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Some Studies Verify the Applicability of the Free Vibration Method of Crack Detection in Composite Beams for Different Crack Geometries

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Abstract: - Defect detection and classification are important issues as they cause structures to catastrophic failure. Many flaws have already been addressed, but non-destructive testing techniques for composite materials have been widely used. However, the impact of arbitrary and unpredictable flaw geometry on these approaches' applicability has yet to be observed. This paper considers the cases of a previously published article, i.e., pultrusion-produced orthotropic (GFRP) cracked cantilever beam, to determine the crack location and depth. In contrast to the well-known V-shaped crack, a new fracture model (a combination of rectangular and V-shaped) is presented due to its practical importance. Using ANSYS software, FEA simulations were carried out on the new and V-shaped crack models for the natural frequencies. The maximum percentage error for the natural frequency between new and V-shaped crack models for the same configurations was only up to 1.815. Then, the ANN model was trained using the natural frequencies dataset of V-shaped cracked cases only. Afterward, the ANN model was used for predicting the crack locations and crack depths in beams, i.e., V-shaped cracked beams and a combination of rectangular and V-shaped (new crack model) cracked beams. The ANN model gave good results for predicting the crack locations and depths in composite cantilever beams irrespective of the crack geometries. Hence, it is clear that even though the ANN model was trained using the dataset of V-shaped cracked cases, it accurately predicts the crack locations and depth in the beams, which have had new geometry.

Keywords: - ANN, Hidden layer, Natural frequency, FEA, Crack depth, and Crack location.

1. INTRODUCTION

In the civil, automotive, and aerospace industries, composites are used in various structural applications. Beams are a typical example of how composites are used in structures. A composite beam can be destroyed by cracks that grow over time. The focus of recent research is the identification or diagnosis of the emergence of faults in composites under free vibration loading. A new technique for numerically simulating the free vibration of a cantilever composite beam with several open, non-propagating cracks was

Free Vibration-Based Delamination Detection in Fiber Metal Laminates Composite Beam

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Delamination is a typical flaw in fiber-metal laminated composite structures that, when hidden from view, can significantly lower structural stiffness and alter a structure's ability to respond dynamically to forces like natural frequencies. Delamination is undoubtedly an important topic as it causes the performance of the Fiber Metal Laminate structures in the service to worsen. Delamination detection and severity analysis are essential in the aerospace industry for both safety and cost reasons. Although natural frequencies do not directly reveal the location or extent of damage, they are the most dependable metrics for damage detection. Frequency shifts in various modes are used to solve the inverse problem to pinpoint the damage location and extent. The bending natural frequencies shift brought on by delamination is utilized as an input to predict the delamination parameters. This study used an approach based on machine learning and a regression model to find the delamination parameters, i.e., locations and severity, in fiber metal laminated cantilever beams. FEA simulations using ANSYS were used to get the dataset pertaining to the position, severity, and eigen values (or bending natural frequencies) of the delamination. The results of this study indicate that the delamination locations and severity predictions developed using machine learning and regression models are reasonably accurate and demonstrate good agreement with the observed data.

1. INTRODUCTION

The use of composite material in the civil, naval, automobile, and aerospace industries is increasing due to its special characteristics, i.e., high strength with minimum weight, high specific strength, fatigue strength, and higher damage tolerance capability. Drilling operations[1,2] on composite laminates (FMLs, CFRPs, and GFRP) are necessary for fastening with different materials to have valued outcomes. Always, the quality of drilling determines the efficiency of fastening. It is expected to make error-free, precise holes in order to obtain high joint strength while assembling materials using riveting. However, the characteristics of the materials that make up composite laminates provide challenges during machining. Numerous unfavorable effects, i.e., pulling of fibers and delamination, are produced because of drilling operations. Additionally, it leads to reducing the materials fatigue strength. Figure 1 depicts the delamination of composite materials brought on by drilling operations. There is a significant difference between the drilling of conventional materials and composite materials. Drilling composite laminates is known to cause serious damage to the laminates, known as delamination. Delamination in the composite materials occurs during drilling operations because, during that time, thrust force and torque are produced and act on the materials. It is considered one of the major modes of failure. The strength and stiffness of the composites are decreased by delamination. The dynamic response, or natural frequencies, changes as a result of the composites' altered stiffness. Fiber Metal Laminates (FMLs) were the subject of a vibration investigation by Merzuki et al.[3] They discovered through their research that natural frequencies rise along with lamina thickness. In fiber-metal laminates,[4–9] alternative layers such as metal alloys and fiber-reinforced polymer composites are included. An aluminum alloy layer gives high impact strength to the composite materials. The relationship between delamination and the stacking sequence for composite materials is clearly explained by Long et al.[10] Along with discussing how well delamination modelling works, they validated the damage model.

To examine how delamination influences the eigen values (fundamental frequencies) and eigen vectors (mode shapes) of the dynamic response, Kim et al.[11] developed a method for dynamic analysis. The derived model's generated natural frequencies, however, show strong agreement with both higher-order theoretical predictions and experimental results. Huang et al.[12] investigated the GLARE-related characteristics of delamination extension and fatigue crack propagation under single overloads. To assess the behavior of fatigue crack propagation and delamination extension, the applied loading variables were examined. The delamination resistance of laminated glass was tested by Dural and Oyar[13] under varied boundary conditions. De-Vries, et al.,[14] conducted an experimental programme to evaluate different splicing geometry and the thicknesses of the metal layer for delamination behavior. Given the scatter in the results discussed in this article, it is imperative to design the yield function using an appropriate test approach first. The squared weighted deviation between the observed mode form of a composite plate with delamination and is used to create a weighted eigen vector damage index.[15] It is investigated whether delamination can be detected using a vibration

Vibration Based Delamination Detection in Fiber Metal Laminates Composite Beam

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Abstract: - Delamination is typical damage in the Fiber Metal Laminate composite structures, usually hidden from the outer side that can reduce the structural stiffness. The delamination is undoubtedly an important topic as it causes to worsen the performance of the Fiber metal laminates (FMLs)structures in the service. The detection and severity analysis of delamination in a field like the aviation industry is vital for safety and economic considerations. The existence of delamination varies the vibration characteristics, such as natural frequencies, mode shapes, etc., of composites. Hence, this indication can be effectively used to locate and quantify the delamination. The changes in vibration characteristics are inputs for the inverse problem to determine the location and size of delamination. This paper used a machine-learning and regression model to determine the locations and severity of the delamination in the Fiber Metal laminate cantilever beams. The dataset related to delamination location, severity, and bending natural frequencies was obtained using the Finite Element Analysis. From this study, it is found that, the machine learning and regression model results related to predictions of delamination locations and severity are close to each other and give good agreement with actual delamination locations and delamination areas.

Keywords: - Natural frequency, Delamination, ANN, Regression, MATLAB, and ANSYS.

1. INTRODUCTION

The use of composite material in aerospace, naval, civil, and automobile industries is increasing due to its unique characteristics such as high strength-to-weight ratio, high specific strength, fatigue strength, and higher damage tolerance capability. Drilling operations [1, 2] on composite laminates Fiber metal laminates, Carbon fiber reinforced polymers (CFRPs), Glass fiber reinforced polymers (GFRPs) are necessary for fastening with different materials to have valued outcomes. Always, the quality of drilling determines the efficiency of fastening. It is expected to make error-free, precise holes in order to obtain high joint strength while assembling materials using riveting. However, the characteristics of the materials that make up composite laminates provide challenges during machining. Numerous unfavourable effects, i.e., pulling of fibers, delaminations, produces because of drilling operations. And it leads to reduce the materials fatigue strength. Figure 1 depicts the delamination of composite materials brought on by drilling operations. There is a significant difference between the drilling of conventional materials and composite materials. Drilling composite laminates is known to cause serious damage to the laminates, known as delamination. Delamination in the composite materials occurs during drilling operations because, during that time, thrust force and torque are produced and act on the materials. And it is considered one of the major modes of failure. The strength and stiffness of the composites are decreased by delamination. The dynamic response, or natural frequencies, changes as a result of the composites' altered stiffness. FMLs were the subject of a vibration investigation by Merzuki et al [3] (fiber metal laminates). They discovered through their research that natural frequencies rise along with lamina

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ORIGINAL PAPER

Bending Natural Frequency Analysis on the FML Plates Made up of Different Nano Fillers Using Experimental and Numerical Means

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Abstract

Purpose Fiber Metal Laminates (FML) are cutting-edge materials that combine the strength of fibers with the versatility of metals. This study prepared FML plates with different compositions, including glass fiber, epoxy resin, multi-walled carbon nano tubes (MWCNT), Layered double hydroxide (LDH), and nano clay. These materials are increasingly used in the aircraft industry for their high performance. Our research, which includes free vibration analysis, is crucial for the design process of such structures, offering practical insights for engineers and researchers in the field.

Methods The bending natural frequencies for the free-free, cantilevered, and clamp-clamped boundary conditions of the FML plates were ascertained using experimental and numerical analysis. The experimental and numerical analysis vibration analysis of FML plates was carried out using the Fast Fourier Transform (FFT) analyzer and Finite Element Analysis software, i.e., ANSYS, respectively.

Results In this study, the bending natural frequencies for the free-free, cantilevered, and clamp-clamped boundary conditions were investigated experimentally and numerically. Firstly, numerical results were obtained using Finite Element Analysis software, and then these results were compared with the experimental results. The bending natural frequencies predicted by means of the experimental and numerical analysis were observed to be in good agreement.

Conclusion It was identified that the natural frequency of the FML composite plates increased with the inclusion of nano-fillers, according to the results of both the experimental and numerical investigations. It was discovered that the clamped-clamped boundary condition specimens have a greater natural frequency than the cantilevered boundary condition specimens for similar setups. It was also discovered that the free-free boundary condition specimens behaved as rigid bodies up to the first six modes.

Keywords Fiber metal laminates · Finite element analysis · Multi-walled carbon nano tube · Fast Fourier Transform · Natural frequency

Introduction

Laminated composites, a sophisticated family of materials, are created by mixing one or more components with various physical and chemical properties. Each layer's material properties are preserved with various orientations, allowing for tailorability. On the other hand, the fiber-metal-laminated (FML) composites are made up of alternate layers of metal with layers of fiber-reinforced polymer (FRP). They offer superior mechanical properties compared to conventional high-strength unified metals and polymer composite laminates. Both metals and fiber laminates are used to their fullest potential in this. The most notable benefits of FMLs over metals are their higher specific strengths, stiffness and better fatigue characteristics. Fiber metal laminates (FMLs)

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ORIGINAL ARTICLE

Thermal evaluation of aluminum welding: a comparative study of friction stir welding (FSW), plasma-fsw, and tungsten inert gas (TIG)-FSW techniques

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Abstract

This research work presents the comparative analysis of heat input during aluminum welding focusing on FSW, Plasma-FSW, and TIG–FSW. This study aims to investigate their thermal behavior and temperature distributions during aluminum welding. With a specific emphasis on their thermal histories, peak temperatures, and simulated weld zones, the study elucidates the impact of auxiliary heat sources on heat input and material flow. A comparison of the heat input, heat dissipation, and heat output of these three welding techniques is necessary for analyzing their weld characteristics. In this research work, ABAQUS software was utilized to develop a computational model and numerical simulation for analyses the thermal aspect of each welding technique. Welding parameters such as heat generation by tool, preheating by auxiliary heat source (electric arc at 45 amp) and welding speed (63 mm/min) are considered to understand heat distribution within the weld zone are evaluated and compared to justify the improvement and development of FSW technique of discrete artefacts. The influence of auxiliary heat source by Plasma arc and TIG arc show improvement in thermal behavior of welding such as peak temperature achieved percentages between 50 and 55% of melting temperature of base metal as compare to FSW (44.4%), indicating enhanced plasticization due to the additional heat provided by preheating sources. However, plasma-FSW achieved higher peak temperature due to stable, higher arc efficiency and high-energy nature of plasma arc preheating which create improved preheating zone with higher temperature. Therefore, the auxiliary source preheating proved crucial for adjusting the characteristics of the plasticized material and regulating the heat input before the FSW process. These results open up new avenues for research in hybrid FSW and encourage efficiency and creativity in welding technology for a variety of industrial applications. They also offer insightful information on how variations in heat input impact thermal behaviour and weld characteristics.

Keywords Comparative analysis · Thermal analysis · Aluminum welding · Friction stir welding (FSW) · Plasma-FSW · TIG–FSW · Hybrid friction stir welding

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RESEARCH PAPER

Comparative Study of Mechanical Properties of Multiwall Carbon Nanotubes and Functionalized Multiwall Carbon Nanotubes/Poly Aryl Ether Ketone Nanocomposites

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Abstract: *The present study deals with the effect of Multiwall Carbon Nanotube (MWCNT) and its functionalized (carboxyl and amine) MWCNT on the mechanical properties of Poly Aryl Ether Ketone (PAEK) polymer composites. The incorporation of nanomaterials into polymer matrices has garnered considerable attention due to the potential for enhancing material performance. The existing literature lacks in providing a thorough understanding of the intricate impacts of MWCNTs on PAEK composites, motivating the need for this research.*
The study examines the varied concentrations of MWCNT and functionalized (carboxyl and amine) MWCNT as 0.25, 0.5 and 0.75 weight percentages. These composites were prepared using a twin-screw extruder via the melt compounding method. The specimens were meticulously prepared through injection molding, adhering to American Society for Testing and Materials (ASTM) standards. Samples were assessed for tensile strength, impact strength, flexural strength, heat deflection temperature, hardness, and density. The key findings reveal a significant and gradual improvement in tensile strength, impact strength, flexural strength, and heat deflection temperature up to a 0.5% filler loading, followed by a reduction at higher concentrations of filler in PAEK matrices. Remarkably, the most notable improvements are observed with amine functionalized MWCNT. These findings highlight the potential of functionalized MWCNTs in enhancing the mechanical properties of PAEK polymer composites. The implications of this study offer valuable insights for material scientists, engineers, and industries aiming to enhance the performance of PAEK-based materials. The identified results provide advanced polymer composites for specific applications.

Keywords: *Poly Aryl Ether Ketone, Multiwalled Carbon Nanotube, Functionalized Multiwalled Carbon Nanotube, Nanocomposites, Fourier transform infrared spectroscopy.*

1. INTRODUCTION

PAEK-based polymer composite materials (PCMs) have gained the attention by many researchers due to their various unique properties like lightweight, corrosion resistance, chemical resistance, etc. The PAEK-based polymer composites are very useful for industrial and automotive applications to manufacture gears, bearings, seals etc.
The molecular chain-ring structure containing ether and ketone in the PAEK chain, coupled with its semi-crystalline thermoplastic nature, confers chemical inertness, biocompatibility, and thermal stability [1, 2]. When compared, the well-known high-performance polymer Poly Ether Ether Ketone (PEEK) exhibits higher structural strength and stiffness. Meanwhile, PAEK is acknowledged for its superior mechanical properties than PEEK. The use of PAEK in additive manufacturing facilitates the development of products with intricate customized structures and functionalities [3]. Low wear resistance and higher thermal expansion of PAEK prevent its application in various demanding areas like subsea connectors, bio-implants and high-performance composites.
Increases in hardness, impact strength and storage modulus have been reported with the addition of boron carbide and multiwalled carbon nanotube in PAEK [4, 5]. A polymer composite was formed through the combination of PAEK with glass fiber as a reinforcement and graphite as a lubricant. The investigation revealed that the composites with the small particle size exhibited superior properties [6]. The incorporation of hexagonal boron nitride (hBN) and thermo-graphite in polyether ketone (PEK) and PAEK has shown noteworthy enhancement in their tribological properties [7–9]. The synergistic effect of these additives has contributed to the formulation of composite materials that exhibit superior and more desirable characteristics in frictional behavior and wear resistance properties. Mica is a naturally occurring mineral with inherent

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Research Article

Study on performance of multiwall carbon nanotubes and functionalized multiwall carbon nanotubes/ poly aryl ether ketone polymer composite gears

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Poly aryl ether ketone;
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Abstract

This study investigates the thermal and wears resistance performance of polymer gears made of pristine poly aryl ether ketone (PAEK) and PAEK polymer matrix incorporating both pristine multi walled carbon nanotube (MWCNT) and functionalized MWCNT polymer composites under different operating conditions. The investigation involves the thermal behavior, wear performance and surface roughness of gears at different torques (0 Nm, 6 Nm, 8 Nm, and 10 Nm) and at rotational speeds such as 1000 rpm and 1500 rpm. The polymer composite materials are prepared by using a twin-screw extruder and the gears of these materials are manufactured by using an injection molding machine. The gears are examined using a gear test rig. The surface temperature, specific wear rate and surface roughness are the parameters that are measured at different torques and rotational speeds using a gear test rig, before and after the running operations of these gears. The gears made of PAEK and amine functionalized MWCNT composite materials exhibits improved performance in terms of wear resistance and thermal behavior.

1. Introduction

Gears are the major element in various mechanical systems used for power transmission. The transformation of power and motion using gears is better than other transmission systems such as belt, rope and chain drive due to less slippage between two mating gears [1]. The polymer gears have gained significant attention due to unique set of inherent properties such as light weight, low noise, and self-lubrication, ability to resist shock and impact load, ease of manufacturing [2]. These properties have driven polymer gears adoption for metal gears replacement in industrial applications such as automotive, aerospace, textile, robotics, industrial machinery, and consumer products.eg. Lightweight gearboxes [3]. The load, temperature, surface roughness, wear and rotational speed are the major analyzing parameters to investigate the performance of polymer gears [4][5]. The teeth of polymer gears experience fatigue loads while operating conditions. It produces heat internally and, on the surface, due to contact stress when the gear pairs are in motion under loading conditions [6].

Several studies have indicated that polymer composite gears showed improved results than pristine polymer gears in terms of overall performance improvement [7-9]. In recent

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REVIEW

A review on current scenario of energy, nuclear reactor technology and cold trap

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Abstract

The present study explores the status of nuclear energy developments for generation of electric power. Notably, India's pivotal role in advancing nuclear technology is highlighted, particularly with the development of a cutting-edge nuclear Fast Breeder Reactor (FBR) technology-based power plant. India has been developing the latest nuclear Fast Breeder Reactor (FBR) technology-based power plant having power generation capacity 10 times higher than the existing nuclear power plants. The review incorporates the most important component of the FBR system i.e. cold trap. Model Sodium Cold Trap (MSCT) is used by India to demonstrate the regeneration of secondary sodium cold trap.The development, advancements and challenges towards the Model Sodium Cold Trap (MSCT) are discussed in detail. It is possible to increase the maximum in-situ regeneration of MSCT up to 82%. This paper also reviews status of energy production using renewable and non-renewable energy sources. Finally, the scope in the advancements of nuclear reactor technology and related future opportunities has also been included.

Keywords Energy · Nuclear technology · Fast breeder reactor · Cold trap · Regeneration

Introduction

Energy is one of the wheels of the development and necessary for growth of the country. After basic needs of a human being, the next priority of every country for the electricity, and transportation network which again add up as a requirement of energy. Presently, developed countries are careful about the environmental pollution caused by the power generation plants. Hence, two historically relevant agreements were adopted by the United Nations in 2015: the Paris Agreement and the Sustainable Development Agenda 2030 (Kale and Rajan 2004; Ahmad and Ramana 2014). Governments have agreed on a long-term objective to limit the global average temperature increase to well below 2 °C above pre-industrial levels (Kale and Rajan 2004; Boran and Fischer 2015). This agreement also focus to limit the emissions of global greenhouse gas (GHG) to plateau with immediate effect, acknowledging that it may take longer period for developed countries to do so. Moreover, in its latest goals of Sustainable Development, the United Nations has included energy for the first time, calling for an accelerated pace of the deployment of renewable energy (RE). The rapid transformation of the global energy system will rely on 2/3 of global GHG emissions from energy production and use. Economies around the world have been facing the daunting task to tackle climate change and at the same time maintaining their people's social and economic growth (Kumar et al. 2020; Chetal et al. 2011). In this context, it is the prerogative of the Group of Twenty (G20), which is a crucial forum for global economic governance, to set the framework for a global transition tool. It covers the world's largest twenty economies (i.e., Germany, Argentina, Australia, the Republic of Korea, Brazil, Canada, South Africa, China, the European Union (EU), Saudi Arabia, France, Germany, Turkey, India, Indonesia, the United States (USA), Italy, Mexico, the United Kingdom (UK), and Russia (Ram et al. 2018). Member countries contribute to the world's 86% of gross domestic product (GDP), have more than 3/4 of global energy demand and also contribute in 84% of global energy GHG emissions, as shown in Fig. 1 (Ram 2019). Given the sheer weight of the G20 nations

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REVIEW ARTICLE

WILEY

Cavitation assisted intensification of biogas production: A review

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Abstract

Intensified cavitation-assisted biogas production from sustainable feedstock has been discussed describing the working principles and governing mechanisms for intensification. Various methods of biogas production discussed in the work include activated sludge processes, membrane bioreactor (MBR), and processes involving methanogenic and sulfate-reducing microorganisms. Design aspects of cavitational reactors (sonochemical and hydrodynamic cavitation) have been presented with detailed understanding into effect of several operational parameters, such as the biomass-to-water ratio, operating pressure, treatment duration, operating temperature, power dissipation, and so on. Selection of optimum parameters is crucial to improve the performance and observed intensification from such processes. The possible benefits in terms of applicability to various types of biomass, efficiency, higher yields, and energy-saving as compared to the conventional production processes have been demonstrated. Overall, cavitation-assisted techniques are very effective in increasing biogas production and have significant potential for commercial applications, which would result in significant cost savings.

KEYWORDS
biogas production, cavitation, design aspects, pretreatment method, process intensification, operating parameters

1 | INTRODUCTION

In recent years, the energy requirement all over the world is tremendously increasing due to an increase in demand at industrial level as well as by increasing population day by day. The problem is compounded by problems with fossil sources of energy both in terms of reduction in available sources and pollution issues. Interest into renewable energy sources to supply energy requirements is hence increasing both at research level and commercial level. Carbon dioxide (CO_2) sequestration via biogas upgrading (BU) is one of the lucrative options (Sravan et al., 2021). Anaerobic digestion or carbon-based waste fermentation technologies are generally used to produce biogas but there are some limitations in terms of deactivation of the catalyst, biogas purification, and H_2S removal in order to have more potential (Kumar et al., 2021; Ohnmacht et al., 2021). Different types of microorganisms are used in the biogas digester to produce a mixture of gases from biomass. It is necessary to upgrade the biogas to biomethane for the effective and efficient use of biogas for several applications (Shetty et al., 2020). Anaerobic digestion may create biogas from low-cost substrates, making it an environmentally beneficial and sustainable energy source. The concept of biorefinery is also targeting the utilization of chemicals, biofuels, energy, and heat derived from plant-based basic materials (Paul et al., 2020). Biogas offers a clean and sustainable energy source that could replace fossil fuel-based sources including coal, oil, and natural gas (Kannah et al., 2017). Municipal and industrial waste, animal waste, and agricultural leftovers are all examples of biodegradable organic materials that may be digested anaerobically to create biogas. As its methane percentage increases from 40% to 70%,

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A review on flow and segregation of granular materials during heap formation

A review on flow and segregation of granular materials during heap formation

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Abstract. Segregation is an important process mainly used in industries during the flow of granular materials. A granular medium is repeatedly collected particles that have different properties like size, shape, and density. Heap formation in the industry occurs if particles with various sizes, forms, material densities or surface properties are made of bulk materials, then they spatially separate during formation of the heap. This paper provides a detailed understanding of segregation dynamics in granular flows within industrial processes. Focusing on the intricate interplay of particle characteristics, mixing phenomena, and heap formation methodology, the review delves into the essential aspects influencing the spatial separation of particles. Granular media, comprising particles with distinct properties such as size, shape, and density, undergo segregation during the flow processes commonly employed in industries. The formation of heaps becomes a consequential outcome when bulk materials consist of particles exhibiting variations in size, shape, material density, or surface properties. The comprehensive analysis within this review encompasses detailed insights into granular material flow, the intricacies of mixing, the mechanisms of segregation, and the profound effects of particle characteristics on these processes. Additionally, the paper scrutinizes various methodologies employed in industrial settings for heap formation, providing a holistic perspective on the key factors influencing segregation dynamics in granular flows. This review aims to contribute valuable insights to researchers, engineers, and practitioners involved in the optimization and control of granular material handling within diverse industrial applications.

Keywords: Granular Materials, Heap flow, Chute flow, Segregation.

1. Introduction

Granular materials are a series of solid materials in the size range of a few mm to a few cm. It is the second most handled substance after water [1] and is found everywhere in existence. Granular products are commonly used in everyday life for salt, sugar, coffee and rice and for sand, stone, coal, powders, fertilizers and prescription tablets. They consist of different components, from one μm to one kilometer (theoretically) and have different forms. Here, the mentioned size spectrum is of particular concern to us as most of the products used in this sector are within this range. Granular structures have very different characteristics than constituent particles [2]. They focus primarily on the composition, and forces between the particles of interstitial fluid (air, water, etc.). Van der Waals, contact, frictional and capillary forces are essential forces in the presentation of such interstitial fluids [3]. We refer to it as dry granular material, where the impact of the interstitial fluid is ignored. The method would otherwise be more complicated.

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RESEARCH

Clogging reduction by addition of small particles of various material densities

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Abstract
We present an experimental investigation on the flow and clogging of bi-disperse mixtures of coarse and fine grains of different densities passing through small orifices. We vary the density ratio (coarse/fine) from 1.87 down to 0.79 by using amaranth seeds, glass and ceramic beads of similar size as the fine species in combination with 2.0 mm glass beads as the coarse grains. We analyzed the effect of the density ratio on the effective flow rate of the coarse species, the segregation during flow and the clogging for a range of orifice diameters. As in previous studies, the flow of the coarse grains is facilitated by the fine species, which prevents clogging. We show that the effective flow rate of the coarse species is virtually independent of the density ratio. These results suggest that in practical applications with the goal of clogging reduction, the density of the fine species used to ease the flow is not a relevant parameter and can be selected based on practical or economic constraints.

Keywords Clogging · Granular mixtures · Silos · Granular flow · Density ratio

1 Introduction

Granular materials, which are composed of discrete solid particles, exhibit complex behaviors when they are stored or transported in confined spaces like silos. Numerous industrial processes frequently include the discharge of granular materials by gravity from hoppers or silos [1–4]. The flow and clogging behavior of granular mixtures in three-dimensional silos is a subject of great interest in mining, agriculture, and pharmaceuticals. Most studies consider mixtures of particles of different sizes but same material density [5–9]. Understanding the effect of mixed material densities on the flow and clogging of granular mixtures is also important for optimizing storage and handling processes, preventing blockages, and ensuring efficient material flow.

Finding methods to prevent blockages and improve the flow of granular materials through narrow passages is a fundamental scientific challenge with significant applications in both industry and the management of crowds in large-scale facilities. The notable similarities identified in the clogging dynamics across various systems indicate numerous potential applications [10]. Over the years, researchers have explored diverse mechanisms to address the clogging issues in granular flows. For example, the container can be agitated to create vibrations that break blocking arches [11–14]; or the particles can be made to repel each other to reduce friction by using magnetic fields [15–17]. Other methods, such as inducing oscillation in the exit [18] and introducing an obstacle in front of the exit [19, 20], have also been examined in the past. Addition of fine particles to coarse materials to reduce the clogging and enhance the flow of the coarse species is another mechanism studied by Madrid et al. [21] for a system of vibrated grains and in our recent work [22] for non-vibrated 3D silos. Madrid et al. [21] have employed Discrete Element Method (DEM) simulations to investigate the flow and clogging of circular grains in a 2D vibrating silo. They have shown that incorporating smaller grains as additives significantly enhanced the overall flow of the original species. Furthermore, they have determined an optimal radius for the additive particles that maximizes this positive effect. This finding suggests potential applications in granular systems and also in scenarios involving active matter, such as pedestrian evacuation.

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Enhancing Cyclone Intensity Prediction through Deep Learning Analysis of Imagery Datasets

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Abstract. Cyclones are a natural disaster that can inflict extensive damage and death. Early forecasting of cyclone intensity can aid in minimizing the effects of such natural disasters. Deep learning has emerged as a viable approach for image processing and analysis in recent years. A deep learning-based approach for estimating cyclone strength using images datasets is proposed in this paper. The proposed method extracts significant information from satellite data and predicts cyclone intensity using a convolutional neural network (CNN). Following that, the model is trained on a huge historical dataset of cyclones and verified on new cyclone data. Data from the National Hurricane Center's HURDAT2 database is used. The suggested approach's performance is assessed using a variety of measures, including mean absolute error, mean squared error, and root mean squared error. With a lower error rate, the CNN model can accurately estimate cyclone intensity. To train the CNN model on the historical dataset of cyclones, the algorithm utilizes a process called supervised learning. This involves feeding the model with labeled examples from the dataset, where the inputs are the satellite data and the corresponding cyclone intensities. The model learns to recognize patterns and correlations between the features in the satellite data and the cyclone intensities, enabling it to make accurate predictions on new, unseen cyclone data.

Keywords: Convolutional Neural Network, Cyclone, Deep Learning, Intensity, Meteorology.

1 Introduction

1.1 A Subsection Sample

Cyclones are large-scale weather phenomena that often originate over warm tropical oceans and can cause coastal areas to experience severe winds, heavy rain, storm surges, and flooding. These storms, commonly known as tropical cyclones or hurricanes, are formed over warm ocean waters when the conditions are just right. The combination of warm water, low pressure, and favorable atmospheric conditions creates a powerful system that can cause widespread destruction [1].

Each category on the Saffir-Simpson scale is determined by the sustained wind speeds of the cyclone. For example, Category 1 cyclones have sustained winds of 74 to 95 miles per hour, while Category 5 cyclones have sustained winds of 157 miles per hour or greater. The scale also takes into account the potential for damage caused by the storm, with higher categories indicating more severe and potentially catastrophic conditions. As a civil engineer and as the director of the National Hurricane Center, Robert Simpson developed this scale in the 1970s [2-4]. It is designed to give an estimate of the potential damage and flooding a hurricane could cause based on its wind speed.

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A NOVEL FRAMEWORK FOR IMPLEMENTING DEEP LEARNING APPLICATIONS FOR THE INDIAN AGRICULTURAL SECTOR

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Abstract : Currently many advanced technologies are used for the growth in agricultural sector instead of traditional one. Deep Learning is a novel technology can help to improvise the agriculture better than the other. DL combines large data analysis with contemporary image processing and data analysis techniques. Deep learning has enormous promise and is already being used in industries such as medical research, self-driving cars, automated voice recognition, NLP (Natural Language Processing), and picture restoration, to list a few. If we think in a broad perspective the possibilities are infinite and only limited by our imagination. Deep learning has been applied in agriculture by some countries and has already demonstrated important promise. The agricultural sector, which contributes significantly to India's GDP, is essential to the country's overall economic growth. This study elaborates on various applications of deep learning systems proposed for smart agriculture, including crop recommendations, fertilizer suggestions, categorization methods, and disease diagnosis by imagery. It also includes an overview of the application of machine learning and deep learning techniques in agriculture. The major drivers of agricultural production include climatological including temperature, rainfall, soil quality, agricultural traditional methods, quality of seeds, fertilizers and the most important is less use of ICT methodologies by the Indian farmers for agricultural developments. Farmers have gained the ability to discuss their perspectives, experiences, and ideas courtesy to ICT technologies used in agriculture. It has increased farmers' exposure and empowered them to apply science that views agriculture comprehensively. Agricultural sector and agriculture serve a primary source of income for over 58% of the Indian population. So that this study is very much useful for the individuals who are referring deep learning concepts, this research paper also helpful to grown up the agricultural research in India. Some of the current issues and challenges were also explored.

IndexTerms **- Deep Learning, agricultural research, Natural Language Processing (NLP), ICT, etc.**

I. INTRODUCTION

Agriculture plays a significant role in the Indian economy. Agriculture is the primary source of income for the vast majority of Indians. India, which has the second-largest agricultural land area in the world, relies directly or indirectly on agriculture for around half of its population's daily needs. Agribusiness is the sector that includes agricultural and farming-related businesses. It includes all of the procedures involved in getting an agricultural product to market, such as production, processing, and distribution. India has the world's largest cattle herd (buffaloes), largest area planted to wheat, rice, and cotton, and is the largest producer of milk, pulses, and spices in the world. Also it is the second-largest producer of fruit, vegetables, tea, farmed fish, cotton, sugarcane, wheat, rice, cotton, and sugar. Agribusiness treats the different aspects of raising agricultural products as an integrated system. Indian Farmers raise animals and harvest fruits and vegetables with the help of sophisticated harvesting techniques, including the use of GPS to direct operations. Still the percentage of Indian farmers using some ICT tools is very less than other foreign countries. In the second phase Manufacturers also increasingly use efficient machines, in the next phase processing plants determine the best

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Design and Implementation of Machine Learning-Based Network Intrusion Detection

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Abstract: Systems for detecting intrusions are vital to network security and are necessary for maintaining network integrity. To improve the effectiveness of machine learning techniques, ensemble learning has been frequently used. Additionally, the quality of training data has a significant impact on detecting abilities. Marginal density ratios have consistently outperformed the powerful unilabiate classifiers. In this paper, we recommend a system for detecting intrusions that is based on groups of SVMs and has been functionally enhanced. Our method involves transforming the original characteristics to marginal density logarithmic thresholds in order to produce new, enhanced, and modified training data. The creation of an intrusion detection model then takes place using an SVM-Set. The system employs a number of machine learning techniques, including ensemble learning, to enhance detection performance. Raising the caliber of training data also involves the use of feature augmentation. Using an ensemble of Support Vector Machine (SVM) models, the suggested approach creates an effective intrusion detection framework. The effectiveness of the proposed design was assessed using simulations and the data base CICIDS2017, which simulates network traffic in the real world. The results of the experiment were compared to earlier studies, and it was found that the precision of binary and multiclass categorization had increased. Another illustration of the efficiency of the model was the high level of precision of the restored transportation system.

Keywords: *Network intrusion detection, Cyber security, Support vector machine, ensemble learning*

1. Introduction

In today's highly interconnected world, network security is an extremely important topic of discussion due to the heavy reliance that businesses place on computer networks to both store and transmit critical information. However, because of the ever-increasing complexity of online dangers, conventional security measures are becoming increasingly ineffective. The monitoring of system traffic and the detection of unusual or malicious activity are two essential functions played by intrusion detection systems (IDS) in the detection and prevention of system attacks. Another key role played by IDS is the identification of potential vulnerabilities in the system. The automatic learning techniques have recently attracted attention in the field of intrusion detection due to their ability to recognize complex undiscovered attacks. In particular, the combination of several classifiers to increase the detection's robustness and precision has demonstrated promising results. The quality of training data affects how well intrusion detection systems perform. High-quality training data that accurately captures the underlying patterns and characteristics of these attacks is necessary for the classification of network attacks.

The system for detecting network intrusions proposed in this paper uses ensemble learning and feature augmentation approaches. The system's overall performance and detecting skills are to be improved. We particularly concentrate on using Support Vector Machine (SVM) ensemble models, which are well-known for their efficiency in dealing with high-dimensional data and nonlinear classification issues. The approach of feature augmentation, which uses logarithm marginal density ratios to change the original features, is also something we introduce. With the help of this transformation, it will be easier to distinguish between legitimate network traffic and criminal activity by producing new and enhanced training data. Through comprehensive testing and evaluation, we show the effectiveness and market advantages of our suggested strategy.

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ORIGINAL ARTICLE

Heavy Mineral and Mineral Magnetic Tracers of Basaltic versus Cratonic Weathering as Indicators of Spatio-temporal Shifts in the Monsoonal Intensity over Central Indian Region

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ABSTRACT

Indian summer monsoon holds its core over Central Indian Region (CIR) through Bay of Bengal and Arabian Sea branches. The majority of CIR is occupied by the Godavari Drainage Basin (GDB) which generates a large and episodic flux of sediments in the Bay of Bengal indicating a major shift in the monsoonal pattern over CIR. The large part of Deccan basalt province of GDB is present in the semi-arid watershed governed by the precipitation mostly from Arabian sea branch. Whereas the cratonic province is present in a high monsoonal zone governed by the precipitation from Bay of Bengal branch. Both these zones also represent Cratonic (non-basaltic) versus Basaltic sources converging at the Pranhita/Godavari confluence before their mixing onwards into delta and finally in the Bengal fan. Based on the heavy mineral and low temperature magnetic mineral characteristics of bed loads from the Godavari River before, at and after the confluence we attempt to characterise these two sources as a function of shift in monsoonal pattern over central India. The quantitative heavy mineral studies show dominance of stable minerals derived from the non-basaltic sources with a downstream trend for stable heavy minerals in a long profile to indicate stronger cratonic sources. The surface textures of garnet, epidote and hornblende indicate rapid transport and low residence time for the sediments derived from Precambrian granites, Proterozoic and Gondwana sediments presently defining the Core Monsoon Zone. The opaque grains represented by discrete ilmenite, magnetite and magnetite inclusions in aggregated quartz characteristic of the Deccan basaltic source show decreasing order downstream. The low temperature magnetic susceptibility for heavy minerals indicate Multi Domain and Ti-rich magnetite from Deccan basalts and magnetic inclusion in siliciclastic grains derived mostly from local sources. More detailed heavy mineral and geochemical analysis of the core sediments would help in documenting the temporal shifts in monsoonal intensity and its core regime over the Indian continent.

INTRODUCTION

Long term changes in the synoptic monsoonal pattern over the CIR have in general influence on the agricultural practices vis-a-vis settlements along the river channel. Such regional changes in the monsoonal pattern can be documented from the sediment signatures, provided their source can be precisely traced. The CIR represents the Arabian Sea branch (ASB) and the Bay of Bengal (BOB) branch of the Indian Summer Monsoon (ISM) which coalesce in this region. This entire region in question is represented by the Godavari drainage basin, which also coincides with two contrasting lithogenic domains of (i) Deccan basalt province with mean annual rainfall between 800 to 1000 mm (Rao, 1999) influenced by the ASB and (ii) the Precambrian cratonic region with rainfall > 1600 mm (Rao, 1999) under the primary influence of BOB along with ASB (Fig.1a). The Pranhita Godavari confluence represents the major first order mixing of these two contrasting domains. In this paper we made an attempt to investigate the surface textural, mineralogical and low temperature mineral magnetic signatures of heavy minerals that can fingerprint the sources from the two domains and alternatively be used as relative changes between ASB and BOB.

Sediment fingerprinting studies are useful for the characterization of sediment transport from the source to sink. Heavy mineralogy is one of the suitable studies for fluvial sediments. Heavy minerals for a long time are mainly studied for provenance contribution (Mackie, 1923; Pettijohn, 1941; Van Andel, 1959; Mange and Maurer, 1992; Mange and Morton, 2007). There are many other applications of this approach such as sediment source and dispersal pattern (Morton, 1985; Mange and Maurer, 1992), study of transport history of sediments (e.g. Cordier et al., 2005; Po et al., 2007) and effect of climate on sediments (e.g. Sevastjanova et al., 2012). Several studies over modern sediments from the Himalayan Rivers suggested the unique applicability of these classical techniques for large fluvial systems (Garzanti and Ando, 2007; Sevastjanova et al., 2012; Ando et al., 2012).

Godavari Drainage Basin (GDB)

GDB with an area of ~3,13,000 km^2 lies in latitudinal range of 17° to 22° N and represents the part of core monsoonal zone apart from the interface of ASB and BOB. The Godavari River originates in Trimbak (Maharashtra) and traverses about 1450 km through Peninsular India to deposit/debouch its sediments into the Bay of Bengal near Rajahmundry (Andhra Pradesh). Godavari River traverses through variety of lithounits including the Basalt of Deccan Volcanic Province (DVP), Peninsular granitic/gneissic complex of Dharwar craton, sandstone and quartzite of Cuddapah Supergroup, sandstone, shale and limestone of Gondwana Supergroup, charnockites and khondalites of Eastern Ghat Mobile Belt (EGMB) and the sandstones

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Design Approach and Comparison of Phase Shifter Performance in DOA Estimation System

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Abstract
The paper outlines three types of phase shifter networks utilized in phased array antennas for direction-of-arrival estimation. It compares the mechanical rotation method of antenna array with Butler matrix-based and software-controlled phase shifter networks. Performance metrics such as phase shift accuracy and response time were considered. Comparisons were made between simulation and measurement results of Butler matrix and software-controlled networks. The mechanical rotation system operates as an open-loop system, while the other two can function as closed-loop systems.

Keywords Butler matrices - DOA - FPGA - Phase array antenna - Phase shifter - Angle error

1 Introduction

Phased array antenna systems conserve energy and enhance the accuracy of receiver positioning; when using phased array technology, the main lobe of the antenna is aimed at the intended receiver, ensuring that the desired recipients receive the signal while blocking out any unwanted interference [1–3]. Direction-of-arrival (DOA) estimation is a crucial aspect for advanced smart antenna systems. DOA, essentially a software component embedded in the baseband of a radio, plays a key role in detecting and pinpointing the target node(s). Various methods and algorithms are available to achieve accurate DOA results [4–9]. The precision in receiver detection and localization heavily relies on the detailed processing of all signals received by the antenna array, including the analysis of their phase shifts and power levels. Utilizing phased array antenna systems not only conserves power but also enhances the accuracy of receiver positioning. By directing the antenna's main lobe towards the specified receiver in the phased array setup, it ensures that targeted receivers are prioritized while minimizing interference [1–3].

Direction-of-arrival (DOA) estimation is a crucial aspect for intelligent antenna systems. DOA functions as a software embedded in the radio's baseband, enabling the identification and positioning of targeted node(s). Various methods and algorithms are available

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Advancements in Biomedical Signal Processing: Innovations, Applications, and Future Trends

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ABSTRACT

Biomedical signal processing, combined with advanced technology, plays a vital role in enhancing patient care and empowering individuals with disabilities. This paper explores the integration of biomedical systems with signal processing techniques, including life support and monitoring systems, physiological monitoring devices (ECG, MRI, EEG), and rehabilitation systems. We discuss signal processing methods and techniques, such as state vector machines, hidden Markov models, wavelet transforms, and pattern recognition, employed in biomedical systems. These methods enable the analysis and interpretation of biosignals, providing diagnostic and therapeutic insights. The paper emphasizes the classification of biomedical systems into medical and rehabilitative systems. Medical systems focus on diagnosis and monitoring, while rehabilitative systems aim to support optimal functioning for disabled individuals. Case studies and examples illustrate the impact of biomedical signal processing on healthcare, including early disease detection, improved treatment delivery, and enhanced quality of life for individuals with disabilities. We conclude by highlighting future trends in biomedical systems and signal processing advancements, exploring the potential for personalized medicine, wearable devices, and artificial intelligence in healthcare and rehabilitation.

KEYWORDS *: Signal processing, State vector machine, Hidden markov model, Rehabilitation systems, Wavelet transform.*

INTRODUCTION

Biomedical signal processing has evolved beyond signal analysis, now encompassing applications such as artificial limb development and advanced medical imaging [1]. Quantitative analysis via powerful algorithms aids in diagnostics, employing techniques like filtering and pattern recognition (2). Medical systems diagnose and monitor patients, while rehabilitative systems enhance the functioning of disabled individuals [3-4]. These advancements improve patient treatment and enhance the quality of life for disabled individuals [1-4].

BIOMEDICAL SIGNAL ACQUISITION

Bioelectric signals like EKG, EMG, and EEG require specialized amplifiers and filters for acquisition [1]. Real-time biomedical applications demand high-speed, flexible data acquisition systems with stringent safety measures [2]. Integrated Data Acquisition Units (IDAU) integrate preamplifiers and filters, ensuring signal integrity without distortion [3]. Preamplifiers amplify signals with high input impedance and CMRR, while filters eliminate unwanted signals [4]. Low-pass filters restrict signal frequency, while high-pass filters block DC offset voltage [5].

BIOSIGNAL PROCESSING TECHNIQUE

Support Vector Machine (SVM)

The Electrocardiogram (ECG) is crucial for diagnosing heart conditions, with distinctive P, QRS, and T-waves indicating different heart activities. However, detecting these waves automatically is challenging due to their low

amplitudes and signal noise. Support Vector Machines (SVM) are employed for wave classification, offering significant advancements in pattern recognition. An algorithm is developed for wave detection, involving steps such as ECG signal acquisition, baseline wander mitigation, slope normalization for QRS enhancement, and SVM-based classification. SVM-trained models detect QRS complexes, which are then replaced with baselines for further analysis. The process is repeated for T-wave detection, followed by P-wave identification after QRS and T-wave removal.

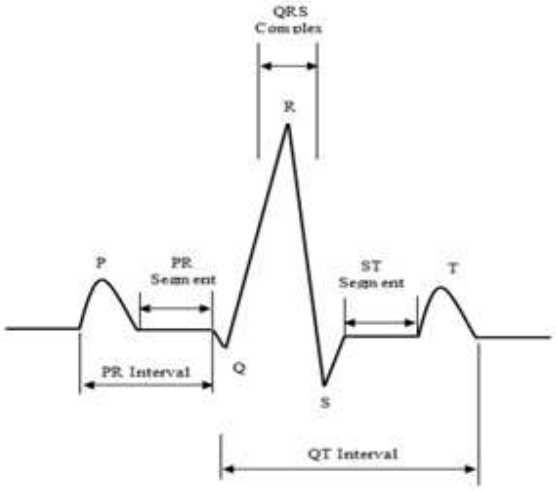

Figure 1. A typical ECG signal waveform.

Fig.1 ECG signal

As illustrated in Fig.1, the first deflection, termed the P-wave, originates from the depolarization of the atria. The QRS-complex, characterized by significant amplitude, arises from the depolarization of the ventricles.

Hidden Markov Models

In random signal processing, models are essential for efficient signal processing and parameter estimation. While exact models are rare in biomedical applications, Markov Chain Processes are valuable for biomedical signal processing. Markov chains consist of synchronized states transitioning with specific probabilities. Hidden Markov Models are widely used in speech recognition and biomedical fields, aiding in the analysis of various signals like EEG, EMG, and bioacoustic signals. Ongoing research explores their potential in detecting physiological conditions.

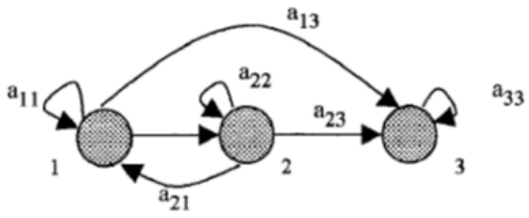

Fig. 2: A three states markov chain model

Neural Networks

Neural networks are effective in analyzing biomedical signals like EMG due to their learning capacity and adaptability. In an EMG classification system (Fig. 3), surface electrodes capture signals post-finger movement, undergo FFT analysis, and feed into a network with 10 input, 7 hidden, and 5 output processing elements. The network matches signals to desired outputs, categorizing EMG signals based on finger movements.

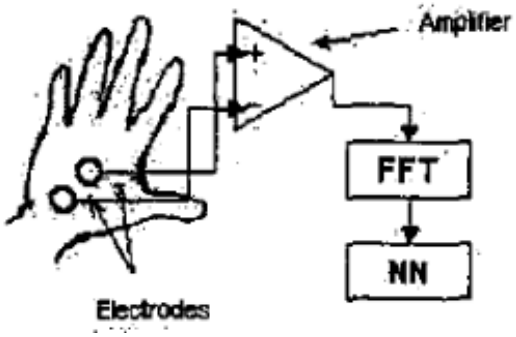

Fig. 3: Schematic diagram of EMG classification system.

Other techniques

Biosignal processing employs techniques like STFT (Short-Time Fourier Transform) and Wavelet Transform. In STFT, a fixed-width window function is moved across the signal to compute its inner product. Wavelet Transform decomposes a signal using basis functions derived from dilations, contractions, and shifts of a wavelet prototype. Unlike STFT, Wavelet Transform's wavelets vary in width across frequencies.

BIOMEDICAL SYSTEMS

Medical Systems

In medical systems, platforms like Physiotrace and Boom-NT provide real-time access to patient data through on-screen processing and display [13]

[14]. Physiotrace integrates hardware, software, and DSP algorithms for biomedical data acquisition, centralization, and visualization, while Boom-NT offers a user-friendly interface for modeling and executing signal processing strategies [13][14]. Textile-based wearable biomedical systems, featuring sensor-embedded jackets, capture signals for further analysis [15].

Rehabilitate systems

Systems utilizing EEG and EMG signals enable control of cursor movement and left-click commands, serving as human-computer interfaces for disabled individuals [16]. These systems differentiate commands using amplitude thresholds and power spectral density estimations, offering affordable DSP-based solutions [16]. Specialized products include an EMG-controlled telephone interface for disabled operators [17]. Innovations include an EMG-based robot for human support, featuring arm and wrist control segments and a graphical feedback display [18]. Another innovation is an EMG-based human-robot interface for rehabilitation aid, integrating signal processing, manipulator, rehabilitation program, and biofeedback [19]..

FUTURE SCOPE

Biomedical signal processing holds great promise, fueled by global research and advancements in real-time systems, wearable technology, and embedded systems. Key areas of interest include the convergence of micro-nano-bio technologies, refining processing techniques with hidden Markov models, and exploring bioinformatics and AI integration. The future landscape anticipates transformative innovations driven by interdisciplinary collaborations, advanced sensor technologies, and cloud and edge computing, revolutionizing healthcare and personalized medicine.

CONCLUSION

In summary, biomedical signal processing is driving innovation in healthcare, empowering real-time monitoring, diagnosis, and rehabilitation. Advanced techniques like Support Vector Machines, Hidden Markov Models, and Neural Networks enable insightful analysis of biosignals. Medical systems prioritize diagnosis, while rehabilitative systems focus on enhancing quality of life for the disabled. Future advancements in wearable tech, AI, and cloud computing promise further breakthroughs in personalized medicine. With ongoing research, biomedical signal processing will remain pivotal in improving patient outcomes and human well-being.

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Prediction of Covid-19 Multiparametric Biomarkers and Drug Target of Patients for Risk Stratification Using Machine Learning Approach

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Abstract: In the situation of Coronavirus disease 2019 (COVID-19), forecasting disease progression and identifying therapeutic drug targets is critical, especially given the nonattendance of a viable approach for treating severe cases. The preparation cohort revealed promising biomarkers, which were then precisely measured and employed to assess prediction accuracy across validation cohorts. This approach holds significant potential in enhancing understanding of severe COVID-19 and aiding the development of effective treatments. However, ultrasound-guided MRI (US-MRI) is an emerging modality that can noninvasively acquire multi-parametric information on COVID-19 and function without the need for contrast agents. This shows that neural network analysis of US-MRI transports exclusive prognosis data and this significantly improved prognosis performance. Consequently, the research proposed a deep neural network model of an Ensemble Multi-Relational Graph Neural Network (EMR-GNN) to determine the optimal model for predicting vascular biomarkers (CRP, IL-6, ferritin). In the nonappearance of a tailored treatment for this emerging virus, scientists are actively investigating various strategies to curb its replication. This work focuses on identifying potential drug targets, drawing from proteins abundant in lung material and those targeted by FDA-approved drugs as catalogued in HPA. This effort reflects a broader initiative within the methodical unrestricted to develop effective means of limiting virus replication. Accordingly, recognized five lung-improved proteins, comprising MRC1, SG3A1, CCL18, histone H4, and CLEC3B, were annotated as "drug targets". For this, the researcher proposes a Heterogeneous Graph Structural Attention Neural Network (HGS-ANN) model to learn topological information of composite molecules and a Dilated Causal CNN-LSTM model with U-Net layers for modelling spatial-sequential information in Simplified Molecular-Input Line-Entry System (SMILES) sequences of drug data. The COVID-19 datasets are downloaded from the GEO database. These data are evaluated using Matlab software. The proposed work evaluated that the AUC of the work is 0.995, however, the AUC is measured based on sex, age, and chronic diseases. This model has a 0.933 accuracy in the subgroup of slices thicker than 1mm. However, the AUC curve and the classification outcome of the proposed method are compared with the existing rad model, deeper, and KNN models. In comparison to existing methods, the proposed model demonstrates superior performance. This research not only identifies potential therapeutic targets nonetheless also serves to uncover biomarkers crucial for comprehending the pathogenesis of undecorated COVID-19.

Keywords: Ultrasound-Guided MRI, COVID-19, Ensemble Multi-Relational Graph Neural Network, Heterogeneous Graph Structural Attention Neural Network, SMILES, and Food and Drug Administration.

1. INTRODUCTION

COVID-19 is an extremely communicable virus disease, first detected in December 2019. People affected by this disease will be affected by slight to unembellished breathing problems. It spread very rapidly, so it was announced as a pandemic. Constructed on clinical symptoms and associated medical investigations, COVID-19 patients are divided into four groups: severely severe, moderate, severe, and mild [1]. Clinicians would be healthier and able to handle the clinical therapy options if they could diagnose patients with poor prognoses early. The term "biomarker" refers to a class of biomolecules that serve as biological indicators of the existence, severity, or kind of a disease. They serve as important predictors of illness severity and diagnosis [2]. Risk factors of COVID-19 are older age, comorbidities chronic lung disease, hypertension, male sex, diabetes and cancer [3]. For the organization of patients based on their condition, primarily the identification of biomarkers is required [4]. Recently utilized COVID diagnosis methods are nuclear acid amplification test, serological test, imaging, biosensors, and microfluidic approach [5]. Artificial intelligence (AI) algorithms, especially deep learning, and neural networks have uncountable progress in the image-recognition field. They are suitable for identifying complex configurations in imaging information and providing valuations of radiographic appearances [6]. Imaging characteristics, particularly those of CT scans, can reveal pleural alterations, bronchial abnormalities, and lung parenchyma [7].

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Optimal Prediction and Disease Severity Classification of Proteomic Survival in Pre and Post-Covid-19 Using Hybrid Machine Learning Approach

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Abstract: Uncertainty surrounds the underlying mechanisms of the severe COVID-19 disease of 2019. The capability to detect COVID-19 through artificial intelligence techniques, particularly deep learning, will help to do so in the early stages, which will increase the likelihood that patients around the world will recover rapidly. The load on the healthcare system globally will be relieved as a result. Several thousand plasmas and serum proteins from COVID-19 patients and symptomatic controls are longitudinally analysed in this study to identify non-immune and immune proteins associated with COVID-19. The development of predictive models thus involves taking into account the topological variations across networks from different scenarios (survivors vs. non-survivors). As a result, the study's test subjects, who weren't included in the machine learning (ML) training, had high prediction accuracy. This study successfully predicted the existence of critically ill (CI) patients both before and after COVID-19 by using an MLM built on a synonymic network that incorporates measurements of several proteins. A rise in some acute phase and inflammatory proteins (IP) with time (e.g. ITIH3, SAA1; CRP, SAA2, LBP, SERPINA1, and LRG1) is related to the danger of death after COVID-19, while an upsurge of kallikrein (KLKB1), kallistatin (SERPINA4), thrombin (F2), Apo lipoprotein C3 (APOC3), GPLD1, and the protease inhibitor A2M, is associated with survival. The same clinical symptoms, such as dry cough, fever, squatness of breath, and others, are linked to both severe and critical patients. The lesion outlines are then retrieved from the COVID-19-contaminated regions after the entropy texture features have been extracted using a Gray-level co-occurrence Matrix (GLCM) to confirm the infected regions (IR). Further, the study implemented a variety of features using CT images with a CNN-based Inception V3 model for selection algorithms to filter significant features. Finally, construct a model of transfer learning (TL) using the VGGNet16 model which could capture and further classify the disease severity. Based on Matlab software, the suggested work is assessed. With a compassion of 96.7% and specificity of 98.2%, the results demonstrate that VGGNet16 is the most suitable TL model to identify COVID-19, nonetheless, it also exceeds the most advanced methods at the moment. The clotting system and accompaniment cataract are home to the bulk of proteins in the forecast model with high significance. This work shows that plasma proteomics (PP) can result in prognostic predictions that vastly outperform the present prognostic markers in critical care, respectively.

Keywords: COVID-19, Synolytic Network, VGGNet16 Model, Gray-Level Co-Occurrence Matrix, Disease Severity, Convolution Neural Network, and Inception V3 Model.

I. INTRODUCTION

The SARS-CoV-2 outbreak that gave rise to the COVID-19 sickness in December 2019 swiftly snowballed into a devastating global healthcare disaster. Human-to-human transmission of Covid-19 is made easier by respiratory droplets produced by coughing and sneezing. Comprehensive blood amount, C-reactive protein (CRP), clotting tests, D-dimer, ferritin, lactic dehydrogenase (LDH) and procalcitonin are the laboratory tests applied to detect the severity of disease, myocardial damage, thromboembolic complications, and/or worse prognosis [1]. For COVID-19, a quantity of replicas has been shaped to determine the level of disease severity and the prediction of clinical outcomes. These models are based on laboratory testing, imaging, and omics technology. Recognizing new biomarkers related to disease severity is essential to help identify patients with the high possibility of developing a critical illness to target the allocation of resources, the intensification of care, and the addition of experimental clinical trials to those who are in most need [2]. The potential prognosticators of COVID-19 severity or impermanence have already been identified as D-dimer, lactate dehydrogenase, and CRP[3]. With their aptitude to identify several proteins in a single analysis, proteomics technologies have started to extend

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Machine Learning-Based Optimization Method for the Oxygen Evolution and Reduction Reaction of the High-Entropy Alloy Catalysts

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Abstract: In recent times, high-entropy alloys (HEAs) have found application in heterogeneous catalysis, capitalizing on their vast chemical potential. Yet, this extensive chemical landscape presents significant challenges when attempting a comprehensive exploration of HEAs through traditional trial-and-error approaches. Therefore, the machine learning (ML) approach is offered to appearance into the catalytic activity (CA) of countless sensitive sites on HEA surfaces in the oxygen-lessening response (ORR) and oxygen evolution reactions (OER). In this research, a Density Functional Theory (DFT) with a supervised ML model is assembled and founded on the gradient boosting regression (GBR) algorithm that predicted the O2 adsorption energies with a high overpotential of all surface sites on the two HEAs. Initially, the HEAs Co-Fe-Ga-Ni-Zn and Al-Cu-Pd-Pt offer a framework for adjusting the composition of disordered multi-metallic alloys to regulate the activity and selectivity of the reduction of oxygen to extremely reduced compounds. This attains generalizability, high accuracy and simplicity with the proposed technique. For fine-tuning such features, HEAs provide a huge compositional space. Consequently, the research reports the custom of the Bayesian optimization model based on HEA active compositions to suppress the formation of Oxygen (O2) and with strong O2 adsorption to favour the lessening of O2. The GBR approach is applied to build a highly accurate, easily generalizable, and effective ML model. The proposed work is analysed using Python software. The findings show that the separate charities of correlated metal atoms close to the responsive site are mixed to form the adsorption energy, which is clear from a thorough analysis of the data. It is suggested that a highly effective HEA catalyst composed of Co-Fe-Ga-Ni-Zn and Al-Cu-Pd-Pt be exploited, which is an effective method for further enhancing the ORR CA of potential HEA catalysts. An instruction manual for the logical design and synthesis of HEA catalysts' nanostructures is provided by the proposed research.

Keywords: High-Entropy Alloys, Oxygen Reduction Reaction, Oxygen Evolution Reactions, Gradient Boosting Regression, Density Functional Theory, Bayesian Optimization.

I. INTRODUCTION

The current focus of advancement in materials chemistry research centers around the utilization of composite electrodes, rooted in atomic-level engineering and the control of multilayer structures. The primary area of study in the sphere of water splitting is the formation of inexpensive and effective electro catalysts. Hydrogen generation by water electrolysis is receiving increasing attention due to the benefits of good flexibility, high efficiency, and minimal production of carbonaceous species. Ere, several strategies such as changing the crystal structure and generating the microstructure are extensively employed to boost the inherent CA and double the number of vigorous positions in catalysts made of nonprecious metals. Particularly, the alloying of several elements into one phase could disclose peculiar physicochemical characteristics, including higher CA [1]. Effective sampling of catalyst materials has also advanced, and experimental catalyst development for a diversity of processes and constituent elements has actively utilised combinatorial investigation of vast alloy composition spaces [2]. Due to the close correlation between the conductivity and intrinsic activity of materials and the electrocatalytic performance, great efforts have been made to adjust electronic properties and design multilayer systems [3]. In the electrocatalytic water-splitting process, a very stable and inexpensive material is urgently needed for the OER, which is a vital step in both water-splitting systems and rechargeable metal-air batteries. [4, 5].

The OER determines the rate of energy conversion and also serves as a testing ground for the manufacture of integrated OER electrodes with high activity and high conductivity. However, there is still a significant obstacle to overcome in the formation of low-cost, highly effective OER electrocatalysts that can be applied industrially on a wide scale. Similarly, the

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Quantum Machine Learning Technique for Automatic Retrosynthetic Reaction Pathway Search Method

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Abstract: Retrosynthetic analysis often involves evaluating many potential candidate reaction pathways and molecules at multiple stages of the reaction, resulting in complex retrosynthesis trees that need to be searched and parsed efficiently. Computational approaches could significantly aid the chemist in solving different aspects of the retrosynthesis problem, such as the graph-theoretic search methodologies for efficient tree traversal to identify feasible reaction pathways, dictionary-based methods to evaluate a large search space of precursors, and chemistry-driven heuristics to eliminate practically infeasible routes. In this research, a new single-step retrosynthesis prediction method of the Retro TRAE SMILES-based translation technique is proposed. Accordingly, quantum computing with tree-tensor network topology is presented to construct an automatic data-driven end-to-end retrosynthetic route planning system (Auto-Syn-Route), which is presented based on the heuristic scoring function. AutoSynRoute successfully reproduced published synthesis routes for the four case products. The model is trained in an end-to-end and fully data-driven fashion. Unlike previous models translating the SMILES strings of reactants and products, a new way of representing a chemical reaction based on molecular fragments is introduced. It is demonstrated that the new approach yields better prediction results than current state-of-the-art computational methods. The new approach resolves the major drawbacks of existing retrosynthetic methods such as generating invalid SMILES strings. The proposed method is implemented using Python software. The proposed approach predicts highly similar reactant molecules with an accuracy of 68%. In addition, the proposed method yields more robust predictions than existing methods. However, the experiments demonstrate that the proposed scheme significantly improves the success rate of solving the retrosynthetic problem by 97% while maintaining the performance of the quantum tree tensor for predicting valid reactions.

Keywords: Retrosynthetic, RetroTRAE, SMILES, Single-Step Retrosynthesis Prediction, Quantum Computing, Tree-Tensor Network.

I. INTRODUCTION

Retrosynthetic planning is a fundamental problem in chemistry for finding a pathway of reactions to synthesize a target molecule. Well-planned and practical retrosynthetic pathways are essential for the effective and ecologically sustainable synthesis of important compounds. Robert Robinson introduced retrosynthetic analysis in the tropinone synthesis process and E. To create target compounds, organic chemists employ a fundamental method called J. Corey. A molecule's production process is typically varied, especially for complex substances like natural products. Based on a collection of reaction rules, choices for each transformation are developed, and a variety of optimization algorithms then suggest potential reaction paths. Even if computer-assisted retrosynthetic route planning and reaction prediction have made significant strides, completely data-driven autonomous retrosynthetic route planning is still difficult [1] [2]. Retrosynthesis is likely one of the more challenging processes among the several activities involved. Retrosynthesis involves designing effective synthetic routes for a certain target. The necessity to identify a series of disconnections schemes, appropriate building blocks, and effective group protection techniques are some of the main justifications.

For a long time, the most effective method used in computer programmes was rule-based or similarity-based. These approaches do not learn chemistry from data, but rather codify synthon creation rules, even though they indicate relatively efficient pathways to molecules of interest. Rule-based systems' fundamental flaw is the requirement for time-consuming manual encoding, which prevents growth as data set sizes grow. Additionally, when more rules are codified, it becomes more

CFD with the Population Balance Model for Packed bed Airlift Reactor with External Loop

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Abstract

An airlift reactor with the external loop (EXL ALFR) is a widely used modified version of a Bubble Column Reactor (BCR). An EXL ALFR can also be used for a three-phase system with the solid phase in a packed or fluidized form. An EXL ALFR provides design flexibility for conventional chemical reactions as well as biological reactions. Shear is an important factor for the reactors handling immobilized enzymes. In the current investigation, the effect of the design variables, like gas hold-up, the velocity of circulating liquid, and the distribution of bubble dimension, was compared for an EXL ALFR and an external loop airlift reactor with a packed bed (EXL ALFR-PB). Particle Image Velocimetry (PIV) was employed for the liquid axial velocity in the downcomer of the reactors, and the computational fluid dynamic with the Population Balance Model (CFD-PBM) was employed. The minimum percentage of errors of 2.3% and 1.2% and the maximum of 4.2% and 3.4% were obtained for the experimental and predicted values of gas hold-up in the EXL ALFR and EXL ALFR-PB, respectively. For the velocity of the circulating liquid, the predicted and experimental values of their minimum percentage error were 1.1% and 0.5% and a maximum of 4.3% and 4.5% in EXL ALFR and EXL ALFR-PB, respectively. Also, the pressure drops calculated from the Ergun equation and CFD simulation had a 0 to 4% difference, indicating good agreement.

Keywords
Computational fluid dynamics ; External loop airlift reactor ; Fixed bed ; Population balance model ; Shear Sensitivity

Main Subjects
modeling and simulation

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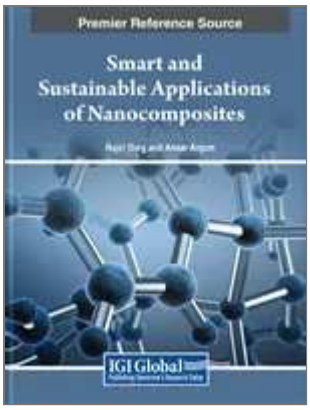

Multifaceted and Diverse Applications of Nanocomposites

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Abstract

The materials produced on nanoscale have a new set of properties. Nanotechnology and nanomaterials have positively affected the human lifestyle. It has an impact on agricultural, energy, petroleum, sports, chemical and catalysis, environmental, paints and coating, medical, beauty, and textile sectors. Feeding the increasing needs of the population has given rise to different innovations in various sectors. The agricultural sector also has benefitted from such innovations. Nanotechnology and nanomaterials have come to the rescue of the farmers. Micronutrients are supplied to the crops through fertilizers. Nanomaterials are explored for fuel borne catalysis for soot prevention. Nanoparticle reinforced tires have greater abrasive resistance and gas permeability. Nanoparticles are used in coating for better gloss, scratch and corrosion resistance, and anti-fog coatings. Nanoparticles and nanomaterials like cubosomes, nanodots, liposomes, dendrimers, nano-emulsions have become common ingredients in cosmetics.

Chapter Preview

Top

Introduction

Advancements in technologies are touching the human life across the world. The technology has enabled human beings to modify plants, animals and materials, according to their needs. The research and investigations in biotechnology, nanotechnology and environmental technology have become very important areas of research. Bionanotechnology has potential to manipulate the plants and animal for better productivity and yield. Nanotechnology is being explored in various applications ranging from chemical engineering to farming. Environmental technology has gained importance due to increasing need to develop the materials and processes with sustainable approach. If we look carefully at these three fields, they can be integrated to provide sustainable solutions to many material synthesis and waste treatment problems. Nanotechnology is being explored due to its huge potential and endless possibilities.

“The technology in which the materials and systems are designed, synthesized, characterized and utilized by facilitating control over their size in nanoscale(1 to 100 nm)”, can be termed as nanotechnology(Kreyling et al., 2010). For fabrication of nanomaterials, two approaches, namely top down and bottom up, are employed(Chaudhary et al., 2016). Carbon nanotubes are replacing silicon chip due to their semiconducting properties with better performance.

The material when disintegrated to nanosize, exhibits different properties than the original material like gold and its nano-counterpart. Gold is shiny yellow metal that absorbs green light when disintegrated to 10 nm and appears red(Roduner, 2006). The nanomaterial can be defined as the one that has minimum one dimension less than 100 nm. (Vollath, 2008). Green nanotechnology focuses on synthesis and application of nanotechnology in sustainable manner (Mahajan et al., 20022). Green synthesis of nanomaterial is widely explored. Surface reactivity and properties of nanomaterials can be enhanced by functionalization. Carbon nanotubes are functionalized by bromine (Mazov et al., 2009). Direct or indirect functionalization methods can be used for nanomaterials. Direct functionalizations include covalent, non-covalent, inorganic, doping of heteroatoms and mediated by immobilization (Mahajan et al., 2022). Grafting is indirect method of functionalization. Nanotechnology and nanomaterials have positively affected the lifestyle of human. It has impact on agricultural, energy, petroleum, sports, chemical and catalysis, environmental, paints and coating, medical, beauty and textile sectors. Over next 30 years global energy demand is predicted to increase by 60%(Esmaeili, 2011). One way to partially counter this issue is, use of effective transmission of energy. Nanotechnology can provide solutions to the issuesconcerningaccess to stranded natural-gas resources.Development of nanocatalysts and nanoscale membranes for gas to liquid production can serve this purpose(Esmaeili, 2011). Nanostructured material can be developed for transport of compressed-natural-gas or electricity transmission between long distance points. In oil industry, for offshore drilling, light weight, stronger, and more corrosion-resistant structural materials can be used in platforms. Investigators have reported 50% reduction in urea requirement by using Hydroxypatite Nanoparticle with urea (Kottegoda et al.,2017). However, some experts have expressed concerns about acute health effects of Hydroxypatite Nanoparticles (Suppan, 2017; Scientific Committee on Consumer Safety, 2016).

Nanoparticles are nanosize particles with three external dimensions of nanosize, whereas nanomaterials have any internal or external structure with nanosize(Dobson et al., 2019). In nanomaterials at least one dimension is of 1 to 100 nm size(Armarego, 2022). Nanoparticles are isolated solid phase objects of size 1 to 100 nm. Carbon nanotubes, graphene, nanowire and fullerenes are examples of nanomaterials. Zinc sulphide, cadmium sulphide, gold, silver and aluminium are examples of nanoparticles. Nanomaterials are made from nanoparticles. In nanocomposites, one of the phases have at least one dimension in nano range of 1 to 100 nm. The nanocomposites are classified metal matrix, ceramic and polymer matrix (Ducheyne,2015; Pacheco and Buzea, 2021; Malhotra, et al., 2018).

Complete Chapter List

Chapter

Environmental, Economic, and Social Sustainability and the Virtual World

Impact of Artificial Intelligence

By
Sunil Jayant Kulkarni (/search?contributorName=Sunil Jayant Kulkarni&contributorRole=author&redirectFromPDP=true&context=ubx) (https://orcid.org/0000-0002-5988-3448)
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Book Green Metaverse for Greener Economies (https://www.taylorfrancis.com/books/mono/10.1201/9781032638188/green-metaverse-greener-economies?refId=a66b0471-f20e-47a8-bede-8828386865ff&context=ubx)

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ABSTRACT

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Next Chapter (chapters/edit/10.1201/9781032638188-8/environmental-economic-social-sustainability-virtual-world-mohd-amir-uzma-perween-abul-quasem-al-amin?context=ubx)

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Disaster Management Activities in an Indian Engineering Institute: A Case Study of Gharda Institute of Technology

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Description Appropriate and fast response to the emergency is the most important aspect of disaster management. Gharda Institute of Technology (GIT) is situated near Chiplun, Maharashtra, India. The predominant natural disasters which are frequent in the nearby vicinity like floods and water logging are not seen in the institute area due to its elevation above sea level. The possible disasters are chemical spillage, fire, and snake related issues (snake bite). Periodic mock drills and demo sessions are conducted for preparedness related to these disasters. The snake bite injections are made available at the nearby hospital. The disaster management cell of GIT has handled the COVID-19 situation with appropriate precaution. The cell conducts frequent checks on the preparedness of the concern taskforce to combat any untoward incident. The display of contact numbers of hospital, police, district level authorities brings about the …

Application of CFD in Healthcare or the Biomedical Field

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Abstract

CFD is not merely a computational tool; it is an indispensable asset with versatile applications, particularly in the biomedical field. Its role in understanding complex physiological systems and guiding decision-making in medical design and interventions through advanced simulations cannot be overstated. Whether in drug delivery systems, physiological flow analysis, surgical planning, or medical device development, CFD emerges as a rapidly developing and essential tool in biomedical research. Despite biomedical applications engage with the nuances of human physiology and internal fluid actions, the accession of high-performance hardware and software together with discoveries in computer sciences have rendered recent computational fluid dynamics (CFD) applications in the biomedical field more accessible and viable. The review paints a comprehensive picture of CFD's journey from a specialized area of mathematics to a transformative force in healthcare.

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Introduction

Recent Development in Biomedical or Healthcare

The human body and its functioning have always intrigued humankind. The legendary Father of Medicine, Hippocrates, initially identified physical ailments as the outcome of biological processes as opposed to mystical or mystic forces in 400 BC. Through the numerous works of the eminent Italian engineer Leonardo da Vinci, the very first attempt to integrate engineering and physics theories to describe the human body could be dated back to the fifteenth century. Leonardo da Vinci has been credited as the first bioengineer (Armentano and Kun 2019) and the first healthcare physicist (Kron and Krishnan 2019) thanks to his innumerable sketches and drawings which helped improve the comprehension of human physiology and anatomy. The multidisciplinary field of biomedical sciences incorporates knowledge from diverse engineering fields to look into biology, medicine, and healthcare. Biomaterials, bioinstrumentation, bioinformatics, biomechanics, medical imaging, and medical devices are merely a few instances among the multitude of subjects that can be classified within the wide umbrella of research in the biomedical field. The use of modern technology in healthcare serves as one of the primary explanations for why biomedical engineering continues to be a major field of study today and in the years to come. For instance, engineering is employed in multiple contemporary surgical

procedures, including laparoscopic surgery (Ooi et al.,2023). Significant improvements in medical treatment, particularly regarding remote monitoring of health, have been brought about by the growth of information technology (IT) (Li et al., 2019). Preventing illness and identifying high-risk individuals early on are among the primary objectives of utilising physical sensor networks (Mohammadzadeh et al., 2020). To be able to track and cure patients' conditions quickly through immediate access and continual monitoring of their health indicators, intelligent technologies and smart gadgets (As an example wearable and Astute wireless sensors) have become becoming increasingly common (Gries et al., 2018). The primary objectives of wearable sensors are for recording and tracking patients' medical problems and conditions while also performing a range of additional functions concerning well-being (Li et al., 2019; Mohammadzadeh et al., 2020).

As a way to foster more promptly and continual assessment of patients' well-being and the associated health sub-systems, an array of smart devices, Internet of Things (IoT), telemedicine, smart pills, and AI-based technologies have been envisioned and created (Junaid et al., 2022). Over the last ten years, a significant rise in interest in smart devices, specifically wearable sensors, mostly in healthcare settings. From physical (body) signs like the rate of your heart (HR), arterial blood pressure (BP), temperature of the body, oxygen consumption, and internally mobility were numerous variables to think about, these instruments search to acquire clinically meaningful health-related data (Majumder et al., 2017). In a nutshell, relevant sensible sensors and networks of wearable sensors are used to extract and share fundamental health information. There's a greater likelihood that the Internet of Things (IoT) could improve healthcare because of its increasing popularity (Muratyan et al., 2022). The expression “Internet of Medical Things” was popularized by many to describe the latest developments in micro processing, which has ramifications for the medical field (Dwivedi et al.,2022). There were 11.3 billion IoT devices in operation (Markets and Markets,2021). The medical device IoT market is projected to rising to $94.2 billion in 2026 from $26.5 billion in 2021(Sinha et al.,2023). With the aid of these advances, the healthcare sector has grown increasingly interconnected, making it hard to ignore IoT. In the years as of late the epidemic commenced in 2020, A lot has changed in telehealth. Patients and treatment teams regularly participate in online video conferences where problems are discussed, and advice is given. To make this possible, the foundational structure is in far better shape. The healthcare study connects 2021 projects that the worldwide value of telehealth solutions would reach $185.6 billion by 2026 (Fortune Business Insights,2023). One of the most innovative applications of internet of things (IoT) the concept of a “smart pill” is used in healthcare technology. (Minaam et al., 2018), which essentially shifts to the Internet of Bodies from the Internet of Things. With its many potential uses, artificial intelligence (AI) represents a fast-emerging field of research and study that is especially relevant to healthcare. Artificial intelligence's application in the battle over COVID-19, diagnosis and development of medications, psychological wellness, chatbots, and various other critical fields has shown its value in recent years (Patel et al., 2023). In 2023, the technologies that has gained attention of audiences are given in Fig 1.

Figure 1. Healthcare technology trend in 2023

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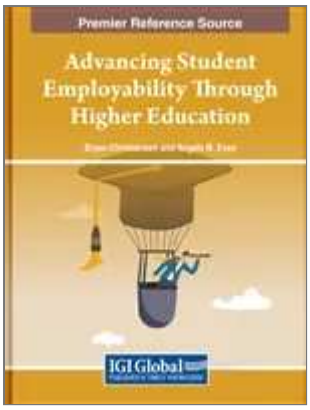
The medical sector has developed in a unique approach to preserve the same high level of assistance owing to major improvements in technology, methods essential to cater to the rising need for access to healthcare, and the accelerating the digitization of private medical data (Robert et al., 2021). Contemporary hospitals depend on its remaining infrastructure and technology, but it's important to consider how it might be updated or completely replaced by newer options. Setting priorities for efficacy, assurances, profitability, and efficiency while preserving dependability and accessibility is crucial (Patel et al., 2023). This study aims to investigate the current trends in technical advancements, such as CFD, that are propelling the the healthcare industry towards digital change up in the near future.



Strategic Plan for Research Activities in an Engineering Institute

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Abstract

Research and innovation increase the intellectual quotient of the organization. Food for good thought is always a sign of harmony. The enhancement of the research activities through research projects of students has twofold benefits in terms of tangible outcomes and accreditation points. Funding applications to various funding organizations shall provide the resources required for the research. Taking up industrial problems can help staff and students to realize real-life problems and learning problem-solving methodologies. Various activities by innovation and research-related committees are aimed at improving paper writing skills, awareness of intellectual property rights, and solving real-life problems through technological innovation. The current document sheds light on the measures taken at Gharda Institute of Technology, Maharashtra in recent past and strategic planning for academic year 2023.

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Introduction

Basic elements involved in the strategic plan for the improvement in research activities are innovation, sustainability, societal responsibility, ethical and moral values and lifelong learning. The employability of undergraduate student depends on skills, knowledge, personality, team work, problem solving ability, communication, leadership and motivation (Hossain et al., 2023). The research activities in undergraduate institutes are becoming important aspects of education as they address some key factors related to employability. Undergraduate (UG) projects are categorized as research, design and manufacturing projects at UG studies of Mumbai university. Gharda Institute of Technology follows Mumbai university curriculum and focuses on obtaining the outcomes of UG projects through the strategic planning and its implementation (R and D Cell Gharda Institute of Technology, 2023).

Outline of the Book Chapter

The book chapter starts with introduction containing fundamentals of research and its categories. The relationship between the undergraduate research and employability is highlighted in introduction. The concept of strategic planning is explained at the end of the introduction. Second section contains some case studies of strategic planning for research and development by various

organizations. Third section is devoted to objectives, goals and actions for developing research culture that are adopted by Gharda Institute of Technology. Fourth section discusses the strategic planning for 2023 for UG research followed by fund allocation strategy for the same, followed finally by conclusion.

Employability and UG Research

UG institutes needs to focus on research appetite of the students and communication skills to make them employable (Finch et al., 2013). Undergraduate students need be provided with the skills required in the modern industry set up. Critical thinking and intellectual abilities need to be inculcated since the innovation in technology is spearheading in the development agenda of most of the countries. Needs of the students required to be considered in developing them into employable graduates (Zhang, 2022). Feeding the intellectual ability and critical thinking can be promoted through UG research projects. The student's ability to evaluate their own interest depends on their understanding of the subject and ability to carry out innovative thinking. This aspect can help them choose the career that can boost their employment selection and longevity in the job (Kazi & Akhlaq, 2017). Providing the engineering education at higher secondary level can be an option to develop engineering professionals that are competent and intellects. Thus, education can be integrated with P 12th grade (Brophy, 2008). Qualitative, quantitative and mixed research approaches are essential for engineering education (Borrego et al., 2009).

Attributes such as self-reliance, resilience, problem solving ability are becoming important along with the domain knowledge for employability (Kunal & Jon, 2023). The factors such as institutional, individual, employer's perspective and contextual approach play vital role in the employability of students (Shumilova & Cai,2015). Proving a well-structured education to develop domain specific knowledge, developing temperament and ability to develop problem solving metrologies are important aspects in institutional contribution to student employability. Research and development activities needs to be planned strategically with setting goals, objectives and activities in time specific manner to bring clarity among the stakeholders.

Complete Chapter List

Investigation on Factors Affecting Batch Drying

Publisher: IEEE

Cite This PDF

Gaikwad Vaibhav Santosh ; Chavan Mayuresh Santosh ; Chavhan Prasad Ramakant ; Kulkarni Sunil Jayant **All Authors**

Abstract:
In industries including medicines, agriculture, food, fertilizers, and chemicals, drying is among the most crucial processes. It is always desirable to dry the product in... **View more**

Metadata

Abstract:
In industries including medicines, agriculture, food, fertilizers, and chemicals, drying is among the most crucial processes. It is always desirable to dry the product in less time and area. The drying operation reduces the weight of the product and decreases the transportation cost. Time required for drying, rate of drying, humidity present in fresh air, air velocity, thickness of material are the most important factors for drying operation. In batch drying, pasty materials including wet filter cakes, lumpy solids, and pastes that may be distributed across trays are commonly dried using tray dryers. Hot air is continuously blown on the surface of the trays. Hot air absorbs moisture present in the solids and exhaust air becomes humid. Different types of batch dryer equipment's are used in industries based up on their role, efficiency, drying rate etc. In the current studies, the impact of air velocity, cake thickness, and air temperature on dryer performance parameters is investigated. Different drying conditions are shown and explained using drying curves. The time required for drying is calculated theoretically and compared with practical time. In drying of foods & vegetables observe that the taste, texture, flavor and color changes, in some cases hardening case occur. It was noted that drying rate decreases with time but improved with air velocity and temperature.

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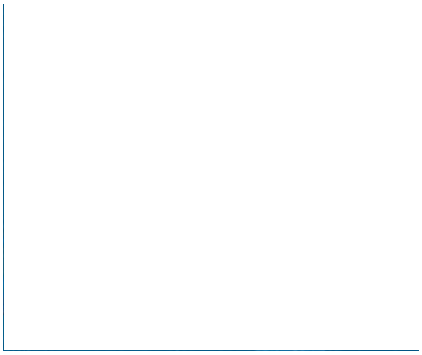
Contents

I. Introduction

The operation of drying involves the removal of volatile liquid or moisture (water) from wet solids using thermal energy. Usually, the primary objective is to dry out little bit of moisture from solid materials. Drying is a mass transfer operation where heat is transferred from vapor to solid so mass is transferred from solid to vapors as well moisture. Using thermal energy, drying procedures try to remove a relatively tiny amount of water and other liquids from solid or semi-solid objects. In contrast, evaporation involves the removal of larger quantities of water from solutions. Drying is performed at temperatures below the boiling point of water, while evaporation occurs at the boiling point, converting water into vapor [1].



Removal of Organic Matter from Wastewater by Adsorption using Coconut Coir as Adsorbent

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Madre Zeeshan Gulam Husain ; Wagle Kaif Zikriya ; Kamble Niraj Shailendra ; Musef Mansoor Nalband ; Dr Sunil Jayant Kulkarni All Authors

Abstract:
The process of adsorption involves the adhesion of the pollutant (solute) to the solid surface (adsorbent). The purpose of the work is to analyse the mechanism of uptake ... **View more**

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Abstract:
The process of adsorption involves the adhesion of the pollutant (solute) to the solid surface (adsorbent). The purpose of the work is to analyse the mechanism of uptake of organic matter present in wastewater through activated material sorbent derived from various starting materials and coconut coir by varying various parameters. The phenomenon occurs due to van der Waals forces which exist between the molecules. Adsorbents for wastewater treatment included coconut coir and activated carbon. Due to the high porosity of Activated Carbon and Coconut Coir they act as an excellent adsorbent for adsorption. Coconut shells were crushed up to 50mm and heated in a Hot Air Oven at 300°C for about 45 min which removes its moisture and increases its porosity. Effluent used for the project was collected from an industry whose oxygen demand(chemical) was 440 ppm with a pH of 4.36. Batch absorption with different parameters like dosage of adsorbent, concentration and pH were studied. Adsorption increases as adsorbent levels increase. Effluent was treated with adsorbent for 90 min on a mechanical rotary shaker. 4gm of coconut coir and 5 gm of activated carbon was the optimum weight required for 50 ml of effluent for the maximum removal of matter. Percentage removal for 4 gm of coconut coir was 89.09% and 5 gm of activated carbon was 90.90%. 7.1 pH was found out to be suitable for maximum adsorption for both coconut coir and activated carbon. To evaluate adsorption data for activated carbon and coconut coir Langmuir and Freundlich Isotherm models were used.

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Contents

India is growing economy and the process of economic development has its own footprints. The development of various sectors is envisaged. This aspect has brought about spread of industrial development in rural and semi urban region. One of the aspects of this development is, its effect on the ecology of the ecosystems. The air and water quality need more and more attention amidst this growth. Chemical engineering sector always face the ethical issues. Pollutants in the wastewater are broadly classified as organic and inorganic. Treatment of wastewater is important aspect of the environmental awareness programs. Removal of organic matter from wastewater is very important aspect of wastewater treatment. Firstly, in initial days of industrialization, meeting the pollution control norms was a major concern. The norms are becoming more stringent and the need for reuse of wastewater is being realized by government and industrialist. Considering the present and potential problem of water scarcity, treatments are now focused on water reuse.

Optimization of Parameters and Modelling for Breakthrough Curve for Chromium Removal in Fixed Bed

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Abstract

Wastewater released from industrial activities is loaded with heavy metals such as nickel, arsenic, lead, zinc, copper, cadmium, chromium. The current investigation is conducted to remove the hexavalent chromium (Cr VI) from the simulated wastewater by adsorption process using activated carbon. Experimental studies were carried out in batch and continuous mode. For studying the fixed bed, namely bed height, concentration and flow rate at the inlet were varied. In batch studies, as the initial concentration of the sample, contact time of adsorption and adsorbent dosage for the given initial concentration increases, adsorption also increases. The optimal pH value is in the acidic range. Isotherms were plotted and studied to understand the adsorption. For fixed bed, increasing concentration decreases the breakthrough time. Experiments show that the time required for exhaustion reduces when there is increase in flow rate and concentration. Fixed bed adsorption results were fitted to the models like Yoon-Nelson and Thomas.

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1. Introduction

Rapid industrialization and technological advancements result in heavy waste water pollution which is a global concern due to disposal of elements like heavy harmful metals such as copper, zinc, nickel, chromium, lead and iron into the water streams (Kulkarni et al., 2018). Pollution of lakes, rivers and other water streams is caused by the release of heavy harmful metals in them which is a huge threat to not only to human beings but also to the flora and fauna of various water bodies. In high dosage, chromium and lead are carcinogenic in nature which creates a risk for human health and flora and fauna of water bodies. Lead, which is a heavy metal, is classified under toxic category while other heavy metal i.e., chromium is classified under micronutrient category and thus, intake of even small concentration of chromium is lethal to the people's health. Heavy metals are introduced in the human body via various ways like drinking water, animal feed, pharmaceutical medicines, green fodder, etc. These heavy metals can be accumulated in the human body directly or indirectly via the food chain. These toxic metals can enter drinking supplies as the industrial waste water is introduced in the water streams. According to WHO, chromium concentration in industrial

wastewater should be 1 mg/l maximum. Excessive uptake of chromium in the human body results in capillary damage, irritation to central nervous system, gastrointestinal irritation and hepatic and renal damage. These metals can get accumulated in the soil causing the agricultural damage. In drinking water, concentration of lead and chromium must be 0.05 mg/l at maximum which is recommended by the World Health Organization (WHO). Because of all these harmful effects, it is extremely necessary to remove these toxic heavy metals before releasing them into the environment. For removal of heavy metals, various methods like reverse osmosis, electro floatation, ion exchange, chemical precipitation, electro dialysis, membrane separation, biological separation, adsorption, etc. are employed. From these different methods, we will use the adsorption method.

During the recent years, the usage of adsorption for treatment of waste water has become more prevalent due to its effectiveness and cost-effectiveness for removing pollutants (heavy metals) from waste water. Chromium has broad applications in different industrial processes. The inappropriate disposal of chromium from various industrial sources leads to the pollution and it has adverse effects. The adverse effects of chromium on the plants, humans, environment and animals include mutagenic, carcinogenic effects, tissue damage and teratogenic effects (2). Cr(III) and Cr(VI) are the two states of chromium ions known as trivalent and hexavalent state respectively. Cr(III)can be used as an important trace element. On the other hand, Cr(VI) is non-essential and toxic in nature which causes various diseases like dermatitis, gastric and kidney damage, lung cancer, respiratory tract and eye irritation (Mitra et al., 2017). Therefore, it is necessary to reduce its concentration in waste water before getting released into the aquatic system and getting included in the food chain. The conventional processes used for chromium removal include Cr(VI) immobilisation or reduction of toxic Cr(VI) to less toxic Cr(III). Some methods for removal of hexavalent chromium involve methods like solvent extraction, membrane filtration, electrokinetic procedures and leaching (Mitra et al., 2017). The mentioned processes are of high cost. Thus, adsorption of chromium on the various adsorbent materials like activated carbon, titanium dioxide, goethite, zeolites, etc. is a low-cost method which has design flexibility and also easy to operate.

Adsorption is a surface phenomenon. In this mass transfer process, molecules get accumulated on the surface of another slid surface. It can be also stated as a physical or chemical bonding of molecules on the surface(active sites) of material through Van der Wall forces or by chemical bonding on the surface with the active sites (Amal, 2018). In adsorption, adsorbate is a material which gets attached to the surface of adsorbent. Adsorbate is the solid particle or molecule which is going to adsorb on another surface i.e., effluent particle while adsorbent is the solid surface on which molecules are going to adsorb; e.g., carbon, zeolite, porous clays, etc. For the treatment of waste water, the commonly used adsorbent is activated carbon as it has ability of adsorbing various organic compounds.

Combinations of Biotechnology and Nanotechnology in Industrial Wastewater Treatment

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Abstract

Wastewater treatment by effective and economical methods is an area of investigations in environmental research. Biotechnological methods are used in the treatment technologies commonly in the form of activated sludge and trickling filters. Nanomaterials for sorptive removal of pollutants have advantages like high surface area, selectivity, and percentage removal. Silver and iron nanoparticles are used for treatment of effluent for contaminant removal. Termed as green synthesis, these biotechnology-based synthesis methods are environment friendly and sustainable. Various treatment technics such as membrane bioreactors, photocatalysis, adsorption, etc., can be made more effective and customized for specific pollutant using nanotechnology approach. The combination of these two methods termed as nanobiotechnology and bionanotechnology, based on transfer of direction advantages, has potential to address the issue of many biological and nonbiological contaminants in wastewater which cannot be effectively removed by other advanced methods.

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Introduction

Conventional wastewater treatment contains physical, chemical and biological treatments. The biological molecules incorporated in nanoparticles have distinct advantages in term of specificity of binding which can be utilized for capturing chemicals from environment. Presence of microbial community in pharmaceutical and healthcare discharge wastewater poses the challenges like change in antibiotic resistance and difficulty in its removal from wastewater. Nano-materials like silver nanoparticles are good antimicrobial agents. Advantages of nanofiltration can be coupled in membrane bioreactor to utilize advantages of biotechnology and nanotechnology for such cases (Al-Gheethi et al., 2020; Lu, et al., 2016; Malik et al., 2022; Rai et al., 2022). Thus, integration nanotechnology with various biological treatments namely microbial fuel cell, aerobic digestion, membrane bioreactor and biosorption can overcome the limitations and offer acceptable solution for wastewater treatment (Al-Gheethi et al., 2020; Lu, et al., 2016; Malik et al., 2022; Rai et al., 2022). This book chapter aims to shed light on applications of combination biotechnology and nanotechnology for wastewater treatment. The green, biotechnology-based modification and synthesis of nanomaterial and

nanoparticles that can be used for wastewater treatment is discussed in the chapter. Also, it contains review of literature on the application of nanomaterial for wastewater treatment containing various pollutants namely heavy metals, pathogens, pesticides and dyes.

Brief Description of Industrial Wastewater Treatment Problem

The treatment of industrial wastewater is one of the major focus areas in modern industrialization. With increased awareness and stringent norms, research in wastewater treatment processes is promoted by government as private sector. The reuse, recycle and reduce (Three R) philosophy has become popular. The effluent which used to be treated to meet the regulatory norm and disposed off in the reservoir needs to be treated further to render usefulness, either in domestic, agricultural purposes. Some investigations are also focused on making it potable. Disinfection becomes crucial in such cases. The effluent needs to be treated with advanced treatment techniques to make it useful for various applications. In addition to conventional treatments, the need of specific advanced treatment methods is highlight of modern effluent treatment processes. Various advanced treatments include, advanced oxidation methods, cavitations, membrane bioreactors, adsorption on carbon nanotubes and ion exchange.

Concept of Nanotechnology and Its Advantages

Nanoparticles are being explored for adsorption of specific pollutant from wastewater. Nanoparticles are unique in terms of their properties. Nano-biotechnology aims to utilize advantages of nanotechnology to biotechnology and exploit nanotechnology-based systems and biomemitic technologies to synthesize nanostructures. Biological wastewater treatments are inherent part of conventional treatment methods for wastewater. Nanoparticles are finding application in modern wastewater treatment methods due to greater surface area, specificity, excellent catalyst and adsorption properties. Carbon nanotubes, titanium oxide, magnesium oxide are some common nano-adsorbents used in wastewater treatment.

Complete Chapter List