is comparable with the layer thickness of the powder. Absorptivity of the powder material, power of laser, powder density were also helps to penetrate the heat energy into the powder bed. The powder is taken as a medium of absorbing and scattering homogenous region. The homogenized radiation transfer equation (RTE) reveals the relation between universal absorptance function when the powder bed at normal incidence versus the absorptance of the dense form material. The fraction of incident radiation absorbed by the substrate (As) decreases with optical depth of the powder layer, while the fraction absorbed in the powder (Ap) increases. Scattering of laser light in the powder bed mainly leads to absorption. But at higher optical depth scattering of laser light doesn't happen so the light escapes without scattering. When porosity is higher the void spaces in the powder bed is higher so the powder particles will absorb more laser energy[5].

Variation of thermal behaviour with laser processing conditions

Major laser processing parameters in SLM are scan speed and laser power. At a low scan speed or high laser power, sufficiently high laser energy is absorbed by the powder bed to yield a higher temperature and a longer liquid life time during SLM. Moreover, a significant heat accumulation effect may occur, resulting in re-melting along the previously scanned track. Under these conditions, SLM leads to excessive molten metal and a sharp decrease in melt viscosity because of the higher temperature and lifetime of the molten pool. In this situation, the balling effect, a typical metallurgical defect associated with powder-bed SLM, is likely to occur because of the high capillary instability of the melt pool[4].At a high scan speed or low laser power, the lower laser energy input to the powder layer leads to a lower temperature and a much shorter liquid lifetime[6]. Therefore, a small amount of liquid with a high melt viscosity and an inadequate wetting time may form during SLM, which tends to lead to micropore formation. The temperature of the powder bed during SLM is directly influenced by the laser power, whereas, the laser scan speed affects the temperature by changing the interaction time between the laser beam and the powder bed.

Conclusion

Rayleigh–Bénard convection effect plays a vital role in getting smooth continous track in laser melting process. Due to Rayleigh–Bénard convection, there is significant amount of temperature distribution along the powder bed. The density of the part depends on the absorptivity of the powder. The general variations in thermal behaviour during SLM with laser processing conditions are discussed.

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Loss Identification using Cost Deployment in a Refractory Industry

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Abstract

This paper concentrates on the identification of losses in a refractory industry with a spotlight on the production line using cost deployment. Here the purpose is to present a new method to identify the different losses on the shop floor. This paper describes an application of the cost deployment methodology by taking an example of a refractory industry.

Index terms – Lean Manufacturing, Setup time, Loss Identification, Cost Deployment

Introduction

The most daunting issue faced by manufacturers today is how to deliver their products or materials quickly at low cost and good quality. The principles of 'lean' focus on eliminating waste[1] and non-value-added activities in a process while maximizing the value-added tasks as required by the customer[2][3].

Refractory is a term given to a class of materials which are produced from non–metallic minerals and possess capability to withstand heat and pressure. Refractories cost about 8%-10% of the total cost of steel production. So cost reduction in refractory manufacturing can have great impact.

Process Detail

The process of making refractory blocks is as given below in the figure 1. This paper explains the process in the shop floor.

The design department gives the report to pattern shop. The patterns are made on the basis of drawings. Mould is made by three sections mostly in EPIC, Header, shell and slab. Then these three sections are assembled in mould assembly. Flasking is the next operation. In this the moulds are positioned in the bins and the surrounding gap is filled with annealing media. The mix after inspection is fed to furnace. An electric arc furnace is used for this where casting process happens. After completion of the cooling cycle, the moulds are removed from the bin and grog is recycled by a process called Deflasking. The de-flasked blocks are thoroughly inspected regarding the features, dimensions, etc. If it meets the requirements, then only it is cleared for other machining operations. The finishing processes includes polishing, cutting, milling and grinding to fulfill the needs of the customers and meet to the specifications given in the purchase orders.

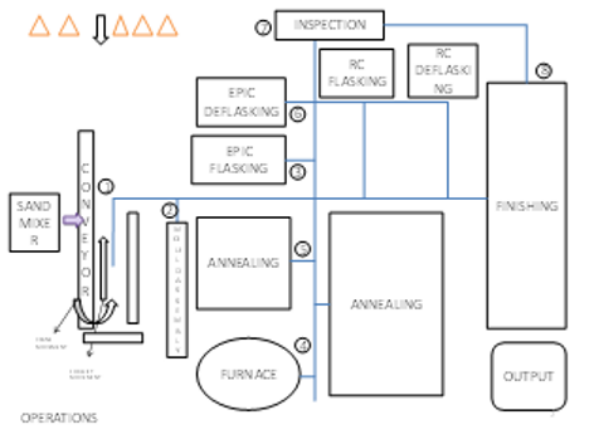

Figure 1: Process of making refractory blocks

Methodology

The general methodology of the project work is as shown in the figure below:

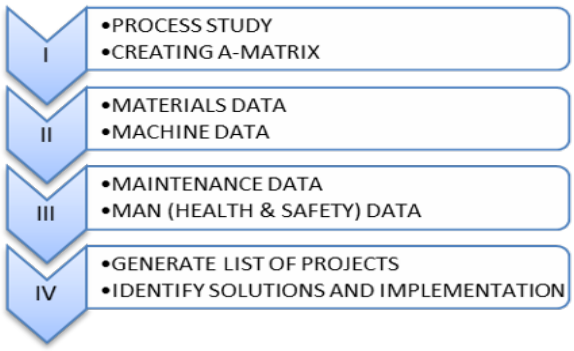

Figure 2 : Methodology

A-MATRIX

A-Matrix is a relationship matrix showing the relationship between the various process steps and the different major losses that are considered. A-Matrix is created through brain storming and observation. The brain storming stages should cover three stage discussions:-

- With the operators
- With the supervisors
- With the department heads

Depending on the scope of improvement and also its benefit to the company, the improvements are classified into three types.

COLOUR	INFERENCE
Red	Large scope for improvement

Yellow Medium scope for improvement

Green Limited scope for improvements of now

Data Collection

The data should be collected for supporting the inferences from the A-matrix and also to identify further areas of improvements. The data are mainly collected for four aspects:

- Material
- Machine
- Maintenance
- Man (Health and Safety)

The A-Matrix was created for pattern shop, mould shop, flasking, furnace, de-flasking and finishing sections in the production department. The machine data, material data, maintenance data and the labour data concerned with health and safety were collected.

Conclusion

Based on the A-Matrix and the data collected in different categories, the problematic areas were identified and a list of improvement projects was generated. The problems that are addressed in this paper are given in Table 1.

Table 1: Problems addressed

Sl no.	Problem definition	Area
1	The searching time for annealed bins is high	Furnace
2	The throughput of saw is less	Finishing

The traceability of the bins was a major problem. The annealing period of the bins range from 7days to 16 days depending on the quality and weight. The bins after pouring were kept without any order. So the average searching time for the bins was around 20 minutes. A bay system as shown in Fig 2 was introduced for keeping the bins for annealing. In the system the bins with the same date of delivery were kept together. Also software for updating the location of the bins was developed and installed which helped in tracing the bins easily. The average searching time was reduced to 12 minutes as a result of the implementation of bay system.

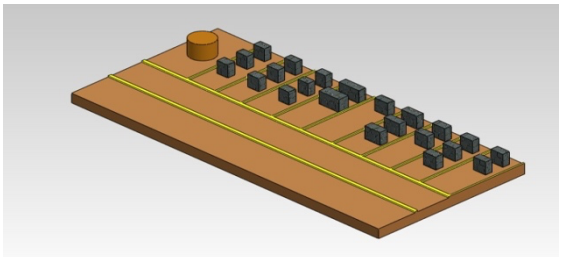

Figure 3: Bay System for Storage

The setup time of saw in the finishing section was around 15 minutes per block. An external set up table was introduced which eliminates the need to stop the machine for setting the next block. The throughput was increased by this improvement and is as shown as in Fig 3.

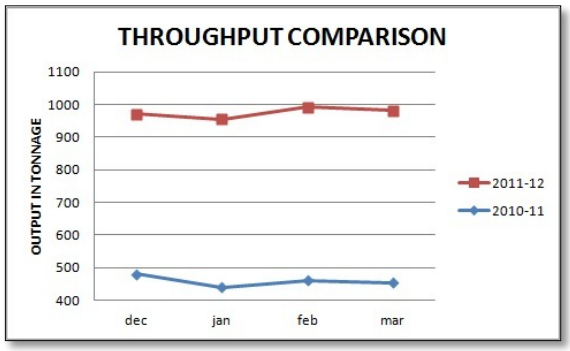

Figure 4 : Throughput Comparison of Saw

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Neuro-Fuzzy Technique for Predictive Diagnosis in Healthcare

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Abstract

Neuro-Fuzzy System (NFS) plays a significant role in predicting different medical conditions. This technique helps the medical practitioners by eliminating false diagnosis. This article presents the literature review of implementing NFS in predicting and diagnosing various medical disorders or conditions.

Index terms – Neuro-Fuzzy, Predictive Diagnosis.

Introduction

Traditional ad-hoc healthcare data analytics, which requires expert-intensive effort for collecting data and analysing data, has been replaced by machine learning-based approaches to perform personalized clinical predictions. Predictive diagnosis in healthcare leverages artificial intelligence and machine learning techniques to forecast outputs such as detect early signs of patient health deterioration in hospitals, monitoring of high-risk patients. Neural Fuzzy Systems is one such technique used to predict various diseases from medical data [1][2].

Fuzzy Neural Networks (FNN) or Neuro Fuzzy System (NFS) inherits the properties of both Artificial Neural Networks (ANN) and Fuzzy Logic (FL). Fuzzy systems and Artificial Neural Networks are widely used in many applications like medical diagnosis, pattern recognition etc. Fuzzy systems are used mostly in applications where it requires human-like fuzziness in decision making. The challenges in the design of such systems are that identifying membership functions and inferential rules are dependent on domain expert. An alternative approach was to use neural networks for automation and development of fuzzy rules sets. Thus combining the concepts of Fuzzy systems and Neural networks shows better performance.

Neuro-fuzzy system modelling

Predictive diagnosis in healthcare using machine learning algorithms is a challenging task due to the nature of data, which can contain incomplete, uncertain, and imprecise information. Fuzzy set theory, introduced by Zadeh [3], is mainly used when the information is incomplete or imprecise. Fuzzy logic provides the degree of membership to the features of the objects. In fuzzy logic, membership functions are used to characterize fuzziness. There are many types of membership functions which some of them are: Triangular, Generalized Bell-Shaped, Gaussian and Π-Shaped [2]. One of the main issues of fuzzy logic is that it is not able to automatically learn the models from the data [4]. In contrast, neural network has solved this issue. However, neural network is not suitable for modeling when the information is incomplete or imprecise. Accordingly, the hybrid of neural network and fuzzy logic, neuro-fuzzy, has solved these issues. This technique is intended to automatically generate or enhance a fuzzy system by means of learning algorithms [5]. Multiple architectures are available where NFS can be introduced. Among this adaptive network based fuzzy inference system (ANFIS) is the most preferred one.

An example of using ANFIS for medical diagnosis, specifically, Hepatitis diagnosis is shown in figure [2]. Mehrbakhsh (2019) et.al investigates the use of ANFIS for hepatitis diagnosis. In this paper, four types of membership functions such as, Triangular, Generalized Bell-Shaped, Gaussian and pi-Shaped were considered. Centroid of Area (COA), one of the most widely used defuzzification strategy was used for defuzzification task. This method calculates the center of gravity of the fuzzy set A, which correspond to the center of the area under the membership function. The crisp value of the fuzzy set A using this technique (zCOA) is calculated from its membership function.

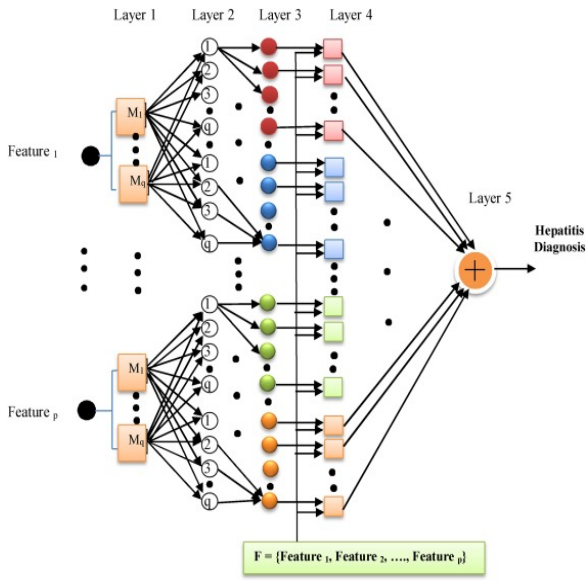

Figure 1: Hepatitis diagnosis by ANFIS model

Significant number of studies has used NFS in cancer diabetes, neurodegenerative disorder diagnosis, and depression and anxiety diagnosis so and so forth. Kour, 2020 et., al has studied the impact of NFS on various disease diagnosis (figure 2).

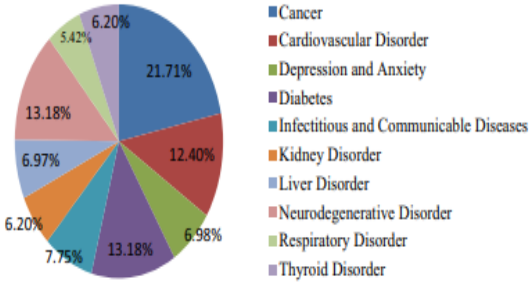

Figure 2 : Impact of NFS development on various categories [5]

Conclusion

Automation in predictive diagnosis of various health conditions has gained a great importance. Machine learning techniques are being widely used in medical field for early prediction. Techniques like, support vector machine, neural networks, fuzzy logic, decision tree, etc. to aid doctors in precise prediction of diseases occurrence. But these techniques have limits in handling the medical data which is uncertain and multidimensional in nature. Thus studies have started to implement hybrid methodologies like Neuro-fuzzy systems (NFS) to design the diagnostic tools that show better performance as compared to the one that developed using single approach.

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Non Fungible Token

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Abstract

NFTs are one-of-a-kind cryptographic tokens that can't be duplicated on a blockchain. Real-world goods such as artwork and real-estate can be represented with NFTs. These real-world tangible goods can be "tokenized" to make them more efficient to buy, sell, and trade while also lowering the risk of fraud. NFTs can be used to represent people's identities, property rights, and other things.

Index terms – Cryptocurrency, cryptotokens, blockchain, non-fungible tokens.

Introduction

From gold to cash, currency has developed over time. At this point, currency has progressed to the next level. Every country has its own currency. There are numerous issues with present money systems.

1. Controlled by a centralized authority at every stages.
2. Risk of inflammation due to mismanagement by central authorities.
3. Inefficient to handle instabilities at time.
4. Dicey in terms of security and threats.
5. Major hassle and delays present in money transfer.

All countries, most likely, have a centralised government that deals with currency. Demonetization is a truth that can come into play at any time. Transactions involving money are not safe or secure. Various banks are often in charge of it. It's possible that banks will close, and we'll lose our money. There are time and transaction limits when transferring money from one jurisdiction to another. Humans proposed a new notion of blockchain technology (cryptocurrency) to overcome all of these limits.

We run a cryptocurrency in which we run our currency utilising blockchain technology. This is a more advanced form of currency. Bitcoin is the first cryptocurrency that has evolved.

We've all heard of the term "applications." The same problem exists in applications as it does in currencies. A centralised authority is also owed to apps. Blockchain technology now offers dApps, a new degree of evolution for centralising apps (decentralized Apps)

Blockchain

Blockchain is a method of storing data in such a way that it is difficult or impossible to alter, hack, or cheat it. A blockchain is a digital log of transactions that is duplicated and distributed across the blockchain's complete network of computer systems[1]. Each block in the chain contains a number of transactions, and each time a new transaction takes place on the blockchain, a record of that transaction is added to the ledger of each participant. Distributed Ledger Technology is a decentralised database that is administered by various people (DLT). Blockchain is a sort of distributed ledger technology in which transactions are recorded using a hash, which is an immutable cryptographic signature[2].

Cryptocurrency

The Cryptocurrency is a form of digital money that is decentralised and based on blockchain technology. Although you may be aware with the most well-known versions, Bitcoin and Ethereum, there are over 5,000 distinct cryptocurrencies in use. A cryptocurrency is a digital, encrypted, and decentralised medium of exchange. Although most individuals invest in cryptocurrencies as they would in other assets such as stocks or precious metals, you may use crypto to buy conventional goods and services[3].

Digital Artists / Crypto space

Unauthorized use of a digital artist's intellectual property is a concern for them. The world of digital art is set up in such a way that anyone from anywhere in the world can utilise anyone else's creations without fear of infringement. As a result, the fundamental worry is that a digital artist is unable to demonstrate complete ownership. Once the artwork is resold, the owner has no claim to credit or royalty[4].

By transforming their artwork into digital tokens, digital artists are finding solutions with blockchain. Artist can tokenize their artwork for adding it into block chain. This will help them to prove their absolute ownership. Every transaction involving their tokenized asset will be recorded in the blockchain. Hence the creator can decide to earn royalty, whenever the asset is traded.

Tokenising

Every token created over an asset will be unique. As a result, these tokens cannot be replaced. The word fungible is a synonym for replaceable. So, they are referred to as Non-Fungible Tokens (NFT). Ethereum is currently the most popular blockchain that runs NFTs. ERC721 is a standard for representing ownership of non-fungible tokens, that is, where each token is unique. An NFT can live in any of the block

chains like Ethereum, Solana, Binance, Polygon etc. People buy NFTs merely to appreciate the art, hence they can be considered collectibles. These collectibles may include photographs, videos, sounds, illustrations, 3D graphics, cards, stickers etc.

Another sort of NFT is usecase NFTs, which are NFTs with a specific use case connected to them. Which may constitute gaming, fashion, metverse event tickets, community platforms, virtual lands etc. These collectibles can even create an opportunity to make money from it. Hence NFTs are tradable asset class.

Conclusion

We should be interested in NFTs as : NFTs change the crypto paradigm by making each token one-of-a-kind and irreplaceable, making it impossible to compare two non-fungible tokens. They are digital representations of assets that have been compared to digital passports since each token has its own unique, non-transferable identity that allows it to be distinguished from others. Ownership information is also included in NFTs enabling easy identification and transfer between token holders. In NFTs, owners can additionally add metadata or attributes related to the asset.

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Perspectives of a Common Man/Engineer on the Prospects of Low Voltage DC Grid

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Abstract

Low Voltage DC (LVDC) grid is relatively a new term introduced in to Electrical Engineering. Governments across the globe are attempting standardization of LVDC grids for its proper operability and that includes Government of India as well. This article intends to summarize the prospects of an LVDC grid from a common man's perspective.

Index terms – Community grids, DC transformers, Home grid, Low Voltage DC (LVDC).

Introduction

It is quite normal for the society to expect that an electrical engineering graduate understands every nook and corner of their household wiring. Else, you should at least know the specifications of electricity that you are getting. This is not any surprise, since it is a scale available to the common man to measure the knowledge of an electrical engineer. So, to cover up my ignorance, let me start this article by mentioning the voltage standards of electric power supply in India: Single phase: 230 V, 50 Hz AC. Three phase: 400 V, 50 Hz AC.

The Indian standard for electric power supply is adopted from UK, since they were the first installers of electricity in India during their colonial occupation.

AC electric power distribution system was fortunate to be highly efficient in power transmission over long distances. Transformer, an equipment available for stepping up or stepping down AC voltages added to its advantage. Thus, AC was victorious in the legendary fight between Nicholas Tesla and Edison. As a result, generation, transmission and distribution of electrical energy has been done using AC for decades. Electric loads were also designed to match the power supply specifications. The complete system was stabilized and standardized with efforts from researchers all over the globe.

At this juncture, the area of power electronics started to flourish. Using power electronic converters, we were able to convert electric power from AC to DC and DC to AC. Also, it was possible to produce an AC voltage of varying magnitude and frequency. In short, power electronics could bridge the gap between supply side and load side specifications. Slowly, the nature of loads that require electric power became more and more electronic in nature ie. they need DC power supply of low voltage values for their operation. For example, LED lights, mobile chargers, laptop chargers, BLDC fans etc. AC dominated the generation and transmission sector for quite some duration, but changes are seen in this area too. Penetration of solar PV based power generation in the electricity grid changed the face of electric power supply system. Generation of electric power became distributed and de-regulated. A roof-top solar PV based generation is very common now a days. These facts paved the path for a different thought that led to the realization of Low Voltage DC systems (LVDC).

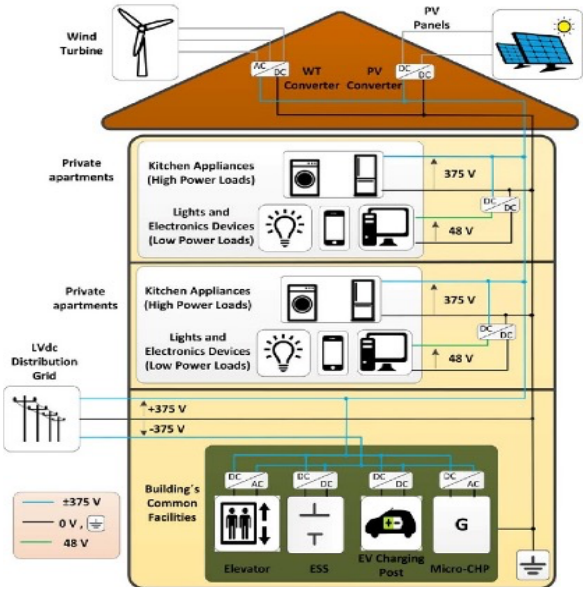

Figure 1: Schematic representation of LVDC. [1]

A grid connected roof-top solar PV based power generation system will pump electrical energy to utility grid which will be converted back to DC to feed DC loads. There arises the question that why can't we have a DC home grid supplying electric power from DC sources like solar PV, battery etc. to DC loads like LED lights, LED TVs etc. This was the beginning of LVDC.

Why Home DC grid is of Low Voltage?

For DC systems, voltage magnitudes less than 60 V is considered to be of low value. It has to be noted that for AC systems, voltage magnitudes up to 1000 V is considered to be low. The discrepancy in definition for low voltage for AC and DC systems can be attributed to the chances of accidental fatal electric shocks. AC voltage waveforms will have two zero crossings in every fundamental cycle and at those points, a person can be retrieved from electric shock, before it proving to be fatal. In the case of DC, we don't have a chance for protecting the effected person.

Also, DC voltage sources generates low voltages normally. For example, output voltage of a roof top solar PV based generation unit has a DC output voltage of magnitude ranging from 30 V to 50 V. Above all, the voltage magnitude demanded by DC loads are of low magnitude. In addition, the protection gear for DC voltages above 60 V (high voltage) is technically difficult to implement and therefore, is costly. Thus, it is advisable to have low voltage magnitudes for DC home distribution.

Problems of Low Voltage DC

With low voltages, as the rated load increases, current to be handled by the system increases and therefore thick bus bars become necessary. For example, if an LVDC system is to be designed for a load of 1 kW at 24 V, then the current magnitude is around 40 A assuming 100% system efficiency. In addition, the percentage voltage drop or voltage regulation due to the voltage drop in the distribution conductors is more in low voltage systems.

Considering the importance and problems associated with the LVDC systems, a proper standardization is essential which is based on the load connected to the system. Government of India has already initiated standardization of LVDC, but the results are yet to be published.

DC Transformers

The term transformer is normally associated to AC power systems. To define a transformer: A transformer is a static device used for changing the AC voltage levels in a power system. As per the working principle of transformer (Faradays principle of electromagnetic induction), it is not possible to design a DC transformer. This was in fact one of the primary reason why DC systems were not popular for power distribution. But, with advancements in technology, different power electronic converter topologies were invented that are capable of changing DC voltage levels. These converter topologies if used in a DC distribution system, are called DC transformers.

With the help of DC transformers, it is possible to switch the voltage magnitude to any desired levels (within practical limits). So, they can be used throughout the LVDC distribution network to match the DC load requirements. Thus, LVDC grid can be connected to AC grids via interfacing converters and thereby have a stable power support from the infinite AC grid.

Remarks

Presently, every building can act as a generating station and each consumer can be a producer of electric power. The generated power can be fed to the AC grid using suitable conversion strategies. Another possibility is to exchange DC power in a locality – named as DC community grid. But the whole system demands standardization of DC voltage levels. Multiple voltage magnitudes may exist within a DC grid to match different load requirement.

Different aspects have to be considered while making decisions on DC voltage levels.

- DC voltage level would depend on the power rating of the load connected.
- DC voltage level would depend on the distance over which the DC power has to be transmitted.
- Standards should impose restrictions on the maximum current handled by an LVDC system.
- Multiple transformations of DC voltage levels would demand large number of DC transformers which can affect the overall reliability and efficiency of the system.
- To reduce the effect of voltage drop, large buildings can employ power electronic converters as repeating stations for different zones/ rooms of the building.
- Proper design of voltage levels and repeating stations in an LVDC system can enhance the quality of electrical energy supplied to the loads.
- Bi-directional power flow capability can be imposed on critical power electronic converters in the system to make sure of reliable power supply through AC grid support in the absence of generation.
- Intelligent features and communication capabilities can be easily added on the system to ensure security, reliability and robustness of the system.

Conclusion

An LVDC grid architecture is a suitable way of electrical energy transmission over a short distance – inside a house or in a neighbourhood. Design of such a system is practically difficult to implement without proper standards, especially when AC grid support is needed. Protection level and drop in load voltage must also be considered while developing standards. This article discusses different possible aspects/suggestions to be considered while developing standards for an LVDC grid system.

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Strut and Tie Methods – an Overview

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Abstract

Strut and tie method is a tool developed for the analysis and design of reinforced concrete structures. It has evolved from conventional strut and tie method to various new methods by means of the adaptations like topology optimisation, material and structural nonlinearity, secant stiffness etc. These methods are more precise and effective than conventional strut and tie method. However, development of new simplified methods is required for encouraging the generous use of strut and tie method among engineers.

Index terms – Nonlinear, Secant Stiffness, Strut and Tie Method, Topology Optimisation.

Introduction

Analysis and design of disturbed regions (D regions, shown in Figure 1) in structure or structural elements were always a difficult task for the practising engineers and researchers. Analysis of shear is not yet fully researched and only empirical equations and design recommendations based on previous experiences are available in IS code [1] for the design of shear reinforcement. Strut and tie method initially suggested by Ritter and Mörsch [2,3] was based on the concept of considering cracked reinforced concrete beam as a truss consisting of inclined concrete struts and steel ties. Later, conventional STM was evolved through the works of various researchers [4-7].

The uncertainty in choosing the best model from various possible models for a particular structural element was the major drawback of conventional strut and tie method. The use of determinate and linear models was also another demerit of conventional strut and tie method. Hence, several researchers extended conventional strut and tie method to nonlinear strut and tie method, topology optimised strut and tie method, secant stiffness method, etc.

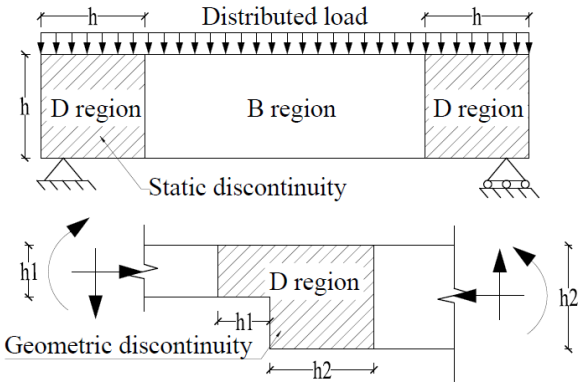

Figure 1: Examples of B and D regions

Conventional strut and tie method

Some of the classical works reported during 90's [4-7] established strut and tie method as an effective tool that can be used for the analysis and design of various reinforced concrete members like beam-column joint, deep beams, corbels, etc. In this conventional strut and tie method, elastic stress distribution or load path method was used to develop determinate models of structural elements. The uncertainty in choosing the best model from various possible models for a particular structural element was the one of the major limitation of strut and tie method. This led to the development of more precise and effective strut and tie methods.

Nonlinear strut and tie method

The use of indeterminate models and inelastic properties, led to the development of nonlinear strut and tie methods [8,9]. Yun [8] considered the nonlinear properties of both concrete and steel in the proposed nonlinear strut and tie method. Additional steel struts and concrete ties were considered along with conventional concrete struts and steel ties inside the model. The proposed method by Yun [8] was more effective and accurate in analysing and designing complicated reinforced concrete structures. To et al. [9] developed a special computer program based on finite element method which incorporated the nonlinear behaviour of both concrete and steel in structures. These nonlinear strut and tie methods were more precise and applicable in the case of complex structures. However, greater processing time and need of sophisticated softwares limited the application of these methods.

Topology optimised strut and tie method

Topology optimisation [10,11] was adopted to overcome the uncertainty in choosing the best model from various possible models for a particular structural element. In the method, a ground structure consisting of all the possible truss elements is generated and it is optimised to minimum volume to obtain the appropriate model for the structures (Figure 2).

Optimisation methods were accurate and applicable to complex structures but were complicated and time-consuming.

Secant stiffness based strut and tie method

In order to predict the inelastic behaviour of structures, Park et al. [12] suggested a strut and tie method based on secant stiffness. In this method, the

regions or elements in the structures which undergo inelastic deformation are allocated with secant stiffness and the rest are allocated with elastic stiffness. Linear analysis of models developed using this concept was able to predict the inelastic behaviour of different structures satisfactorily. However, choosing the best model for particular structure was cumbersome in this method also.

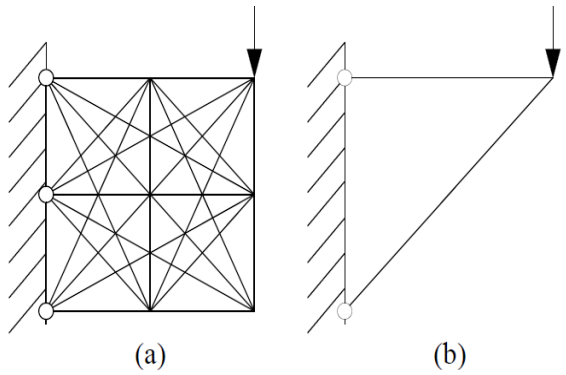

Figure 2: Topology optimisation (a) Ground structure (b) Final model

Conclusion

Strut and tie method was developed and evolved to solve the analysis and design problems of complex structures or structural elements. Adaptations of topology optimisation, material and structural nonlinearity, secant stiffness etc. developed the accuracy and scope of strut and tie method. However, the longer processing time and complexities are limiting the generous use of these methods among the engineers. Further research is required for developing more simplified and effective strut and tie methods.

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Strength of Cement Mortar Using Rice Husk Ash And Nano Silica

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Abstract

In recent years, efforts have been made to enhance the strength and durability of cement mortar by incorporating admixtures. Rice husk which is a by-product from rice mill process when fermented leads to methane production leading to global warming and faces disposal issues. So, this husk is converted into ash by firing process to produce rice husk ash (RHA). Since RHA possess cementitious property, it can be used as a replacement for cement and other engineering applications like water proofing, drainage pipe linings etc. Nano materials are observed to cause enhanced properties of concrete in many conditions and it is seen to provide extra dimension to interact with cement. Nano silica exhibits pozzolanic activity which leads to the formation of additional C-S-H gel by reacting with Calcium Hydroxide. Micro silica fills the voids between the cement particles improving the packing and reducing the porosity. In the project cement is replaced by 10% and 15% RHA along with 2.5% and 5% nano silica. The objective is to study the strength and durability of cement mortar when cement is replaced with rice husk ash and nano silica.

Index terms – Rice husk ash (RHA), Nano silica (NS), compressive strength, C-S-H gel formation.

Introduction

Nano materials has significant role in changing the properties of concrete at the ultrafine level due its micro size and large surface area. Since the pozzolanic reaction is directly proportional to the surface area, a faster reaction can obtained. The strength and permeability of concrete is improved by filling up the minute voids and pores in the microstructure with the micro replacement of the nanomaterials like nanoSiO2, nano- Al2O3 and nano-Fe203.

Some researchers have reported that the use of nanosilica in concrete mix was found to increase compressive strength development for mortars. The very small size of nanosilica providing a large surface area leads to the increase in the rate of cement hydration and pozzolanic reaction with calcium hydroxide crystals to produce C-S-H gel [1][2]. Studies have shown optimum strength can be achieved a with smaller dosages of the additive as it leads to agglomeration which is caused due to inability to disperse higher percentages of particles during the mix.

Rice Husk Ash (RHA) is an agro-industrial waste generated from rice milling industry. It is obtained by burning rice husk in the incinerator comprising of unburnt carbon. As the percentage of silica content is about 90% it can be used as a construction material. Several papers show that the addition of RHA in mortar can improve its compressive strength with optimum replacement below 20% of the weight of cement and also enhance its durability.

Methodology

Various mortar mixtures for compressive strength test specimens were designed and an adequate amount of water was added to cement binder to obtain the required consistency of mortar mix. The cementitious component comprising of PC with colloidal NS ranging from 0 to 5% and RHA ranging from 0 to 20% are the optimum dosages mentioned by the researchers.

The mixes were as follows 10% RHA , 15% RHA, 10% RHA and 2.5% NS ;and 10% RHA and 5% NS. Using the electric mortar mixture, the procedure in ASTM C305 was followed.Mix the cement, fine aggregate and sawdust on a water tight none-absorbent platform until the mixture is thoroughly blended and is of uniform color. Add the nano silic and mix until it is uniformly distributed throughout the batch [3][4]. Add water and mix it until the mortar appears to be homogeneous and of the desired consistency. Mortar cubes of 50mm size wete caste.

Compressive strength

Compressive strength test was done for 3, 7 and 28 days and the combination which gave maximum strength was found out [5][6]. Apply the load gradually without shock and continuously till the specimen fails. Record the maximum load and note any unusual features in the type of failure.

Results and Discussions

From the test results for compressive strength, RHA10 is taken as having maximum strength and this is kept as control specimen for the combined RHA+NS mix. It is observed that RHA10 has 2.5% and 3.6% higher compressive strength than RHA15 at 3 days and 7 days respectively. Also nano silica 2.5% and 5% mixed with RHA10 showed much greater values for compressive strength than the control specimen. We see that among all the mix nano silica with 5% mixed with RHA10 showed maximum compressive strength values.

The strength and permeability of concrete is improved by filling up the minute voids and pores in the microstructure with the micro replacement of the nanomaterials like nanoSiO2.The very small size of

nanosilica providing a large surface area leads to the increase in the rate of cement hydration and pozzolanic reaction with calcium hydroxide crystals to produce C-S-H gel. Smaller dosages of the additive as it leads to agglomeration which is caused due to inability to disperse higher percentages of particles during the mix.

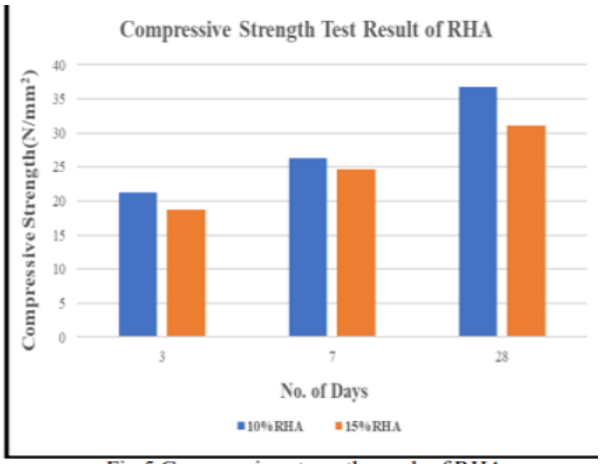

Figure 1: Compressive strength graph of RHA

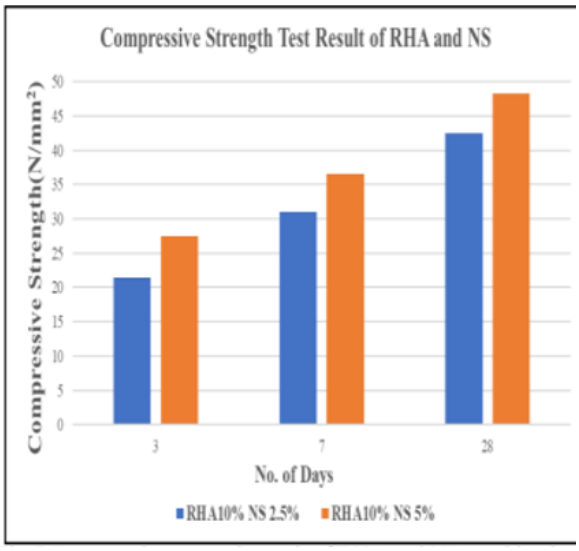

Figure 2: Compressive strength graph of RHA and NS combined mix

Conclusion

According to test results, Nano silica with 5% mixed with RHA10 showed maximum compressive strength values. The strength and permeability of concrete is improved by filling up the minute voids and pores in the microstructure with the micro replacement of the nanomaterials like nano-SiO2. The very small size of nanosilica providing a large surface area leads to the increase in the rate of cement hydration and pozzolanic reaction with calcium hydroxide crystals to produce C- S-H gel. Smaller dosages of the additive as it leads to agglomeration which is caused due to inability to disperse higher percentages of particles during the mix.

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5G – The Aviation Scenarios

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Abstract

The field of aviation has put forth many novel application areas for the 5th generation of mobile networks. The major requirement for aviation includes the exchange of data or information among the pilots and controllers. 5G, being the next generation communication platform, provides a great amount of improvement in terms of the speed, coverage, latency as well as the quality of communication. But along with the benefits, there are certain challenges or concerns being caused by 5G communication – a major concern being raised in the field of avionics.

Index terms – 5G, Avionics

Introduction

The demand for data has been showing an exponential growth and this is likely to show an even higher boost with the advent of 5G applications. 5G, being the next generation communication platform, provides high flexibility in various different ways [1]. The key objectives being aimed by the 5th generation communication systems include decreased latency, increased capacity, higher quality of service and better data rate[2].

With a highly improved mobile connectivity, supported by new types of mobile devices and a surge in the mobile applications, the network data traffic has been growing exponentially. The future may be imagined as a networked society with unbounded access to information and sharing of data which is accessible everywhere and every time for everyone and everything. The present generation communication standards will be incorporating better and advanced technology components for meeting the future needs [2]. But still there would definitely be scenarios that cannot be addressed properly or adequately by them. Hence the Fifth-generation network is being looked upon as the next-generation platform for communication.

The ever-growing demand for mobility and for data, speed and coverage has led to the development of 5G communication. In spite of the benefits offered by 5G, there are many challenges to be faced as well. The deployment of advanced wireless technologies is associated with high energy consumption and might in turn pose serious threat to the environment. Apart from these challenges, another major issue foreseen is the threat posed by 5G communication network in the field of Avionics.

5G and Avionics

Within the past decade, the number of passengers transported and the flight traffic worldwide has been increasing significantly every year for the past couple of decades. Mobile users seek undisturbed broadband connectivity even during a flight above the clouds. As there is a huge number of passengers expected to be connected to the internet, the speed, robustness and capacity of the network should be high enough to provide a seamless network connectivity. This is one of the major attractions of the 5G communication system.

The 5G communication network is typically assigned the C-band frequency which hovers around 4 GHz range. The frequencies that the aeroplanes use for communication with the air traffic controllers fall above the 4 GHz mark and the frequencies below it are the frequencies that have been opened up for use by the wireless network operators to meet the growing bandwidth demands of the 5G networks. The greatest challenge currently is that, these frequency ranges are too close that they may interfere with each other.

The Federal Aviation Administration (FAA) has currently raised concerns over the interference that might possibly happen between the radio altimeter signals of the aircraft with the 5G band frequencies, which could pose serious threat to the aircrafts concerned. The radio altimeters help the aircrafts to determine how far above the ground the aircraft is by bouncing a signal off the ground below and timing how long it takes it to return to the plane. Such information is highly crucial when the plane is taking off or landing, especially when the visibility is poor or at night, in fog or rain etc. Hence anything that messes with the radio altimeter signals could affect the data and return incorrect altitude measurements or worse, have their signals blocked entirely. The concern is that the radios being used with the altimeters may not be able to properly filter out signals lapping over from another part of the spectrum. So, it is very important that the 5G communication networks do not operate in the same bandwidth as that of the frequencies used for aviation purposes[3].

Currently this issue has been reported uniquely for the United States. Around a couple of hundred flights were cancelled during the first day of C-band signal operation. Currently there are many other countries which have operating 5G networks with no effect on aircraft altimeters at all[3]. This is because for various purposes, the radio spectrum has been allocated in different ways in different countries [4].

Possible Solution

The safety of the aircrafts requires the mitigation of even the potential or possibility of any such interferences. A possible solution may be to restrict the C-band frequency usage around the airports so that the interferences during take offs and landings may be avoided. The 5G technology has been built to exacting standards, whereas there have been no common altimeter standards to measure against. An adequate product that designed in the earlier era might require a redesign. The devices were built according to the scenarios that existed at the time of product design. As the technologies change, the assumptions that previously governed the spectrum-based environment would also change. There could also be large variation in the radio altimeter receiver performance between different manufacturers. Some altimeters were equipped with radio receivers with good filters to provide protection against spurious emissions, while others allowed signals from outside their operation band to intrude and result in erratic results [5].

Conclusion

Studies are being conducted to understand the problem in depth and the solution to be obtained as well. Some of the studies consider the concerns raised by the FAA to be extreme, thus leading to extreme conclusions. Under any circumstance, the safety of the passengers should be safeguarded and currently the FAA has created a guard band between the avionics spectrum and the 5G spectrum, in which the 5G communication has been forbidden. Nevertheless, the long-term solution for the issue would be to develop standards, equipment and aircraft integration solutions.

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