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The Function of HAK as K^+ Transporter and AKT as Inward-Rectifying Agent in the K^+ Channel

Moumita Chatterjee, Pallabi Ghosh, Supatra Sen, Dwaipayan Sinha & Sharmistha Ganguly

Chapter | First Online: 30 October 2022

Abstract

Potassium (K^+), a vital macronutrient regulates different physiological processes such as osmoregulation, pH balance, maintenance of turgor pressure, activation of an enzyme, membrane electric potential regulation, and expansion of the cell. A huge amount of K^+ is accumulated by plants in their cell vacuole. In higher plants, K^+ transportation regulated by transporter protein of two classes depending on the concentration of K^+ varies from micromoles (µmol) to millimoles (mmol). If the K^+ concentration is high in soil, then K^+ crosses the cell membrane through the K^+ channel, whereas at lower K^+ concentration, active transport system is essential for the influx of K^+ against cell electrochemical gradient. Salinity and K^+ deficiency reduced cellular K^+ content, and drought induced the K^+ concentration inside the cell vacuole. Not only dicotyledonous but also monocotyledonous plants possess HAK transporter gene, expressed mainly in roots, and have high affinity toward K^+ showing enhanced expression during K^+ starvation condition. The C terminal binding site, that is, AKT and nucleotide binding site of some K^+ transporter protein, regulates the process of binding with cytoskeleton without helping in the interaction between the subunits of K^+ channel protein. In the tissue of the root, the AKT acts as an inward-rectifying agent, and it has sensory property toward the K^+ channel and thereby plays a vital role in the translocation of K^+ through the vascular bundle. AKT-mediated K^+ absorption gets hampered due to the presence of nitric oxide (NO), which gets accumulated during salinity stress. CO_2 assimilates, and light upregulates AKT expression in the plant. These transporter proteins help plants to overcome unfavorable environmental situations like drought, salinity, and deficiency of potassium. These two proteins play a pivotal role in salt tolerance, thereby controlling different metabolisms of plants. So, the authors have made an effort to bring all the possible and relevant information in the present chapter, related to these proteins, which will help in better understanding of the physiological role and structure of the two transporter proteins.

Keywords

K^+ transportation | HAK | AKT | Potassium deficiency | Salinity | Stress response

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Re-designing the pension business processes for achieving technology-driven reforms through blockchain adoption: A proposed architecture

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ABSTRACT

High administrative costs and associated operational inefficiencies present multiple challenges for pension industries across different countries. Although blockchain is considered a potential solution for these concerns, the pension industry has not fully leveraged this disruptive technology. This paper provides a blueprint for a blockchain-based end-to-end digital transformation of the pension industry. First, we identified the pre-requisites for blockchain adoption in pension. Then, we developed an architectural design of blockchain-based re-designed pension business processes. Subsequently, we elaborated on how smart contracts can make pension transactions in such redesigned processes optimized, automated, and error-free. Finally, we presented how blockchain can be integrated with the existing pension IT systems, using an API layer, to enable seamless onboarding of all pension participants to a single digital platform – a critical ask for any blockchain implementation. We concluded with an elucidation of the potential of such blockchain-based digital transformation of the pension industry in reducing turnaround time, lowering operating expenses, and facilitating the achievement of other pension reform agendas. This architecture of a blockchain-enabled pension network represents a flexible and scalable knowledge construct that can act as a foundation for further investigations by pension regulators or pension industry participants interested in achieving technology-driven pension operations reforms.

1. Introduction

An additional annual charge of only 1% of funds under management reduces the accumulated value of retirement savings by more than 17% over a 30-year contribution period (assumed 5% yearly interest and no growth in annual contributions).[1] Managing the cost of retirement products is critical given its implications on the rate of returns and cost of old age income security (Bikker and Dreu, 2009; Mielonen et al., 2013). Nevertheless, high administrative cost remains a critical issue for pension industries across several countries, be it defined contributions or defined benefits schemes (Benish et al., 2017). Additionally, low returns on retirement savings and low growth of pension assets feature as other prominent pension challenges in many countries (OECD, 2018). These negatively affect both pension accumulation (replacement ratio) and plan subscribers' participation rates.

Various countries are adopting several control measures to address these issues, like implementing cost transparency across competing pension schemes (Federation of the Dutch Pension Funds, 2016), capping the cost of particular pension products (Rofman et al., 2009; MPFA, 2017), and achieving economies of scale through collective and centralized pension fund management services (Ashcroft and Stewart, 2010). Such is the criticality that some countries are, also of late, encouraging work after pension age and discouraging early retirement (World Bank, 2020). However, implementing these measures often becomes difficult due to some limiting factors, namely the industry's maturity level, scheme features, and socio-demographic factors.

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SURVEY AND ROLE OF MANGROVES IN DISASTER MITIGATION IN NAMKHANA, WEST BENGAL: PROTECTION OF COASTAL ZONE

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Abstract

The Mangroves provides support in various ways regarding the safeguarding of the coastal section from the exasperation of environmental disasters instigated due to alteration of weather pattern, specifically providing so as to fight against the consequences like rising sea level, invasion of salt water, seaside soil weathering, superstorm upsurge, and devastation due to cyclone. Altogether, they behave as a line of defence to the coastal areas where they endure. The cyclone exerts a lesser amount of destruction due to the presence of the mangrove delta.

Keywords-Mangroves, coastal area protection, tropical cyclone, salinity rise, mangrove species.

Introduction

Mangroves are a spread of littoral plant formations that are found along tropical and subtropical shielded coastlines. Mangroves are halophytic shrubs that germinate underneath the highwater mark of spring tidal flow and have an intriguing capacity for saltwater forbearance. Mangroves are salt-defiant and heat-defiant plant genres that developed in tropical and subtropical seashore areas. Mangrove families, predominantly the mangrove forests in India, have a spread of adaptations in their anatomy, morphology, and physiology to enable them to measure in wet soils, high salinity, storms, and tide surges. Mangrove forests are especially found round the equator in tropical and subtropical latitudes. The mangroves show extraordinary characteristics like pneumatophores which stand up straight and creep on the ground. They serve humans for both economic purposes and their daily livelihood needs like wood, medication, and honey (Tabuchi, 2003). They also play a crucial role in providing shield to human life and their property and belongings from the hands of various marine catastrophic events like cyclones and floods.

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Thymoquinone incorporated chitosan-sodium alginate/psyllium husk derived biopolymeric composite films: A comparative antibacterial and anticancer profile

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Interactions of Ag nanoparticles with humic acid present in surface water

Srijita Basumallick

Applied Water Science **12**, Article number: 48 (2022) | Cite this article

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Abstract

The present paper reports aggregation behaviour of humic acid (HA) in the presence of silver nanoparticles. Aggregation behaviour has been studied from dynamic light scattering (DLS) measurement, in the presence of silver nanoparticle. Silver nanoparticle has been prepared through chemical route and characterized by plasmon resonance spectroscopy. HA used in the study has been characterized by UV–Vis and fluorescence study; its charged state has been evaluated from the study of its interaction with a cationic dye ruthenium bipyridine. It has been found that HA forms small–medium- and large-sized aggregates in the presence of silver nanoparticle as obtained from DLS diameter. The result has been explained in terms of Langmuir–Hinshelwood adsorption model. It has been proposed that hydrogen bonding and hydrophobic interaction play an important role in the formation of aggregates of HA.

Introduction

According to the WHO report (Drinking water 2017; Banik and Basumallick 2017), globally 2 billion people uses a contaminated water source for drinking water. Again, about 144 million people use surface water (Drinking water 2017) without any treatment. Thus, purification of water for a safe drinking purpose is a major challenge of the day. Recently, Inamuddin et al. have nicely reviewed (Mashkoor et al. 2020) the use of carbon nanotubes for the removal of dyes from contaminated water. Inamuddin et al. also recommended the use of organic–inorganic composite exchanger (Mohammad and Inamuddin (2015), Inamuddin (2010) for water purification. Banik and Basumallick 2017; Basumallick and Santra 2017) reported a cost-effective method of removal of humic acid (HA) from surface water using ZnO nanoparticles and sun light using photo-Fenton-type reaction. Santra and Basumallick Banik and Basumallick (2017), Basumallick and Santra (2017) designed a fluorescence sensor for the detection of ppm level HA in surface water.

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Research Article

Selection of Additive Manufacturing Machine Using Analytical Hierarchy Process

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3D printing or additive manufacturing (AM) is considered to be the most important technology among the emerging technologies. 3D printing technology is considered as an alternative to the conventional manufacturer machine traditionally used in the manufacturing sector. 3D printing technology is generally classified into seven types. Each type of 3D printing technology has its separate own uniqueness (i.e., operation, material usage, and no wastage). The price of a manufactured item includes all its costs. The most important of these is to take into account the price of the machine being manufactured and the features of the machine. Moreover, the price of the product produced in AM will depend on all the costs required to produce it. Then, it is possible to reduce the cost of the product by choosing the AMM that has significant features and the right price. Therefore, this paper aims to solve a decision-making problem from the AMM selection by using one of the multicriteria decision-making (MCDM) tools, i.e., analytical hierarchy process (AHP). This paper outcome is meant to meet the expectation of end-users. As an initial step, the Micro, Small, and Medium Enterprise (MSME) company gets quotations from some AM companies to choose a type of AM machine known FDM for its structure product and doll product. The first step is to select the most appropriate machines based on cost, size/volume, extruder type, and weight of the machine. Criteria for AHP are derived from decision-makers. Also, in AHP, the pair-wise matrix is obtained from the decision-makers by answering the standard Saaty's scale criteria questions. In this paper, such a selection method is explored. The outcome of this paper may vary depending on the expectations of the decision-makers. The end of this paper helps to choose the AMM with the right price and features to suit the decision-makers.

1. Introduction

AM is a method of converting a digital file into an STL file or suitable file format (OBJ, VRML, etc) and producing the products layer by layer directly [1]. From this, we can easily produce even the most rigorous geometric materials. According to previous literature [2], the selection process is a major issue in fields such as defense and manufacturing that involves the decision-making of end-user [3]. Therefore, choosing the right AMM in the production cycle or integrated design product can be very difficult. The raw materials used in 3D printing are in the form of filament or powder or resins (metal, polymer, and plastic) [4, 5]. Each AM process has an individual separate feature of its own. Before choosing an AM machine, we should know the preference of the machine buyer as well. Moreover, qualitative data play a vital role in maintaining performance in this competitive environment. At this time, everyone needs decision-making tools with qualitative and quantitative data as well. The choice of the decision-maker and the right machine, however, involves a psychological and mathematical factor. This paper combines the two features mentioned above to help the MSME company select a suitable and highly user-friendly AMM. This paper covers the attitudes and

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Research Article

Fault Diagnosis Using Data Fusion with Ensemble Deep Learning Technique in IIoT

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Detecting the breakdown of industrial IoT devices is a major challenge. Despite these challenges, real-time sensor data from the industrial internet of things (IIoT) present several advantages, such as the ability to monitor and respond to events in real time. Sensor statistics from the IIoT can be processed, fused with other data sources, and used for rapid decision-making. The study also discusses how to manage denoising, missing data imputation, and outlier discovery using preprocessing. After that, data fusion techniques like the direct fusion technique are used to combine the cleaned sensor data. Fault detection in the IIoT can be accomplished by using a variety of deep learning models such as PropensityNet, deep neural network (DNN), and convolution neural networks-long short term memory network (CNS-LSTM). According to various outcomes, the suggested model is tested with Case Western Reserve University (CWRU) data. The results suggest that the method is viable and has a good level of accuracy and efficiency.

1. Introduction

Connected gadgets are commonplace in the IoT, a computing paradigm that relies on ubiquitous Internet connectivity. These smart things can sense their surroundings, transmit, and analyze the data they collect from the environment and then return relevant details to their surroundings in a form that can be understood by humans. M2M technologies with applications in the automation industry make up a subset of the IIoT, which is a subset of the IoT. Improved production efficiency and long-term viability are two key benefits of the IIoT's [1, 2] introduction to the industry. For Industry 4.0, which is enabled by the integration of cloud technologies and cyber systems, a wide range of sensors are being installed around the industrial operational situation and tackled. Proactive maintenance and a reduction in unplanned downtime can be achieved by the use of [3–7] data analysis technologies.

If some measures are missing owing to network or hardware subjects in the IIoT, then we must have a working mechanism in place. The problem of value imputation becomes crucial when sensor data contain many missing values. High-frequency data collection results in large gaps between data points, and all measurements taken during that period are lost if the network goes down. When data are missing [8], it could be because of a sensor failure or a network failure, or because hackers have removed data with malicious intent while it is being collected, processed, stored,

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Stochastic Learning in Kolkata Paise Restaurant Problem: Classical and Quantum Strategies

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We review the results for stochastic learning strategies, both classical (one-shot and iterative) and quantum (one-shot only), for optimizing the available many-choice resources among a large number of competing agents, developed over the last decade in the context of the Kolkata Paise Restaurant (KPR) Problem. Apart from few rigorous and approximate analytical results, both for classical and quantum strategies, most of the interesting results on the phase transition behavior (obtained so far for the classical model) uses classical Monte Carlo simulations. All these including the applications to computer science [job or resource allotments in Internet-of-Things (IoT)], transport engineering (online vehicle hire problems), operation research (optimizing efforts for delegated search problem, efficient solution of Traveling Salesman problem) will be discussed.

Keywords: collective learning, critical slowing down, decoherence, KPR problem, minority game, quantum entanglement, three-player quantum KPR

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1. INTRODUCTION

Game theory was initially developed to investigate different strategic situations with competing players (Morgenstern and Von Neumann, 1953). Of late, the concept of game theory is being applied to different statistical events to measure the success rate when one's success depends on the choice of the other agents. The game of Prisoners' dilemma (refer to e.g., Prisoner's Dilemma, 2019) is a popular example where two non-communicating (or non-interacting) agents choose their actions from two possible choices. It is a two-person, two-choice, one-shot (one-time decision) game. The Nash equilibrium (refer to e.g., Osborne and Rubinstein, 1994) solution employs the strategy, where the other player can not gain from any of the choices, and both the players necessarily defect. However, this is not a Pareto optimal solution (refer to e.g., Lockwood, 2008), where no change in the decision can lead to a gain for one player without any loss for the other. This problem has been used to model many real life problems such as auction bidding, arms races, oligopoly pricing, political bargaining, and salesman effort.

The minority game theory (refer to e.g., Challet et al., 2005) generalizes this idea of a very large number of non-communicating players with two choices for each of them. As the name suggests, the players who make the minority group choice (at any time) receive a payoff. This game is not a one-shot game, and the players learn from their previous mistakes (loss of payoffs) and continuously try to upgrade their respective strategies to gain the payoffs and they (the society as a whole) learn collectively to reach a level of maximum efficiency, where no one can improve their payoff any further. A phase transition (refer to e.g., Challet et al., 2005) occurs at

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SHORT PAPER

Visual attention-based deepfake video forgery detection

Shreyan Ganguly[1] · Sk Mohiuddin[2] · Samir Malakar[2] · Erik Cuevas[3] · Ram Sarkar[4]

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Abstract
The prime goal of creating synthetic digital data is to generate something very closer to real ones when the original data are scarce. However, the trustworthiness of such digital content is dipping potentially in society owing to malicious users. Deepfake method that uses computer graphics and computer vision techniques to replace the face of one person with the face of a different person is becoming an area of big concern. Such techniques can easily be used to hide the identity of a person. Therefore, a method is needed to verify the originality of such face images/videos. To this end, we design a deep learning model enhanced with visual attention technique to differentiate manipulated videos/images (generated by deepfake methods) from real ones. At first, we extract the face region from video frames and then pass the same through the pre-trained Xception model to obtain the feature maps. Next, with the help of the visual attention mechanism, we mainly try to focus on the deepfake video manipulation leftover artifacts. We evaluate our model on two publicly available datasets, namely FaceForensics++ and Celeb-DF (V2), and our model outperforms many state-of-the-art methods tested on these two datasets. Source code of the proposed method can be found at: https://github.com/tre3x/Deepfake-Video-Forgery-Detection.

Keywords Deepfake · Visual attention · Video forgery · Deep learning · FaceForensics++ · Celeb-DF (V2)

1 Introduction

The advent of generative adversarial networks (GANs) [1] has opened up many new research avenues in the computer vision domain since the last few years. Undoubtedly, the most important task tackled by GANs is to generate new synthetic samples from an existing collection of samples where the original samples are scarce. The goal of these GANs is to generate new unseen data, mostly images, from scratch, which is possible by extensive training of generative and discriminative models on the original set of data. Some of the important applications of GANs include cartoon character generation, clothing translation, high-quality image generation, etc. However, this synthetic data generation has some negative implications for society that raises some security issues. For example, one can easily generate an almost realistic but artificial image/video by manipulating the target image/video with the help of GANs. Such scenarios create a new research problem which is the detection of a manipulated image/video produced by some means using machine learning or deep learning models.

The continuous evolution of GANs has resulted in the generation of high-quality digital data with minimal observable error, which makes authentication of these synthetic

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Expert Systems with Applications
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ViXNet: Vision Transformer with Xception Network for deepfakes based video and image forgery detection

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Abstract

With the advent of image generative technologies, there is a huge growth in the development of facial manipulation techniques that allow people to easily modify media data like videos and images by changing the identity or facial expression of the target person with another person's face. Colloquially, these manipulated videos and images are termed "deepfakes". As a result, every piece of content in digital media comes with a question — is this authentic? Hence, there is an unprecedented need for a competent deepfakes detection method. The rapid changes in forging methods make this a very challenging task and thus generalization of the detection methods is also of utmost required. However, the generalization strengths of the prevailing deepfakes detection methods are not satisfactory. In other words, these models perform well when trained and tested on the same dataset but fail to perform satisfactorily when models are trained on one dataset and tested on another. The most modern deep learning aided deepfakes detection techniques looked for a consistent pattern among the leftover artifacts in specific facial regions of the target face rather than the entire face. To this end, we propose a Vision Transformer with Xception Network (ViXNet) to learn the consistency of these almost imperceptible artifacts left by deepfaking methods on the entire facial region. The ViXNet comprises two branches — one tries to learn inconsistencies among local face region specifics by combining patch-wise self-attention module and vision transformer, and the other generates global spatial features using a deep convolutional neural network. To assess the performance of ViXNet, we evaluate it using two different

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ORIGINAL ARTICLE

An iterative approach to unsupervised outlier detection using ensemble method and distance-based data filtering

Bodhan Chakraborty[1] · Agneet Chaterjee[2] · Samir Malakar[3] · Ram Sarkar[2]

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Abstract
Outlier or anomaly detection is the process through which datum/data with different properties from the rest of the data is/are identified. Their importance lies in their use in various domains such as fraud detection, network intrusion detection, and spam filtering. In this paper, we introduce a new outlier detection algorithm based on an ensemble method and distance-based data filtering with an iterative approach to detect outliers in unlabeled data. The ensemble method is used to cluster the unlabeled data and to filter out potential isolated outliers from the same by iteratively using a cluster membership threshold until the Dunn index score for clustering is maximized. The distance-based data filtering, on the other hand, removes the potential outlier clusters from the post-clustered data based on a distance threshold using the Euclidean distance measure of each data point from the majority cluster as the filtering factor. The performance of our algorithm is evaluated by applying it to 10 real-world machine learning datasets. Finally, we compare the results of our algorithm to various supervised and unsupervised outlier detection algorithms using Precision@n and F-score evaluation metrics.

Keywords Outlier detection · Unsupervised learning · Iterative approach · Ensemble method · Distance-based filtering · Dunn index

Introduction

Outliers or anomalies are data objects which show different behavior to the rest of the data in a particular dataset. Outliers are generally caused due to errors that occurred during data entry, data measurement, data sampling, data processing along with natural and experimental errors, and many more. Outlier detection is an important application domain of machine learning and such algorithms are commonly used in fraud detection [1], network industry damage detection [2], healthcare analysis [3], surveillance [4], security [4], intrusion detection [5] and many more.

Detection of outliers is a challenging task as it involves the proper modeling of actual data and outliers. Different flavors of data possess unique challenges. The outlier hypothesis in one domain might not be applicable in another disparate problem. Sometimes, the difference between actual data objects and outliers is minimal, and hence classifying certain abnormalities in data as outliers is quite challenging. The variations on which data objects are classified as outliers vary with the domain of applications [1]. For example, small variations in observed data are neglected in the case of a stock market analysis or fraud detection but in the case of medicinal domains like healthcare such variations cannot be ignored.

The field of outlier detection has been researched extensively in past and various algorithms have been developed to deal with the problem of outlier detection. Such algorithms are generally classified into three common categories namely, supervised method [6], unsupervised method [6], and semi-

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ORIGINAL ARTICLE

Handwritten Arabic and Roman word recognition using holistic approach

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Abstract
The research community considers handwritten word recognition (HWR) as an open research problem to date. The reasons behind this are variations in intra-/interpersonal writing style, overlapping and/or touching characters in a word, degraded scanned document images, etc. Two major approaches, namely holistic and analytical, are followed by the researchers while designing an HWR system. In this work, we have followed the holistic approach as it works well on limited and predefined lexicon as compared to the analytical approach. As observed in the literature related to handwritten word recognition, irrespective of the approaches, researchers generally extract various local features from hypothetically partitioned segments of a word image while dealing with the said problem. However, no such work has been found which has considered inter-segment similarity that might carry some distinct information about different patterns (here, word segments). To this end, in the present work, we have used Hausdorff and Fréchet distances to quantize the similarity among all possible word segments taking two at a time. Along with this, conventional chain code histogram (a shape-based feature descriptor) and modified negative refraction-based shape transformation features have been used. Finally, a majority voting schema is used to combine outputs from six different classifiers. The model has been evaluated on two standard databases, namely IAM and IFN/ENIT, and the results obtained are promising in comparison with state-of-the-art holistic word recognition methods. Moreover, a performance comparison of the present method with some deep learning models confirms the usefulness of the proposed method.

Keywords Handwritten word recognition · Document image · Hausdorff distance · Fréchet distance · IAM and IFN/ENIT database

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1 Introduction

Word recognition from handwritten documents is one of the widespread research problems in the domain of document image processing as it has a wide range of real-life applications like postal automation [1, 2], bank check processing [3, 4] and document searching and categorization based on keywords [5–7]. In general, two different approaches to performing handwritten word recognition (HWR) have been followed by the research fraternity: the analytical approach [8–10] and the holistic approach [11–13]. The methods that follow the first approach segments a word image into its constituent characters through some word segmentation approach [8–10, 14, 15], and then, each character is recognized individually to recognize the whole word. However, the segmentation algorithm generally produces several ambiguities regarding the decision of exact and accurate segmentation

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FOCUS

Image contrast improvement through a metaheuristic scheme

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Abstract
Contrast enhancement is an important pre-processing task for several image and video processing applications. The objective of a contrast enhancement method is to improve the quality of the visual information contained in the images for further processing. Due to the enormous challenges, it is still considered as an open research problem. Several approaches have been proposed in the literature based on spatial and fr uency domain techniques. Among them, the Incomplete Beta Function (IBF) is a popular scheme used for image contrast enhancement. In the IBF based image contrast enhancement technique, quality of an image is improved by two controlling parameters. Under such conditions, these parameters need to be tuned for obtaining better outcomes. In this paper, a new gray-scale contrast enhancement algorithm is introduced where, instead of tuning the controlling parameters of IBF experimentally, their near-optimal values are calculated with the help of a recently published meta-heuristic algorithm called Artificial Electric Field Algorithm (AEFA). The proposed method has been compared with many state-of-the-art techniques in terms of some standard metrics considering three different datasets, namely Kodak, MIT-Adobe FiveK and USC-SIPI. Simulation results demonstrate that the proposed AEFA based image enhancement technique increases the overall image contrast and enriches the information present in the image.

Keywords Contrast enhancement · Incomplete beta function · Meta-heuristic · Artificial electric field algorithm · Kodak dataset · MIT-Adobe FiveK dataset · USC-SIPI dataset

1 Introduction

The contrast of an image can be defined as the dissimilarity in pixel intensity values of two nearby pixels. Alternatively, it is the change in the visual aspect of an image that helps in differentiating an object of interest from other objects as well as from the background. An image with higher contrast is always preferable over its low contrast version from an aesthetic point of view or in terms of machine understanding. It is a general perception that a high contrast image implies a better quality image. These facts demand the need for enhancement of the low-quality images, thereby making it one of the essential tasks in different video and image-based applications. Some of the important areas where this has huge applicability are real-world hyperspectral image based applications (Hardie et al. 2004; Md Noor et al. 2017), medical imaging systems (Rundo et al. 2018; Dey et al. 2022; Qiu et al. 2019) and satellite image enhancement (Singh et al. 2019; Demirel and Anbarjafari 2011) and many more. In addition to this, image contrast enhancement also helps in improving the visual quality of images for human eyes as contrast is a major factor used for the emotional assessment of any image.

Several algorithms to achieve better contrast than that of the original contrast reduced image are found in the literature. These methods are broadly classified into two categories (Yu et al. 2021; Ray et al. 2021): spatial domain methods and

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REVIEW ARTICLE

Computer Based Diagnosis of Some Chronic Diseases: A Medical Journey of the Last Two Decades

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Abstract
Disease prediction from diagnostic reports and pathological images using artificial intelligence (AI) and machine learning (ML) is one of the fastest emerging applications in recent days. Researchers are striving to achieve near-perfect results using advanced hardware technologies in amalgamation with AI and ML based approaches. As a result, a large number of AI and ML based methods are found in the literature. A systematic survey describing the state-of-the-art disease prediction methods, specifically chronic disease prediction algorithms, will provide a clear idea about the recent models developed in this field. This will also help the researchers to identify the research gaps present there. To this end, this paper looks over the approaches in the literature designed for predicting chronic diseases like Breast Cancer, Lung Cancer, Leukemia, Heart Disease, Diabetes, Chronic Kidney Disease and Liver Disease. The advantages and disadvantages of various techniques are thoroughly explained. This paper also presents a detailed performance comparison of different methods. Finally, it concludes the survey by highlighting some future research directions in this field that can be addressed through the forthcoming research attempts.

1 Introduction

In this digital era, many organizations have been established across the globe which provide continuous health monitoring facilities for humans. In the traditional method, patients visit the clinic and the health professionals advise them through their expertise in diagnosis. However, in this age-old way of medical diagnosis, patients face various difficulties owing to the increase in the number of health related problems as well as the population, especially in developing countries. This scenario sometimes leads to improper care of a patient, which can even prove fatal.

To this end, technology provides an alternative to the traditional system. Hence, it plays a significant role in healthcare systems by incorporating a large number of computer aided supporting systems and tools. This bonding has not only improved the quality of patient care but also reduced the cost of treatment by imparting efficient allocation of medical resources. The main components of technology-enabled healthcare systems are medical experts, hardware and software. However, designing an automatic system that can predict the disease from electronically available medical data is very challenging. The huge social impact of this research field motivates researchers from various domains like computer science, biology, medicine, statistics, and drug design. These researchers are continuously trying to come up with a near perfect system for better patient care.

In this context, it is worth mentioning that with the growing availability of digital records and data, the last two decades have observed an exhaustive adoption of data mining and machine learning (ML) techniques [89] in healthcare/

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CovidConvLSTM: A fuzzy ensemble model for COVID-19 detection from chest X-rays

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ABSTRACT

The rapid outbreak of COVID-19 has affected the lives and livelihoods of a large part of the society. Hence, to confine the rapid spread of this virus, early detection of COVID-19 is extremely important. One of the most common ways of detecting COVID-19 is by using chest X-ray images. In the literature, it is found that most of the research activities applied convolutional neural network (CNN) models where the features generated by the last convolutional layer were directly passed to the classification models. In this paper, convolutional long short-term memory (ConvLSTM) layer is used in order to encode the spatial dependency among the feature maps obtained from the last convolutional layer of the CNN and to improve the image representational capability of the model. Additionally, the squeeze-and-excitation (SE) block, a spatial attention mechanism, is used to allocate weights to important local features. These two mechanisms are employed on three popular CNN models – VGG19, InceptionV3, and MobileNet to improve their classification strength. Finally, the Sugeno fuzzy integral based ensemble method is used on these classifiers' outputs to enhance the detection accuracy further. For experiments, three chest X-ray datasets, which are very prevalent for COVID-19 detection, are considered. For all the three datasets, it is found that the results obtained by the proposed method are comparable to state-of-the-art methods. The code, along with the pre-trained models, can be found at https://github.com/colabpro123/CovidConvLSTM.

1. Introduction

COVID-19 or severe acute respiratory syndrome coronavirus 2 (or SARS-CoV-2) has led to a global pandemic scenario in recent years and affected normal life for all people. COVID-19 is a highly contagious virus and spreads predominantly from person to person according to the reports of the World Health Organization (WHO). Patients infected with COVID-19 can carry the virus for a period ranging from two days up to two weeks before showing any symptoms. This is because an affected subject can spread the virus to others without even being aware that it is a carrier of the disease. Some of the common symptoms of the affected subjects are cough and cold, shortness of breath and fatigue. In certain cases, these symptoms turn into severe health complications like trouble in breathing, blue lips or face, pain in the chest, and also Pneumonia. Hence, early detection of the virus is very important for caring for the infected ones. One of the common ways of detecting COVID-19 cases is by using the reverse transcription polymerize chain reaction (RT-PCR) test. However, the problem with this method is that it is costly to be used in developing countries like India, Bangladesh, and Sri Lanka. Moreover, this test is not completely accurate and as a result, it needs to be performed multiple times for assurance which makes this testing process more expensive. Though vaccines are now readily available in most parts of the world, however, to have a world with fully vaccinated people, we will need more time. Moreover, there is no assurance that fully vaccinated people will not get infected by COVID-19. Hence, early detection in a timely and cost-efficient way is of utmost need to fight this deadly disease.

Alternatively, specialist physicians use chest X-ray or computed tomography (CT) scan images to predict the presence of COVID-19. However, manual inspection of these images might lead to inaccuracies in detection due to the inter-/intra- personal observation and hence,

The code (and data) in this article has been certified as Reproducible by Code Ocean: (https://codeocean.com/). More information on the Reproducibility Badge Initiative is available at https://www.elsevier.com/physical-sciences-and-engineering/computer-science/journals.

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Disjoint and Overlapping Community Detection in Small-World Networks Leveraging Mean Path Length

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Arnab Kumar Ghoshal ; Nabanita Das ; Soham Das All Authors

Abstract:

Recent developments on identifying the community structures in real-world networks have established that the community structure may be either disjoint community set (DCS) or overlapping community set (OCS), showing high resemblance with each other. Still, given a network, researchers mostly followed distinct approaches to achieve optimal solutions, either for DCS or for OCS. Moreover, prior knowledge of community structure is needed to select the appropriate class of algorithms, since one cannot produce the optimal solution for the other. In this article, a comprehensive two-phase approach based on genetic algorithm (GA) is proposed that can be applied to any small-world network to generate the DCS and the OCS very fast without any prior knowledge of the community structure. In the first phase, an upper bound on the mean path length of a community is applied, relative to the equivalent Erdős–Rényi (E–R) random graph that expedites the convergence significantly. In the second phase, the search space is reduced considerably, by selecting a smaller subset of boundary nodes of the DCS generated in the first phase, to be manipulated probabilistically. To the best of our knowledge, we are the first to consider the mean path length of the community as a key parameter for finding the good quality communities at the earliest. Experimental study on six synthetic networks and five real-world networks shows that the proposed approach not only outperforms the state-of-the-art algorithms in terms of quality and scalability, but its parallel implementation also improves the speedup significantly.

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Trust-based Misinformation Containment in Directed Online Social Networks

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Arnab Kumar Ghoshal ; Nabanita Das ; Soham Das ; Subhankar Dhar All Authors

Abstract:
In today's world, Online Social Networks (OSNs) play a crucial role in our everyday life. But, its abuse to disseminate misinformation has turned out to be a major concern to us. Hence, the misinformation containment (MC) problem has attracted a lot of attention in recent times. For a given OSN with a fixed budget, this paper proposes a trust-based static technique independent of the distribution of misinformed nodes to select a set of trusted seed nodes leveraging the topologies of the network, to contain and decimate the misinformation faster. We follow a modified form of Competitive Linear Threshold Model with One Direction state Transition (LT1DT) to study the propagation dynamics of both the correct information and misinformation. Simulation studies on three real-world OSNs show that proposed method outperforms earlier work [1] significantly in terms of maximum number of misinformed nodes, infected time, point of inflection and number of misinformed nodes in steady state re-spectively. Moreover, its parallel implementation achieves almost 32 x speedup, making the procedure scalable for large scale OSNs to contain and decimate misinformation in real-time.

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Surface engineering of solar glass covers for soiling related issues by applying electrodynamic screens (EDS)

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ABSTRACT

Soiling of PV modules causes energy generation loss in utility-scale power plants installed worldwide and particularly severe in regions with water scarcity, like deserts and arid zones. This problem can be addressed by various surface engineering-based solutions. A potential solution to this problem is using an Electrodynamic Screen (EDS) on solar panels, which is a dry cleaning method requiring minimal energy from the solar panels. The work reported here explains the mechanisms involved in the dust particle movement for both 1-Φ and 3-Φ EDS through simulation and modeling first. Various operational parameters, like Dust Removal Efficiency (DRE), Threshold voltage (V_{th}), have been experimentally evaluated for 1-Φ EDS. The effect of Relative Humidity (RH) on EDS performance has been studied. Our studies reveal that EDS performance would decline on reaching RH value beyond 55%. A novel method using amorphous Hydrogenated Silicon (a-Si: H) based photosensor is reported for the first time for DRE evaluation. Finally, we suggest the circumvent 3-Φ EDS fabrication complexity, resulting in low yield. Again, the use of 1-Φ EDS by applying a higher pulsed voltage for a short duration at the end of the cleaning cycle could as well be attempted.

1. Introduction

Solar energy is an alternative to fossil fuel-based energy sources, and its efficient use is of fundamental importance. India receives average solar intensity of 200 MW/km^2 and with a geographical area of 3.287 million km^2. Therefore, if this energy is utilized more efficiently, as envisaged by the government of India, it would give an effective solution to the country's energy problems. In India, solar energy is mainly harnessed by using solar PV modules.

Solar PV power plants in megawatt scale across the globe are installed primarily on the arid and semi-arid regions. Solar PV panels in these areas are exposed to high rates of dust deposition. Sandier the region, more significant is the rate of soiling, as in deserts like parts of Rajasthan and Gujarat in India, Sahara region in Africa, Israel, USA, and other areas. These areas are prone to desert storms, and power generation may get severely affected [1,2]. Literature survey shows that power output from PV arrays experiences losses of more than 40% in Saudi, 65% in Kuwait on an average day due to dust deposition on their surface [3]. Furthermore, dust adheres to the surface of solar panels, thus hampering their performance in space, where it is often the primary source of power. Global soiling losses are likely to be 4–7% of annual Solar PV power generation, causing a loss of more than 5–8 billion US Dollars by 2023. This estimate is based on global efforts to harness solar energy by PV in highly soiled-affected insolation regions of China and India. Under this, a right picture is emerging for Solar PV as it has been seen that gradually lower solar electricity price requires that soiling mitigation methods remain cost-effective [4,5]. Laboratory experiments conducted by NASA show that only one milligram of dust deposited per square centimeter may decrease the power output by more than 90% [6].

This calls for periodic cleaning of the optical surface of the solar panels. At present, water and a cleansing agent is the most common technique for cleaning PV modules [7,8]. For large-scale solar power plants, gallons of de-ionized water is sprayed to wash out dust from the surface of the panels. Again, washing uses up a lot of water resources, and it is labor-intensive. Anything other than de-ionized water, if used,

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'I'm mortgaged.' Strength of a tyrannized in Mahasweta's The Glory of Sri Sri Ganesh

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Abstract: *Lachhima is used as a kept by Medininarayan who has sent his wives to their fathers' homes as they cannot fulfill his sexual desire. Lachhima also takes care of her Malik's son, Ganesh who exceeds his father in cruelty and lechery. After his father's death Ganesh proposes Lachhima to come back to Ganesh's house and live there as she used to do when his father was alive. Ganesh reads the silence and modesty of Lachhima as the weakness and fear of a dispossessed tribal. Later in the novel, Lachhima breaks her silence and becomes instrumental in bringing Ganesh's doom. This paper will focus on the transformation in Lachhima's character who from a submissive tribal turns to be an unyielding fighter.*

Key Words: *Lachhima, Ganesh, tribal, submissive, unyielding.*

Mahasweta Devi is the voice of the tyrannized and agonized tribals who do not receive primary facilities in life from a so-called civilized nation. 'While nobody cares to pay heed to their claims to the right to survive, the hired writers pandering to the middle and upper classes content themselves with weaving narcissistic fantasies in the name of literature' (Bashai Tudu, xxiii), Mahasweta Devi cannot ignore the demands of the time. Anjani Sharma writes : 'Devi's writings act as an eye opener for everyone as she records and criticizes the far-reaching consequences of the politics and the pathetic conditions of the tribal, dalits, bonded labourers, landless peasants and women. She makes the readers hear the voice of a part of the community that is otherwise voiceless. Around this core, Mahasweta Devi weaves the stories about real people who generally lie hidden in the great piles of statistical data. In a way, she has given names to poverty. Her stories are provocative, jarring and shocking to the point of being macabre'. Lachhima, in *The Glory of Sri Sri Ganesh,* who is forced to live as a kept in Medininarayan's house is in love with Mohor Karan and they are living in the hope that when Lachhima will be released by her Malik, they will marry and live happily. But Medininarayan is such an inhuman that he commands Lachhima wait for another eight-ten years to marry Mohor because she will be allowed to do so when Ganesh's wife will come to that house. She earnestly requests 'If you're getting rid of me anyway, let me go now, Malik. Let me have someone to lean on. Or else where will I go? When I'm forty? I've served you all these years, shall I serve Chhota Malik for eight more years? You could keep a maid, no?' Kicking out at Lachhima, he roars 'Take the lower castes to bed, and they forget their place.' Medini continues in anger ' You're being kept in comfort for the sake of the boy. You know it, so do I. The bahu will not come to live here immediately after the wedding. When she does, you can go. Won't Mohor wait?' Lachhima feels so dejected and tortured that she prays to him for forgiveness. Having received the force of kick Lachhima's ears bleed and he orders ' Wash the blood off your ears. Light the lamp and rub in some warm oil.' Darkened and disappointed Lachhima secretly meets Mohor Karan and tells him to marry Dhanpatiya. Mahasweta writes with a touch of romantic note - 'They sat under a mango tree. Mohor Karan looked at her hopefully. Lachhima lowered her face, doodled in the dust'. Then slowly, she says, 'You get married. Dhanpatiya will be a good wife.' After a short exchange of few words she also says -'The Malik has bought me in exchange for three bighas of land. Just like he keeps bullocks and buffaloes. Even when the boy is married I won't be let off. I'll have to stay another eight years. Then I'll be let off. That's what he said.' Despite her own penury, she offers Mohor Rs. twenty out of the deep-rooted feeling of love for Mohor and suggests him to buy two goats as wedding gift - 'Buy two goats. Lots of profits. Think of it as a wedding gift. You lost so many years waiting for me. You could have married earlier.' We feel for Lachhima, Mohor does so, but the Malik does not. They spend a short period of time together before their final separation. They do not want to be separated, but they have to be because Malik is more brutal than the beast.

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Roles of Humanitarians in Mahasweta's The Glory of Sri Sri Ganesh and Water

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Abstract: *Mahasweta Devi has delineated the roles of the major characters elaborately along with the discussions of the social and political perspectives, but she has not ignored the roles of minor characters who try to apply balm to the wounds of the most neglected tribals who are stigmatized as untouchable in the society and in doing so they do not hesitate to resist the tyrannies of the powerful jotedars and money lenders. In The Glory of Sri Sri Ganesh and Water there are Pallavi, Abhay, and Jiten who work like humanitarians to the disinherited tribals. They do try to provide primary needs of life to the poorest people, uplift living-standards, teach what is Indian Constitution, educate the children, solve the problem of untouchability.*

Key Words : *untouchable, humanitarian, jotedars, tribals.*

The world of the tribals was not only filled with the maliks-mahajans, there were also some people who had struggled hard against these very powerful jotedars to bring some relief to the life of the tortured and evicted tribals. Although, the main emphasis is laid on the major characters and main themes, the roles of the minor characters cannot be underestimated. The minor characters who ceaselessly work as humanitarians take the plot or development of story forward, reveal more about the major characters, play crucial roles and help readers understand the story better. The humanitarians in Mahasweta's *The Glory of Sri Sri Ganesh* and *Water* do not only stand by the wretched ones in weal and woes, they also fight with the corrupt oppressors for the rights of these people. Dr. Anjani Sharma writes: 'Devi's writings act as an eye opener for everyone as she records and criticizes the far-reaching consequences of the politics and the pathetic conditions of the tribal, dalits, bonded labourers, landless peasants and women……Her extensive research work shows the actual state of affairs in which the poorest in India survive. These are tales of poignant misery, and at the same time of admirable courage' (Sharma, 171). The deprived and exploited people of the state of West Bengal participated voluntarily in the naxalite movement around 1970 to snatch away their minimum rights to life from the jotedars and money-lenders.

Pallavi Shah in *The Glory of Sri Sri Ganesh*, a twenty three year pampered daughter of a rich, Mumbai-based business man, Tejlal Shah, reached Barha to serve the bhangis who were the lowest of the low. It was the consequence of an advice by Edwin Krishnatma who introduced her to Gandhi Mission and told 'Go amongst those who are the most deprived, the lowest of the low. Serve society.' The local administration and organizations tried desperately to make Pallavi understand the real threats she was going to face. The SDO told several times-'If you go, you might get into some trouble, then my job will be on the line.' She stuck to her goal-'You're trying to scare me off. I'm telling you, I'm dedicating one year to the poor and the oppressed. A few bhangi families here live in inhuman conditions. I shall serve them.' Finally she reached Barha and experienced the poorest living conditions of the bhangis. When the SDO asked her what she planned to do there, she said-'Find out what they need. I can tell right away that they don't have proper houses, health centres, schools, drinking water facilities. They must be very, very poor.'

Pallavi reached Barha in a Jeep and Abhay Mahato accompanied her. He left her in the bhangi locality and returned. Mahasweta writes-'The Bhangi *toli*, so foul-smelling and filthy, the dirt-poor Bhangis, gave Pallavi a sensuous pleasure.' Pallavi ate boiled corn in dirty plates, slept on bamboo platform, made notes with notebook and pencil what the Bhangis needed. She sincerely explained Indian Constitution to Mangalal's wife and told 'There was no such thing as a malik, because in independent india, Mangalal and his malik were considered equals.' Ganesh felt an another kind of hunger at the sight of Pallavi and when she did not act according to Ganesh's order, Ganesh put the bhangi toli on fire. The bhangis looked at Pallavi with hatred because she was only responsible for that. She wanted to help them with money, but it seemed useless. Mohan said-'No land, no savings, if you rebuild your huts in the village, they'll only burn them down again.' Pallavi met the SDO and informed him everything about the damage caused by Ganesh, but the SDO did not take any action. When Abhay met her, she burst into tears as she knew that the bhangis were extremely scared of the malik and their huts were put on fire for her independent attitude. She told Abhay-'I still have a lot of money. Money. I couldn't give anything else. Will you give it to them? To rebuild their houses?' Pallavi's mission was great, but because of the lawlessness at Barha, she could not do anything.

Abhay Mahato who read till class six and was a lower caste himself tried ceaselessly to help the people of Barha under the umbrella of Harijan Sangh. When Abhay was a child, his father was killed by Zamindar's men and he had to leave

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Biopolymer linked activated carbon-nano-bentonite composite membrane for efficient elimination of PAH mixture from aqueous solutions

Shramana Roy Barman, Priya Banerjee, Aniruddha Mukhopadhayay & Papita Das

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Abstract

Rapid urbanization has resulted in the discharge of large amounts of polyaromatic hydrocarbons (PAH) into the environment. Due to PAH-associated health hazards, their presence in water bodies has attracted increasing concern worldwide. Hence, it is necessary to device, new, efficient, and cost-effective technologies for their removal. The present work reports the fabrication of a novel chitosan linked activated carbon-nano-bentonite composite (AC-NB-C) membrane removal of acenaphthene (ACE) and naphthalene (NAP) from aqueous solutions containing both PAHs individually as well as a mixture (MP). The formulated membrane was characterized using SEM, TEM, EDS, FT-IR, XRD, and BET. The PAH removal efficiency of the membrane was evaluated in terms of varying process parameters such as initial PAH concentration, pH, and feed pressure. Process optimization was conducted using the central composite design (CCD) feature of response surface methodology (RSM). Reusability potential and antifouling property of the membrane was also evaluated. Under optimized conditions, the AC-NB-C membrane demonstrated a mixed PAH (MP) rejection of approximately 99.3%. The BET surface area and total pore volume of the membrane were observed to be 482.07 m^2g^{-1} and 0.251 cm^3g^{-1} respectively. The FT-IR analysis suggested π-π interaction and H-bonding as possible mechanisms guiding PAH uptake. A 4.9% reduction in flux ratio indicated good antifouling potential of the AC-NB-C membranes. Moreover, the membrane could be regenerated and reused for 7 consecutive cycles of filtration without any decline in its efficiency. Also, the optimum membrane performance recorded at pH 6 established its immense potential for large-scale treatment of municipal wastewater whose pH values are normally between 6 and 8.

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Original Research Paper

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Open Access Journal

Application of Geo-electrical Methods for Estimating Water Infiltration in Soils

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ABSTRACT

In this study, an alternative approach was applied for the characterization of the subsurface geological conditions to estimate the hydrological parameters in the absence of subsurface soil data. The study revealed that the hydrological parameters, estimated from the Transient Electromagnetic (TEM) and Electrical Resistivity Tomography (ERT), were significantly correlated with in situ data. Overall estimated infiltration rate (below 20 inches/h) predicted fine-grained soil was also associated with in situ data. A high correlation among the bulk electrical resistivity, porosity, and the resistivity of the pore fluid thereby confirmed the relevance of Archie's law used in this study. Furthermore, results showed that both TEM and ERT are vital tools for hydrological parameter estimation.

Soil water infiltration is a significant part of the hydrological cycle (Todd & Mays 1980). It depends on the distribution of subsurface soil texture and structure, which maintains soil moisture conditions. Infiltration in unconsolidated soils is proportional to grain size and distribution (Cui et al. 2017). While the infiltration in the clayey soil is slow because of the small grain size and high resistance to water movement. The spatial variability of soil structure is determined by soil profile observations and soil properties measurements such as bulk density and porosity. The tools available for the investigation of water movement in the soil are limited to a specific point measurement and are destructive, whereas the geophysical methods are usually non-invasive. They disturb neither the structure nor the water dynamics of the soil (Michot et al. 2003).

Infiltration rate can be measured using in-situ methods such as the double-ring method (Shaari et al. 2016, Fatehnia et al. 2016) and laboratory experiments (Morbidelli et al. 2015). However, it is difficult to carry out experiments in high-relief areas due to slope steepness and logistic handling. Alternatively, geophysical methods are cost and time-effective methods for the proper assessment of subsurface soil parameters. As the soil's electrical conductivity varies due to the presence of pore water, saltwater, and temperature, electrical resistivity methods will be helpful to estimate subsurface hydrological factors such as hydraulic conductivity, porosity, and permeability (Anees et al. 2017).

In previous studies, electrical resistivity techniques have been used for different purposes such as groundwater developments (Kumar et al. 2016, Afshar et al. 2015), water distribution in landfills (Dumont et al. 2016), landslide investigation (Perrone et al. 2014), monitoring of seasonal water content variations (Chrétien et al. 2014, Brunet et al. 2010), porosity or hydraulic conductivity estimation (Chou et al. 2016, Niwas & Celik 2012, Ghose & Slob 2006) and infiltration estimation (Crosbie et al. 2014). Some of these studies used a variety of electrical resistivity techniques, such as electrical resistivity tomography (ERT), vertical electri-

PLOS WATER

RESEARCH ARTICLE

A model-based prediction and analysis of seasonal and tidal influence on pollutants distribution from city outfalls of river Ganges in West Bengal, India and its mapping using GIS tool

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Abstract

River Ganges (locally called as river Ganga) is one of the most scared rivers in India. The river is symbol of hope, faith and is worshipped for its wholesomeness due to its purity and sanctity. Pollution of river water due to anthropogenic activity is a very common issue worldwide. Similarly, river Ganga pollution in India throughout its entire courses, is a major concern due to city outfalls. This river, also named as river Hooghly in West Bengal, India, is exposed to outfalls carrying domestic wastewater of its both bank and their distribution in river Ganga is strongly influenced by season and tide. This study aimed to generate an idea of distance and direction wise changes of concentration of pollutants in wastewater in river Ganga. During 2014, the selection of five major outfalls was done by considering Dissolved Oxygen (DO), Biochemical Oxygen Demand (BOD), heavy metals, total fecal coliform level, and the study continued for next four consecutive years to find out the influence of tide and season. Geographical Information System (GIS) based maps provided a better reflection of these changes. Student's t-test highlighted the significant changes in concentration of parameters season wise. A significant higher value of DO, BOD, nitrate nitrogen, and chloride were found in pre-monsoon season compared to monsoon season. Regression Equation generated for highly correlated parameters (coliform and heavy metals) helped to predict the level of one parameter with others. The zone of influence of BOD, DO, phosphorus and nitrate nitrogen from each of the five selected outfalls was very prominent. Acoustic Doppler current profiler at two of the five outfalls helped to estimate strip-wise depth average discharge which helped to estimate the value of water quality parameters by Plug Flow Model during high tide and low tide. A strong tidal variation was observed during low tide. This study helped to predict the influential zone from outfalls which will help to generate an alternative solution of river water use. This approach can be applied globally to prepare river water usage guidelines.

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Short Review

Review of Curcumin and Its Different Formulations: Pharmacokinetics, Pharmacodynamics and Pharmacokinetic-Pharmacodynamic Interactions

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Abstract

Curcumin, the yellow principle of the Indian Turmeric, 'Haldi' has recently attracted renewed interest in the field of experimental medicine with pleiotropic activity. This review has emphasized three pharmaceutical studies of interest: the pharmacokinetics, pharmacology, and pharmacodynamics of curcumin. In this review, we attempted to review the general pharmacokinetics profile, pharmacokinetic interactions, and pharmacokinetic-

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Article

Toxicity of Nanoscaled Zero-Valent Iron Particles on Tilapia, *Oreochromis mossambicus*

Arivarasan Vishnu Kirthi,* Gaurav Kumar, Gaurav Pant, Manu Pant, Kaizar Hossain,* Akil Ahmad, and Mohammed B. Alshammari

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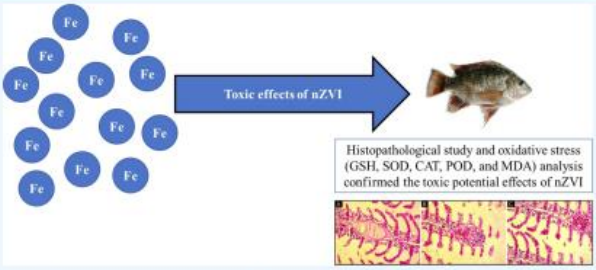

ABSTRACT: This research effort aims to evaluate the hazardous potential of the redox state (OH^-) of zero-valent iron nanoparticles (nZVI) and its histopathological and oxidative stress toward Mozambique tilapia, *Oreochromis mossambicus*. X-ray powder diffraction (XRD) validated the nZVI nanoparticles' chemical composition, while transmission electron microscopy (TEM) revealed that their physical form is round and oval. The exposure to 10 g/mL of nZVI induced the activation of the cellular superoxide dismutase (SOD) activity. Dose-dependent testing of *O. mossambicus* had a reduction in SOD and an increase in malondialdehyde (MDA) levels, suggesting that nZVI caused oxidative damage. At a concentration of 100 g/mL, the catalase (CAT) and peroxidase (POD) activities of diverse tissues exhibited a gradual decrease after 2 days of exposure and a fast increase until day 6. The scavenging of reactive oxygen species (ROS) in the epidermis, liver, and gills of *O. mossambicus* deteriorated and accumulated gradually. MDA levels in the skin, gill, and liver tissues were substantially higher after 8 days of exposure to 100 and 200 g/mL nZVI compared to those of the control group and those exposed to 10 and 50 g/mL nZVI for 2 days. Extreme histological and morphological abnormalities were seen in the skin, gill, and liver tissues of experimental animals, demonstrating that the damage resulted from direct contact with nZVI in water. A one-way ANOVA followed by Dunnett's post-test was performed to investigate significant differences.

INTRODUCTION

The properties of nanoparticles that contribute to biological perturbations strongly depend on their size, mineralogy, crystallinity, and surface reactivity, which is directly connected to nanoparticle toxicity through redox reactions, the production of oxygen- or nitrogen-free radicals, the dissolution of nanoparticles, the release of toxic ions, and the sorption and transport of metal ions or xenobiotic pollutants.[1] There is an understood assumption that zero-valent iron nanoparticles (nZVI) are relatively nontoxic because Fe^0 simply oxidizes to Fe^{2+} and then to Fe^{3+}, both of which are common chemical species in the environment that most organisms are well adjusted. However, the usage of nZVI applications increases the concentration of Fe^{2+} and/or Fe^{3+} substantially at a local level in the short term. nZVI oxidation can also contribute to the production of reactive oxygen species (ROS), such as hydroxyl radicals (OH^-) from superoxide (O_2^-) and hydrogen peroxide (H_2O_2) in living cells.[2−4] There are reports on the toxic effects of iron nanoparticles. Previous studies have reported the cytotoxic effects of iron oxide nanoparticles on the cytoskeleton of growing neurons and human melanoma cells.[5,6] Recent studies showed that uncoated nZVI produced neurotoxic in cultured neurons, whereas nZVI surface modified with polyaspartate decreased nanoparticle (NP) toxicity by

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RAINFALL VARIABILITY AND ITS IMPACT ON CROP CALENDAR OF RAIN-FED RICE CULTIVATION IN EAST COAST OF INDIA: A STUDY OF PURBA MEDINIPUR COASTAL AREA, WEST BENGAL, INDIA

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ABSTRACT

The crop calendar of a particular region is extensively dependent on rainfall. And the onset of the rainy season plays a vital role to maintain it. Thus the rainfall variability can hamper the crop calendar vividly, and affect the whole agricultural system, including yield and production. The condition might become more difficult for the developing countries, where a huge number of small and marginal farmers are solely dependent on agriculture for their livelihood. Since more than 60% of India's total agricultural land is rain-fed, a large proportion of it is used to cultivate rice therefore, and rainfall variability has a direct impact on the Indian agricultural system especially on rice farming. Limited irrigation facility, and exposure to extreme climatic events (e.g. cyclones) makes agriculture of the coastal zones as one of the most vulnerable areas to rainfall variability. The current study intends to find out the impact of rainfall variability on the crop calendar of Rain-fed rice cultivation in the Purba Medinipur coastal area, a part of the east coast of India. The study analysed the rainfall data of a long term period, and identified the years with very high to extreme rainfall anomaly for the period of 2010-2020 by applying Rainfall Anomaly Index. And examined the crop calendars of those particular years, then compared with a normal year's crop calendar. To analyse the crop calendar, some vegetation indices have been calculated for the growing season and heading season by using

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A Critical Review of the Increasing Participation Rate in MGNREGA Programme during the Paddy Harvesting Season: A Case Study in Rampurhat CD Block, Birbhum, West Bengal

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Keywords
MGNREGA,
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Combine Harvester,
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Abstract

The MGNREGA program is designed to provide supplementary livelihood opportunities to the rural population. It has been observed in the study area that the demand for work under this program is increasing during the rice harvesting period. The harmful effects of combine harvesters on agricultural workers are significantly higher than other agricultural machinery in the study area. This study also analyses the factors responsible for the shifting demand of MGNREGA works from lean to peak agricultural season of paddy cultivation. The importance of the MGNREGA programme to reduce the detrimental impact of a combine harvester on employment is discussed here. The problems and prospects of this programme are also being analyzed here.

Introduction

To reduce the unemployment rate and incidence of poverty, the Government of India introduced the world's largest public works program i.e. Mahatma Gandhi National Rural Employment Guarantee Act (MGNREGA) in 2006 to guarantee 100 days of wage employment to rural households whose adult members are willing to do unskilled manual workers (World Bank, 2015). About 60 percent workers of in the study area are mainly dependent on agriculture. The Rampurhat-I block is in a transitional stage of agricultural mechanization (Halder and Mukhopadhyay, 2019). This study analyses the impact of agricultural mechanization on rural employment in recent years and identifies the effectiveness of MGNREGA to lessen the unemployment rate of the study area.

Objectives

1. To find out the total person-days loss due to the use combine harvesters in the study area.
2. To identify the impact of MGNREGA on employment generation among agricultural laborers in the study area.

The Study Area

The study was conducted in the Rampurhat-I block of Birbhum district, West Bengal from 2018 to 2019. Four villages, namely Balia-Mrityunjoypur and Narayanpur of Narayanpur Gram Panchayat, Panisail village of Ayas Gram Panchayat and Garia village of Mashra Gram Panchayat were selected for survey (Fig.1).

Database and Methodology

The study is based on primary and secondary data. Secondary data is collected from the MGNREGA portal, District Statistical Handbook of Birbhum District, Census Report of Birbhum District, etc. Ground-level data were collected through structured questionnaires, observations, semi-structured interviews, and

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An Integrated Assessment of Flood Risk Using Geospatial and Multi-Criteria Based Analysis: A Case Study from Mayurakshi River Basin, India

Anirban Kundu, Sayani Mukhopadhyay ✉ & Sumit Panja

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86 Accesses

Abstract

Flood is considered to be one of the most important and common hydro-meteorological events and cause damage to the social system. A heuristic framework to assess the distributive pattern of flood risk is, therefore, an essential need for policymakers. This study aims to delineate the spatial distribution of flood risk in the Mayurakshi River Basin (MRB) region using an inclusive methodological foundation of comprehending geospatial and multi-criteria techniques. Spatial distribution of 10 natural and 8 socio-economic factors contributing to flood in the MRB region have been attained to delineate the Flood Susceptibility Index (FSI) and Flood Vulnerability Index (FVI) of the MRB region using Remote Sensing (RS), Geographic Information System (GIS) and multi-criteria based Analytical Hierarchy Process (AHP). Finally, after successful inculcation of FSI and FVI, a Flood Risk Index (FRI) has been adopted to represent the spatial distinction of the intensity of flood risk in the MRB region. Results show that the lower basin region of MRB has comparatively higher FSI and FVI which in turn resulted in a higher degree of FRI concerning the middle and higher basins. The West Bengal part of MRB has 46.74% of the area consisting of very high—high flood risk compared to the 1.94% area of the Jharkhand part. This study thus tries to introduce a holistic methodological framework in the comprehensive apprehension of flood risk and after synthesizing all the results, it calls for some area-specific policy intervention for flood management in a more sustainable and radical manner.

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Impact of Lockdown on Floriculture during the COVID-19 Pandemic in Haora District, West Bengal, India

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Abstract

Coronavirus creates a worldwide pandemic situation for all sectors of the economy and floriculture is not an exception to that. Floriculture is one of the important profitable agricultural sectors of Haora district, West Bengal, which provides a good source of income and employment opportunities to the rural people. Here the paper intends to find out the economic impact of COVID-19 pandemic lockdown on floriculture by using both primary and secondary data. The field survey was conducted purposively to the floriculture concentred villages of Bagnan I and II CD Blocks in Haora district. Data related to cost analysis and labour requirement of the flower cultivation have been collected through the primary interview schedule. On the basis of the collected data, cost and return analysis have been done to find out the amount of economic loss (INR) and also find out the numbers of loss of man-days in floriculture during the COVID-19 pandemic lockdown period. The result reveals that the amount of economic loss was very significant and it impacted badly to the district economy and the losses number of man-days was huge during that time, which created a temporary unemployment situation in the rural areas.

Introduction

In recent decades, floriculture is becoming an important profitable diversified agriculture sector in West Bengal as well as in the Haora district. Floriculture is a discipline of horticulture that deals with the production of flowers, flower products, and ornamental plants for commercial purposes. West Bengal is endowed with varied agro-climatic conditions suitable for growing a number of flowers but the traditional flower cultivation is predominant in this state and these flowers have been grown in India as well as West Bengal in the open fields (Mondal, 2017).

The Haora district of West Bengal is considered an important flower-growing district of West Bengal. Floriculture is one kind of sector of agriculture where daily income is generated and numerous numbers of skilled labourers are required throughout the year. The economic return of these flower crops is quite high than the other main field crops. The net return of horticulture crops (especially flowers) is much ahead of the main field crops (Sarkar and Chakravorty, 2005). These special types of cultivation practice require numerous numbers of labourer employments throughout the year (Sarkar et al, 1997).

In the Haora district, thousands of families are getting their livelihood through this sector. But from the very first of the year 2020, all over the world along with India were getting badly affected by the COVID-19 pandemic. The COVID-19, originating from Wuhan, China has eventually spread through the whole world and emerged into a pandemic. When the situation was getting worse, an almost worldwide lockdown was declared. India was no exception to that situation.

For protective and preventative measures, a complete nationwide lockdown was declared from 25th March 2020 to till the situation comes under control. During the lockdown periods, the economy of floriculture in West Bengal as well as in Haora district was badly affected.

Objectives

1) Analyze the total economic loss that occurred in floriculture during COVID-19 lockdown in Haora District.
2) Find out the numbers of man-days loss in floriculture during the COVID-19 lockdown period.

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The Scourge of Domestic Violence in India

Looking Back and the Way Ahead

Subhasri Ghosh

Contents

Abstract

Domestic violence, in the Indian context, has most often been studied within the rubric of the feminist movement – how the feminists from 1970s onwards broke into the innermost domains of personal space to highlight the victimization of women by their near ones and drew attention of the government and the civil society to the menace leading to pro-active measures as also the socio-economic fallout of such violence. This chapter, while acknowledging the contribution of the women's movement in bringing to the fore the issue of violence perpetrated at home, argues that within the matrix of Indian society violence was an embedded feature throughout the nineteenth and twentieth centuries. The ugly face of domestic violence is no recent phenomenon since, if one flips through the pages of history in the colonial period, one can trace the prevalence and predominance of these violent behaviors. Though quantification of such violence from the 1970s and 1980s brought the phenomenon into the public domain, the chapter by rewinding to the colonial period and drawing heavily from first-hand narratives of contemporary women writers from across India, attempts to show that the past enmeshes into the present and that violence remained and remains a part and parcel of a woman's everyday domestic life. Even the remedies that are now being mooted have their roots in the colonial times. Taking a holistic view of the

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১৯৪৭-র দেশভাগ ও পুনর্বাসন : একটি পুনর্মূল্যায়ন

শুভশ্রী ঘোষ

মুখবন্ধ

দেশভাগ—এই চার অক্ষরের শব্দটির ব্যাপ্তি গভীর—এর সঙ্গে জড়িয়ে আছে অনেক অনুভূতি, অনেক অব্যক্ত যন্ত্রণা অনেক হৃদয়বিদারক কাহিনি। বিংশ শতাব্দীতে ঔপনিবেশিকতার চরম পরিণাম হিসাবে দেশভাগ মানব জাতির ইতিহাসকে বার বার ক্ষতবিক্ষত করেছে। ব্রিটিশ শাসকের Divide and Rule নীতির প্রতিফলন এই বিভাজন দক্ষিণ এশিয়ার বুকে প্রথম নেমে আসে ১৯০৫ সালের বঙ্গভঙ্গের মধ্য দিয়ে। যদিও প্রবল প্রতিবাদের সম্মুখীন হয়ে শেষপর্যন্ত বঙ্গভঙ্গ রদ করতে বাধ্য হয় ব্রিটিশ প্রশাসন, তা সত্ত্বেও তাঁদের অনড় মনোভাবের পরিচয় পাওয়া যায় যখন ইতিহাসের পাতা ওল্টালে দেখি এই দ্বিখণ্ডনের ছুরি কীভাবে টুকরো করেছে আয়ারল্যান্ড, ইজরায়েল ও ভারতবর্ষকে। বিংশ শতাব্দীর প্রথমার্ধে সংঘটিত এই তিনটি বিভাজনের যন্ত্রণা আজও ভোগ করে চলেছে এই দেশগুলি। Arie M. Dubnov ও Laura Robson তাঁদের সম্পাদিত Partitions: A Transnational History of Twentith Century Territorial Separation নামক গ্রন্থে উক্ত তিনটি বিভাজনকে এক সূত্রে গ্রথিত করার প্রচেষ্টা করেছেন।[১] Kate O'Malley তাঁর প্রবন্ধে পঁচিশ বছরের ব্যবধানে সংঘটিত আয়ারল্যাণ্ড ও ভারত ভাগের সাদৃশ্য তুলে ধরে ব্রিটিশ সাম্রাজ্যবাদী মানসিকতার ক্ষেত্রে যে ধারাবাহিকতা দেখা যায় তার প্রমাণ দিয়েছেন।[২] Lucy Chestor আন্তর্জাতিক সীমানা নির্ধারণের ক্ষেত্রে ভারত ও প্যালেস্তাইনের ঘটনাসমূহের নেপথ্যের ইতিহাস বিশ্লেষণের মধ্য দিয়ে এই প্রবহমান ধারার প্রতি দৃষ্টি আকর্ষণ করেছেন।[৩]

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Acute toxicity of fluoride and aluminium on the freshwater fish, *Cyprinus carpio* L.

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Fluoride is a trace element which has beneficial effect at lower concentration but detrimental at higher concentration. The fluoride contamination in ground water is a major global problem. Similarly, aluminium is the most abundant metal of the earth, highly toxic to all organisms. In the present study, we investigated the acute toxicity of fluoride and aluminium on three month old fingerlings of *Cyprinus carpio* L. in hard water (Hardness 125 mg/L of $CaCO_3$) under static renewal bioassay. The 96 h LC_{50} value of the fluoride and aluminium were 675.615 and 224.214 mg/L, respectively. There was a significant correlation (P <0.01) between mortality rate of *C. carpio* with all concentrations of fluoride as well as aluminium. The exposure time (24, 48, 72 and 96 h) and different concentration of fluoride (680, 684, 686 and 692 mg/L) and aluminium (228, 229, 231 and 232 mg/L) was also significantly correlated (P <0.05). The different abnormal behaviour displayed by the fluoride and aluminium exposed fishes were erratic swimming movements, rapid opercular activity and excessive secretion of mucous. The safe level of concentrations of fluoride and aluminium were 6.75 and 2.24 µg/L, respectively. The LC_{50} values of fluoride and aluminium of the present study may be useful in deriving water quality standards in West Bengal.

Keywords: Aquatic pollution, Dental fluorosis, Indian major carp, Opercula, Sodium fluoride, Water toxicity

The fluoride ion is derived from the element fluorine, reacts with the cations of other elements to forms fluoride compound which together represent about 0.06-0.09% of the earth crust[1,2]. Fluoride at low concentration (0.5-1.0 mg/L) in drinking water, is beneficial for human health preventing dental decay by remineralization. But it causes dental fluorosis, a hypo mineralization disorder of ameloblasts and a crippling bone disease called skeletal fluorosis when drinking water contains a higher concentration of fluoride (>1.5 mg/L)[3] . The permissible limit of fluoride by World Health Organization (WHO) and Bureau of Indian Standard (BSI) is 1.5 mg/L and according to Indian Council of Medical Research (ICMR), and the Committee on Public Health Engineering Manual and Code of Practice, Govt. of India it is 1.0 mg/L[4,5]. Ground water with more than 1.5 mg/L of fluoride is reported in 21 out of 29 states of India[6,7], including West Bengal[8,9]. Fluoride contamination in ground water has also been reported from Africa, China, Japan and Sri Lanka[10].

Aluminium is the most abundant metal in the lithosphere, exist in the form of silicates, oxides and hydroxide[11]. Despite its low abundance in the water, aluminium is acutely toxic to fish but the toxicity of aluminium is depends on pH, temperature and presence of inorganic and organic ligands[12]. The toxicity of aluminium is most severe between pH 5.0 and 6.0 and the toxicity is increase when pH rises in the water due to polymerization of aluminium[13]. Aluminium induces hypoxia in fishes due to accumulation on the gill surface after polymerization[14]. Several studies reported the neuro- as well as cardio-toxicity of aluminium to fish[15,16]. The permissible limit of aluminium in drinking water by Bureau of Indian Standard is 0.2 mg/mL[5].

Both, the fluoride as well as aluminium, exert oxidative stress in animals through excess production of reactive oxygen species via the fentom reaction and inhibition of antioxidant enzymes[1,17,18]. Also, fluoride and aluminium damage the gill of fishes, result in ionoregulatory, osmoregulatory and respiratory dysfunction, and lead to fish death[17,19]. The growth[20], biochemical[20,21], hematological[11], and histopatho-logical[22] parameters of fish are also severely affected by fluoride and aluminium.

The common carp, *Cyprinus carpio* L. is the 4th major species (7.7% of the total) produced in world aquaculture in 2018[23]. With its importance in commercial aquaculture and wide geographical distribution, the common carp has been selected for the present study [18,24,25]. Though extensive studies are available on the impact of fluoride and aluminium on *C. carpio*, detailed report on the acute toxic effects are lacking. Hence, in the present study, we investigated the acute toxic effect of fluoride and aluminium on *C. carpio* fingerlings under static renewal bioassay.

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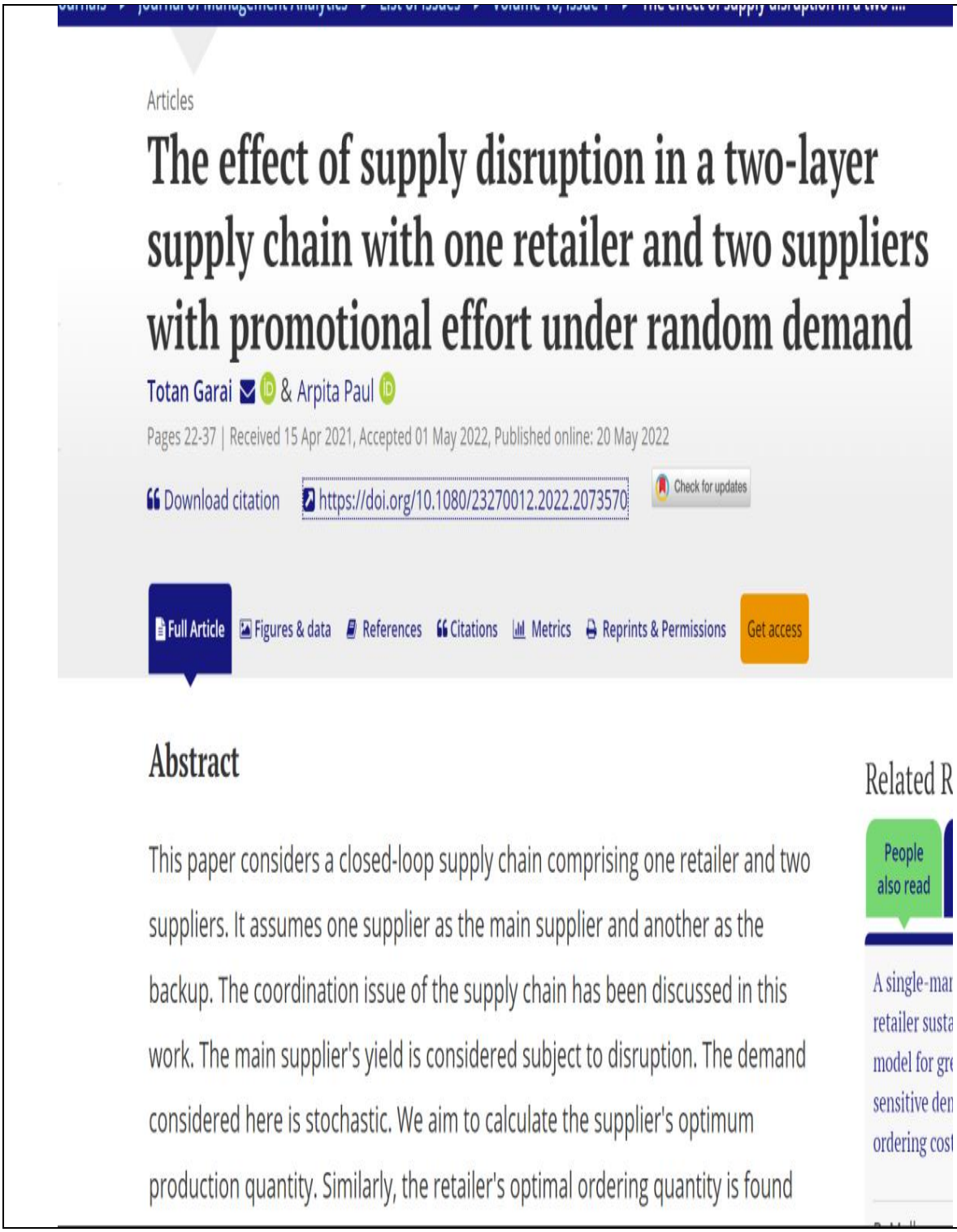

Articles

The effect of supply disruption in a two-layer supply chain with one retailer and two suppliers with promotional effort under random demand

Totan Garai & Arpita Paul

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Abstract

This paper considers a closed-loop supply chain comprising one retailer and two suppliers. It assumes one supplier as the main supplier and another as the backup. The coordination issue of the supply chain has been discussed in this work. The main supplier's yield is considered subject to disruption. The demand considered here is stochastic. We aim to calculate the supplier's optimum production quantity. Similarly, the retailer's optimal ordering quantity is found

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Title: Pricing strategy of competing retailers in a two layer supply chain under nonlinear stochastic demand

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Abstract: This paper develops mechanisms to deal the strategic issue that arises in a two-echelon closed-loop supply chain comprising of one manufacturer and two competing retailers. The chain works under stochastic nonlinear demand. Here the manufacturer works as the supplier and the retailers compete with each other on the basis of their retail price. The prime objective is to investigate a news-vendor model to govern the optimal order quantity. A buyback contract between the manufacturer and retailer has been considered and scenario of shortage has also been contemplated. The profit functions of manufacturer and two retailers are analysed following centralised approach. A numerical example is given to illustrate the theoretical results. Computational results show that it is always beneficial in integrated system for the members of the chain.

Keywords: pricing; news vendor; stochastic nonlinear demand; supply chain.

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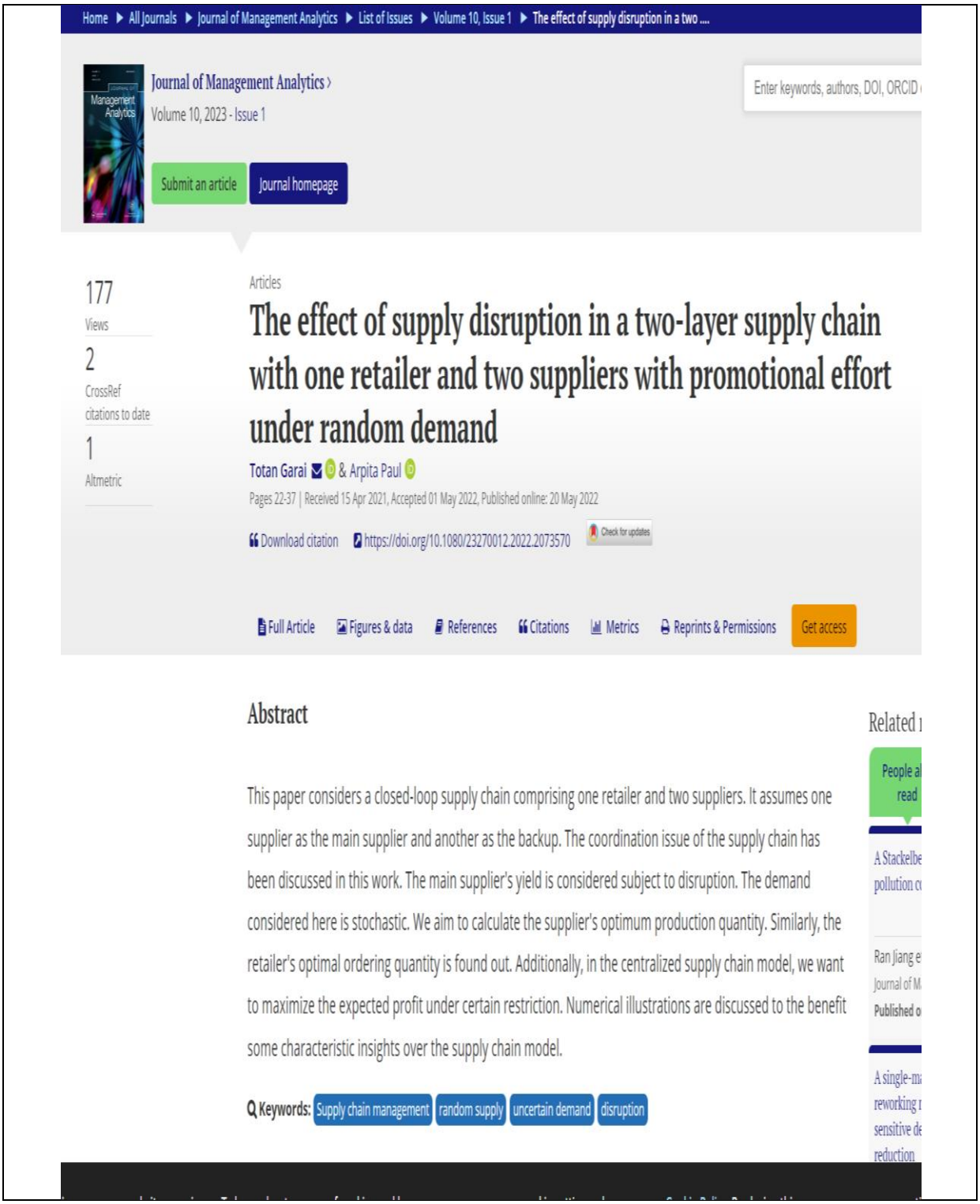
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The effect of supply disruption in a two-layer supply chain with one retailer and two suppliers with promotional effort under random demand
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Abstract
This paper considers a closed-loop supply chain comprising one retailer and two suppliers. It assumes one supplier as the main supplier and another as the backup. The coordination issue of the supply chain has been discussed in this work. The main supplier's yield is considered subject to disruption. The demand considered here is stochastic. We aim to calculate the supplier's optimum production quantity. Similarly, the retailer's optimal ordering quantity is found out. Additionally, in the centralized supply chain model, we want to maximize the expected profit under certain restriction. Numerical illustrations are discussed to the benefit some characteristic insights over the supply chain model.
Keywords:
Supply chain management
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Traversable wormhole in logarithmic $f(R)$ gravity by various shape and redshift functions

Jafar Sadeghi, Mehdi Shokri, Saeed Noori Gashti, Behnam Pourhassan, and Prabir Rudra

https://doi.org/10.1142/S0218271822500195 | Cited by: 5

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Abstract

In this paper, we study the traversable wormhole solutions for a logarithmic corrected $f(R)$ model by considering two different statements of shape $b(r)$ and redshift $\Phi(r)$ functions. We calculate the parameters of the model including energy density ρ, tangential pressure P_t and radial pressure P_r for the corresponding forms of the functions. Then, we investigate different energy conditions such as null energy condition, weak energy condition, dominant energy condition and strong energy condition for our considered cases. Finally, we explain the satisfactory conditions of energy of the models by related plots.

Keywords: Traversable wormholes ▪ modified gravity ▪ energy condition

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Constraints on cubic and $f(P)$ gravity from the cosmic chronometers, BAO & CMB datasets: Use of machine learning algorithms

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Editor: Stephan Stieberger

Abstract

In this work we perform an observational data analysis on Einsteinian cubic gravity and $f(P)$ gravity with the objective of constraining the parameter space of the theories. We use the 30 point $z - H(z)$ cosmic chronometer data as the observational tool for our analysis along with the BAO and the CMB peak parameters. The χ^2 statistic is used for the fitting analysis and it is minimized to obtain the best fit values for the free model parameters. We have used the Markov chain Monte Carlo algorithm to obtain bounds for the free parameters. To achieve this we used the publicly available *CosmoMC* code to put parameter bounds and subsequently generate contour plots for them with different confidence intervals. Besides finding the Hubble parameter H in terms of the redshift z theoretically from our gravity models, we have exercised correlation coefficients and two *machine learning* models, namely the linear regression (LR) and artificial neural network (ANN), for the estimation of $H(z)$. For this purpose, we have developed a *Python* package for finding the parameter space, performing the subsequent statistical analysis and prediction analysis using machine learning. We compared both of our theoretical and estimated values of $H(z)$ with the observations. It is seen that our theoretical and estimated models from machine learning performed significantly well when compared with the observations.

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GREEN SUSTAINABLE SUPPLY CHAIN UNDER CAP AND TRADE REGULATION INVOLVING GOVERNMENT INTROSPECTION

Arpita Paul[1,*] and Bibhas Chandra Giri[2]

Abstract. This paper investigates Government intervention in a three-echelon supply chain comprising one manufacturer and one retailer. Government is the top level member trying to reduce environmental impacts based on the amount of carbon emission during the production process. Government controls the chain by collecting tax from the retailer which is indirectly paid by the customer and paying subsidy/imposing fine on the manufacturer. Government encourages manufacturer to reduce carbon emission by contributing some subsidy and also makes an effort to generate Government net revenue (GNR) by imposing tax. The GNR is generated by collecting tax from the retailer on the sold product and penalty from the manufacturer at the trading price for the extra amount of emissions. The retail price is decided based on the selling price, tax and greening level. We aim to determine optimal levels of pricing, greening and amount of tax to be levied. The models for both linear and iso-elastic demand patterns are developed. The aim of this piece research is two-fold: (i) review the existent literature on the relationship between environmental collaboration and sustainability performance and (ii) render a tenable prototype of supply chain to illuminate the relationship between sustainability and profitability. According to the aforesaid goals this paper has carried out a detailed empirical research by using advanced structural equation modelling approaches. The research findings will be particularly important for manufacturing companies struggling to find techniques to achieve sustainability performance. Also it will aid the supply chains in developing environmental collaboration with the Govt. in order to attain the targets of GSCM.

Mathematics Subject Classification. 90B50, 91A80.

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1. Introduction

According to the report of the Intergovernmental Panel on Climate Change (IPCC), the rising rate of global temperature in recent 50 years is approximately twice as fast as that in previous periods. Climate change arising due to anthropogenic activities has been identified as one of the greatest threats to the mankind. Carbon emission is held responsible for the majority of this threat. Reducing carbon emissions is urgently needed otherwise the existence of the whole civilization will come at stake. Therefore, the issue of environmentally

Keywords. Supply chain management, green supply chain, carbon footprint, game theory, channel coordination, sustainable development, government introspection, cap and trade, iso-elastic demand, subsidy.

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Energy-momentum squared symmetric Teleparallel gravity: $f(Q, T_{\mu\nu}T^{\mu\nu})$ gravity

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ABSTRACT: In this work we propose the $f(Q, T_{\mu\nu}T^{\mu\nu})$ gravity as a further extension of the $f(Q)$ and $f(Q, T)$ gravity theories, where Q is the non-metricity and $T_{\mu\nu}$ is the energy-momentum tensor. The action involves an arbitrary function of the non-metricity Q and $\mathbf{T}^2 = T_{\mu\nu}T^{\mu\nu}$ in the gravity Lagrangian. The field equations for the theory are derived in the metric-affine formalism. The theory involves a non-minimal coupling between the geometric and the matter sectors, and hence the covariant divergence of the energy momentum tensor is non-zero, thus implying the non-conservation of the same. The vacuum solutions of the theory are investigated and it is found that the theory perfectly admits a de-Sitter-like evolution of the universe. The cosmological equations are derived and it is found that there are two correction terms arising as modification of the gravity. Two specific toy models of the form $Q + \eta\left(\mathbf{T}^2\right)^n$ and $f_0 Q^m \left(\mathbf{T}^2\right)^n$ are explored to gain further insights into the dynamics of the theory. It is seen that the field equations of both the models have terms similar to those arising from the quantum gravity effects and are thus responsible for the avoidance of the singularity. One striking feature of the model is that the non-linear correction terms dominate in the early universe and gradually fade away at later times giving standard FLRW universe. Solutions for the FLRW equations are found wherever possible and the evolution of the scale factor and the matter energy density is plotted. Other cosmological parameters like the equation of state, deceleration parameters and Hubble functions are also studied. Finally the energy conditions are explored in the background of the theory. Using these conditions and some observational data the parameter spaces of the models are considerably constrained. $f(Q, T_{\mu\nu}T^{\mu\nu})$ is a theory that can perfectly explain the cosmological dynamics of both the early and the late universe without resorting to any dark energy.

KEYWORDS: non-metricity, energy-momentum, symmetric teleparallel gravity; cosmology, energy conditions.

Thermodynamics of the apparent horizon in the generalized energy-momentum-squared cosmology

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ABSTRACT: In this note, we explore the thermodynamic properties of the universe in the background of the generalized energy-momentum-squared gravity. We derive the energy density of matter from the non-standard continuity equation and use it in our analysis. We consider two types of models depending on the nature of coupling between curvature and matter and perform thermodynamic analysis on them using the cosmic apparent horizon. The models are kept as generic as possible from the mathematical point of view in order to gain a wide applicability of the work. In this work we have considered power law and exponential form of models. All the thermodynamic parameters are expressed in terms of the cosmic apparent horizon radius and its time derivatives and their time evolution are studied. By using temperature, heat capacity analysis and the evolution trend of Helmholtz free energy the conditions for thermodynamic stability of the models are derived. It is seen that our stability analysis considerably constrain the parameter space of the model.

KEYWORDS: Modified gravity, Thermodynamics, Cosmic apparent horizon, Energy-Momentum, Stability.

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A comparative study between Anti-Clastogenic synergestic effect of Ursolic Acid, Beta sitosterol and Sitosterol-3-O glucoside (Drug I) and only Ursolic Acid, Beta sitosterol (Drug II) on human chromosomes.

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ABSTRACT
Introduction:
In the current context of globalization, cancer is costing millions of life worldwide, and commercially available allopathic anti-cancer drugs have many side effects. Search for a phyto-active (ayurvedic) component acting cornerstone for anticancer agent will be a boon to mankind. In our previous studies, we reported for the first time, potent anti-cancer properties in leaf extract from Barleria lupulina Lindl. Ursolic acid, beta-sitosterol andsitosterol-3-O-glucoside were found to be the active components. Even though a substantial work on ursolic acid and beta-sitosterol have been done by many investigators, but studies on sitosterol-3-O-glucoside is limited. The present comparative study was carried out to find the anti-caner property of only sitosterol-3-O-glucoside on human chromosomes in vitro.
Methods:
The formulation containing active ingredients - Ursolic acid , beta sitosterol and sitosterol-3-O-glucoside were mixed in different proportions and treated to gamma-irradiated human lymphocyte chromosomes in vitro. Percentages of chromosomal aberrations were elucidated at different time intervals. Various statistical tools were used to analyze the data.
Results & Discussion:
Convincing results were obtained, that synergistic effect of Ursolic acid , beta sitosterol and sitosterol-3-O-glucoside was demonstrating more amelioration effect (54.25% recovery) than only the combination of Ursolic acid and beta sitosterol. Even, the formulation was able to cure squamous cell carcinoma of human lungs, in vivo. This may stand out to be a potent anti cancer drug in near future.
Index Terms: *anti-cancer, human chromosome, mutagen, ayurveda, sitosterol-3-O-glucoside*

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I. Introduction

Cancer is a life threatening disease, and is the cause of death of millions of people all over the globe. According to the World Health Organization, in 2008 approximately 7.6 million people died worldwide due to cancer and in 2018 (after ten years) the mortality number is 9.6 million (current statistics) (WHO: Cancer: Overview). Anti-cancer drugs currently available as chemotherapeutic agents, not only destroy cancer cells, but also kill normal cells and leave a heavy toll on patients with severe side-effects (Krukiewicz K & Zak JK., 2016) Therefore, discovery of an anticancer drug with minimum side effects but satisfyingly potent preferably from plant origin needs immediate attention of researchers.

Chromosomal aberrations lead to tumor formation and cancer (Donna GA,ColinCo, FrankMcC, JoeWG.,2003). Chromosomal aberration is used as an index of cancer. The pioneering discovery by Muller(1927)on artificial mutagenesis in *Drosophila* opened a new horizon to the cytogenetic study of chromosomal aberrations.

In our previous works (Sur P.K. & Das P.K., 2012), we reported the anti-clastogenic, anti-cancer, radio-protective activities of leaf extract from *Barlerial upulina* Lindl. on laboratory animals as mice and fish. Further isolation of phyto-active molecules from the leaf extract, proves the presence of ursolic acid, beta-sitosterol, and sitosterol-3-O-glucoside as major anti cancer agents (Das P.K. & Sur P.K., 2012)

In the present invention, the author studied the anti-cancer effect of sitosterol-3-O-glucoside alone. A comparative study between anti-clastogenic &anti cancer-synergestic effect of UrsolicAcid+Beta

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Res. J. Biotech

Bioremediation of melanised poultry feather waste for production of mosquitocidal keratinase

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Abstracts
Melanised chicken feather wastes are great resources of amino acids and oligopeptides which can be biodegradable by the bacterial keratinase enzyme. Biodegradation of melanised chicken feathers waste directed by P. woosongensis TKB2 cells was successfully carried out in 8 L EYELA-MBF-800ME laboratory scale fermentor. The fermentation processes were conducted at 30 °C, 700 rpm agitation speed and 0.7 vvm air flow rate in a basal medium (%, w/v, 0.05% K_2HPO_4; 0.025% $MgSO_4$; 0.02% $CaCO_3$ and 5% NaCl) containing 1.0 % (w/v) melanised feathers.

Highest net levels of released feathers hydrolysis end products like soluble proteins of 4.15 mg/mL and an adequate level of free amino acids (isoleucine>serine>alanine>arginine>histidine>valine>phenylealanine>leucine>tyrosine), keratinolytic protease activity (71.68 UmL^{-1}) and 98.8 % feather degradation capability in the fermentor were greatly comparable to those of shake flasks. The crude enzyme showed optimum activity against Anopheles stephensi larvae in native water at pH 8.0 and 50 °C (LD_{50}-0.60 UmL^{-1} at 48 h). Therefore, the studied keratinase can be used as an effective mosquitocidal agent.

Keywords: Melanised feather, Biodegradation, Fermentor, *Anopheles stephensi.*

Introduction

Chicken feathers, available globally, as a cheap bioorganic waste, are a very useful substrate for the industrial production of keratinase enzyme, especially in developing countries towards the pollution control program. Every day, enormous quantities of bioorganic wastes are discharged from poultries and poultry processing industries[23]. Almost 8.5 billion tons of poultry feather are produced early. The three major chicken producers in the world United States, China and Brazil will produce 16.63, 13 and 11.75 million tons of chicken meat respectively in 2011 according to estimates from United States Development of Agriculture (USDA). In India, early 350 million tons of poultry feather waste were produced from poultry processing slaughterhouses. Since the feathers represent 5-10% of chicken body weight, the dried feather contains 85-99% proteins[7]. Agro-industrial wastes, which are produced in high quantities universally, have low viable value.

The removal of such wastes often results in additional costs to the producers and their enhanced production can lead to ecological problems. Such factors are resulting in growing interest in the application of agro-industrial wastes in biotechnological processes, for instance, as low-cost substrates for the production of enzymes and other value-added microbial products[10,12,24]. Currently, the feather waste is treated by using chemical (acid and alkali) and physical treatments which are costly, dangerous and also lead to the pollution of air, water and soil[6]. The microbial bioremediation offers great advantages over conventional procedures. Microbial keratinase (E.C. 3.4.99.11) is a hydrolytic enzyme that can degrade the recalcitrant feather waste by splitting the disulfide linkage and hydrophobic bonds that serve the resistant back bone of keratin proteins.

Keratinase is a very important group among protease and accounts for 60% of the world wide sales value of the total industrial enzymes[2]. This market is expected to reach $ 4.4 billion by 2015, a compound annual growth rate of 6% over the 5 year forcast period[2]. Much of the previous work has been focused only on degradation and production of value added products[19], enzyme purification[20], detergent additives[21] and on analysis of dehairing agents[22], but little is known about its effects and applications as mosquitocidal agent. Degrading these wastes as unused disposals without accruing additional benefits has led to an idea to develop a suitable technology to employ organic recalcitrant keratinous wastes by a simple fermentation technology into cost-effective disease control agents.

Keratinolytic proteases have also been tested as biocontrol agents against numerous agricultural pests like nematode species, known to be pathogenic to crop plants leading to huge economic losses[28]. Our study reported that the mosquitocidal activity is shown by crude keratinase enzyme. Mosquitoes are major vectors of deadly diseases causing deaths of millions of people in developing countries both in urban and rural populations[7].

Malaria, filariasis, encephalitis, dengue and nowadays, chikungunya are the major mosquito-borne diseases in India and other south eastern Asian countries. *Anopheles stephensi* is a major vector in India as well as in other tropical regions of the malaria. The biotechnology gives the eco-friendly tools like microbial enzymes now being employed as a

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Capturing a Crucial 'Disorder-to-Order Transition' at the Heart of the Coronavirus Molecular Pathology—Triggered by Highly Persistent, Interchangeable Salt-Bridges

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PROTEINS
STRUCTURE ■ FUNCTION ■ BIOINFORMATICS

RESEARCH ARTICLE

Can the jigsaw puzzle model of protein folding re-assemble a hydrophobic core?

Gargi Biswas, Semanti Ghosh, Sankar Basu, Dhananjay Bhattacharyya, Alok Kumar Datta, Rahul Banerjee

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Abstract

According to the "jigsaw puzzle" model of protein folding, the isomorphism between sequence and structure is substantially determined by the specific geometry of side-chain interactions, within the protein interior. In this work, we have attempted to predict the hydrophobic core of cyclophilin (LdCyp) from *Leishmania donovani*, utilizing a surface complementarity function, which selects for high goodness of fit between hydrophobic side-chain surfaces, rather in the manner of assembling a three-dimensional jigsaw puzzle. The computational core prediction method implemented here has been tried on two distinct scenarios, on the LdCyp polypeptide chain with native non-core residues and all core residues initially set to alanine, on a poly-glycine polypeptide chain. Molecular dynamics simulations appeared to indicate partial destabilization of the two designed sequences. However, experimental characterization of the designed sequences by circular dichroism (CD) spectroscopy and denaturant (GdmCl) induced unfolding, demonstrated disordered proteins. Stepwise reconstruction of the designed cores by cumulative sequential mutations identified the specific mutation (M122L) as primarily responsible for fold collapse and all design objectives were achieved upon rectifying this mutation. In summary, the study demonstrates regions of the core to contain highly specific (jigsaw puzzle-like) interactions sensitive to any perturbations and a predictive algorithm to identify such regions. A mutation within the core has been identified which exercises an inordinate influence on the global fold, reminiscent of metamorphic proteins. In addition, the computational procedure could predict substantial regions of the core (given main-chain coordinates) without any reference to non-core residues.

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Studies of scintillations and TEC variations with GPS satellite links together with soil radon anomalies preceding Nepal earthquakes of April–May 2015

Arpita Guha Bose ✉, Aditi Das, Saheli Chowdhury & Argha Deb

Natural Hazards **112**, 1137–1163 (2022) | Cite this article

Abstract

Ionospheric effects like scintillations and anomalous variations in total electron content (TEC) monitored with Global Positioning System (GPS) satellites of L1 frequency over Kolkata, West Bengal, India, in April–May 2015 were studied together with radon activity in soil recorded by solid-state nuclear track detector (SSNTD) during summer of 2015 in the same city, with a view to identify possible precursory signals for earthquakes that occurred in the Nepal Himalayas during April–May 2015. Weak-to-intense fluctuations even up to saturation levels in some links of GPS satellites and anomalies in TEC were observed in the pre-earthquake days, although 2015 was a medium-to-low solar activity year. Prominent near-simultaneous anomalies of all three precursors were observed prior to the two massive earthquakes of magnitude > 7 that devastated vast areas of Nepal in 2015. The occurrence of anomalies and spurious pulses has been studied in the present work, and the effectiveness of analysing together two different types of earthquake precursors for short-term prediction of high-magnitude earthquakes has been discussed. Moreover, this is the first work on the Nepal Himalayan region in which ionospheric scintillation and TEC have been studied concurrently with soil radon in Kolkata for earthquake precursor research.

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आत्म-साक्षात्कार के विचार में आध्यात्मिक जीवन की प्रासंगिकता

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मानवता मानव जीवन की आधारशिलाओं में से एक है। 'मनुष्य बनना सीखना' का विषय उतना आसान नहीं है, जितना कि यह प्रतीत होता है। लेकिन व्यवस्थित तरीके से हो सकता है। इसलिए, इस विषय पर बहुत ही कुशल तरीके से संपर्क करना आवश्यक है। यदि सत्यं शिवं सुंदरम् की स्थापित अवधारणा को दूर तक फैलाना चाहते हैं या यदि वे स्वयं को आध्यात्मिक जीवन से जोड़ना चाहते हैं, तो उन्हें मानव जीवन के आंतरिक और बाह्य विकास में सक्रिय होना चाहिए। जब समग्र विकास प्राप्त हो जाता है, तो जो प्रवाह देखा जाता है वह प्रकट होता रहता है और हमें विकास की दिशा में ले जाता है। यद्यपि 'आत्म-साक्षात्कार' की यह धारणा विशुद्ध रूप से व्यक्तिगत चरमोत्कर्ष पर बनी है, विषय का संदर्भ, अर्थात् अवतार, सार्वभौमिकता का संकेत है। इसलिए, आध्यात्मिक जीवन में जीवन की भावना को विकसित करना सबसे अच्छा है।

किसी विषय के दायरे का विश्लेषण करने के लिए, पहले विषय को समझना आवश्यक है। अगर कोई विषय दिल से आसानी से समझ में आता है या अगर विषय को दिल में जगह मिल जाती है तो वह बोधगम्य हो जाता है। भावनाएं मानव इंटीरियर को विकसित करने के लिए गठबंधन करती हैं। आध्यात्मिक जीवन में ईश्वरीय विचार का मूल्य अथाह है। भावनाएं मानव मानसिक दृष्टिकोण या ध्यान संबंधी विचारों के विकास में भी भूमिका निभाती हैं। जब हम बड़े क्षेत्रों में डूबे होते हैं, तब भी हम उस विषय के साथ एक बोधगम्य संबंध विकसित करते हैं। इसलिए कोई विषय जितना हमारे साथ जुड़ा होगा, हमारे साथ उसकी स्वीकार्यता उतनी ही बढ़ेगी। इस मामले में एक सुधारात्मक संदर्भ और प्रासंगिक लाना। जब किसी विषय का संबंध सांस्कृतिक बाढ़ के भीतर बनता है, तो उसकी दिशा और चौड़ाई दूर-दूर तक फैल जाती है। यदि मन में प्रकट आंतरिक चेतना को सही तरीके से उत्तेजित किया जा सकता है, तो ध्यान की भावना को सही तरीके से विकसित करना संभव हो जाता है। हमारे विचारों और दिमागों में और जब हम कुछ ठीक करने के बारे में सोचते हैं, तब भी हम भावना के द्वार पर होते हैं। कहने की आवश्यकता नहीं है, कभी-कभी हम अनुभव के संचय में अपना अनुभव पाते हैं। आधुनिक संदर्भ में, ईमानदार महसूस करना बहुत प्रासंगिक है।

आध्यात्मिक जीवन पर ध्यान केंद्रित करने का पहला और सबसे महत्वपूर्ण प्रयास भावनात्मक विकास करना है। विचार - इस मुद्दे को मजबूत करने की जरूरत है ताकि कोई बाधा इसे छू न सके या यह कहा जा सकता है कि जब हम मुश्किल समय में होते हैं या जब कोई बुरा समय हमें घेर लेता है, तो उस जगह का विचार और मोक्ष हमारी मदद के लिए आना चाहिए। जिस तरह हम तकनीक में महारत हासिल करके समृद्धि प्राप्त कर सकते हैं, उसी तरह हम इंद्रियों पर और अपने भीतर महारत हासिल करके इसे बढ़ाने का प्रयास करते हैं। हम यह भी जानते हैं कि कभी-कभी हमारे अंदर बुरे विचार उत्पन्न हो जाते हैं या विचारों का संरचनात्मक रूप हमारे सामने ठीक से प्रकट नहीं हो पाता है, जिसके परिणामस्वरूप बाधाएँ हमारे भीतर मौजूद प्रतीत होती हैं। ऐसे में हमें काफी परेशानियों का सामना करना पड़ता है। फिर जब मैं सटीक कारण का निरीक्षण करने गया, तो मैंने देखा कि भावना में पूर्णता नहीं देखी गई। अत: विचार की भावना का विकास आध्यात्मिक जीवन में, अर्थात् जीवन के सही तरीके में समान रूप से उपयोगी है। हमारा विकास तभी संभव होगा जब हम उदारता, मानवता और अहिंसा को जगह देंगे। हमें यह याद रखना चाहिए कि हम इस दुनिया में बेहतरी के लिए आए हैं। इसके बारे में हम सभी को सोचना होगा। हमें सबके साथ जाना है। हम कभी भेदभाव नहीं चाहते।

उस वैदिक सभ्यता के आरंभ से ही हम परम सत्य की

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स्वप्नवासवदत्तम्- राजात्वं च असीमप्रेमादर्शस्य एकम् प्रामाणिकपत्रम्

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अखिल भुवने प्राचीनकालतः मानवाः नानाविध विषये चर्चां करोन्ति। संस्कृत साहित्याकाशे पौराणीक काहिनितः वर्तमान समयोपयोगि अधिकः विषये रचनाः सन्ति। सर्वं विषयस्य प्रामाणिक दलिलं संस्कृतम्भवति। मानवजीवने आनन्द प्रदानाय संस्कृतसाहित्यम् इति उत्तमं विषयः खलू। अत्र नानाविधः गल्पकाहिनि, नाटकं, गद्यकाव्यं, पद्यम् इत्यादि विशेषरूपेन उल्लिखितम् अस्ति । मानवजीवने सुख-दुःखम् अनुभूतिः भिन्नम् अपरः विषयः नास्ति, परन्तुः तन्मध्ये यदि वयं आनन्दविषयरूपेन साहित्यचर्चां करामहः तर्हि केवलमेव आनन्दं हि आनन्दम् । संस्कृत नाट्यसाहित्ये यथा प्रणयविषयरस आलोचना अस्ति तथा राजनीति विषये अपि अधिकः निदर्शनं प्राप्यते। संस्कृत नाट्यशास्त्रे एताइशं बहुनानि नाटकानि सन्ति तन्मध्ये भासरचितं श्रेष्टः नाटकं 'खमवासवदत्तम्' इति। अस्मिन् नाटके यथा राजनीतिविषयः अस्ति तथैव प्रणयकाहिनि अपि उल्लिखितम्।

सूचकशब्दः-

राज्यजयः, राज्ञः सर्वाङ्गिन् मङ्गलसाधनम्, अद्वयः मेलवन्धनम्, नैसर्गिकं मेलवन्धनम्।

राज्ञः नीति राजनीतिः । राज्यपरियाजनाय अत्यावश्यकः राजनीतिः इति । यदि कस्मिनश्चित् राज्ये राज्ञः नीति वलशाली न भवति तर्हि राज्यं दुर्बलः भवति। एतत् सत्यं यत, यदि राजा अधिकरुपेण राजविद्यां निपुनं न भवति तर्हि मन्त्रिभिः सह विषयस्यचर्चाम् अत्यावश्यकं करिष्यति। मन्त्रिबुद्धिवलेन राजा अधिक कार्ये सफलं भवति। यराजमन्त्रिः सः सर्वदा राजकार्यकल्यानविषये अधिकः तत्परं भवति। 'खप्नवासवदत्तम्' इति नाटके एतादृशं मन्त्रिः अस्ति सः '। सः सर्वदा राजकार्ये निपुनः आसीत्। तस्य राजनीतिमतेन राजा उदयनः हृतराज्यं पुणः प्राप्तवान्। एतत् सर्वं मन्त्रि यौगन्धरायणस्य मध्ये सुनिपुनाम राजनीतिविद्यां आसीत्।

राजा सर्वदा तस्य राजत्वं तथा राजकोषवर्धनाय प्रादेशीक नृपेन सह युद्धं करोति । यद्यपि राज्यजयं अधिकः आनन्दं परन्तुः राज्यजयविषये सम्पक् रुपेन अन्तशक्तिः अनिवार्यम् भवति । राज्यजये राज्ञः राजकोषः वर्धनाय अधिक सहायतां करोति । परन्तुः राजा यदि सर्वविषये सम्यक् रुपेन ध्यानं न ददाति तर्हि राज्यः द्रुतं शक्तिहीन भवति । स्वसवासवदन्तम् नाटके राजानां कते एतादृशम अभवत।

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Vedic Literature Echoed in Monotheism and Humanism

Humans are social creatures. Society is deeply involved with the sense of human life. That is why fear, longing, appeal are all reflected in human nature as well as in society. From time immemorial, many great men have entered this land of our virtue. They also gave guidance in the way they were guided. We have been hearing about this path since ancient times. It is said that when a subject is seen to be presented, the need for some relevant subject is observed behind the presentation of that subject. So we are very much indebted to the Vedic literature for the formulation of this advanced concept.

From the Vedic period onwards, we have been acquainted with the feeling of human exploitation. And we observe that in the sounding sage's mantra. You can never go too far with narrow ideas and values. Expansion of the field of ideas and values is the only way to achieve success in life. The ideology that we see in Vedic literature is the expression of the combined ideology. Running from 'I' to 'we'. Today and in the context of this modern age, we can always understand the relevance of that larger sense of thought in every step we desire. Therefore, it is desirable for us to look at how and in what way the Vedic sages have revealed the direction of that passage. Society and sense of well-being - this subject or field is not limited to a handful of people.

The more we move towards the civilized side, the more we will meet with better thinking. We see in Vedic literature the aspects of the cultural culture that we find in the previous level of Vedic literature being unveiled more and more.

Civilization also changes with the combination of society and culture. One has to be initiated from a narrow mind to a liberal consciousness. We have to change our direction due to the variability of society or contemporary thinking. There are many examples of that variability in Vedic mantras. Such variability is one of the contributors to the progress of the society and the state. Therefore, in most of the Vedic literature, we find the search for a new direction.

It is always desirable to avoid differences. Divisiveness becomes the main

Origin of and deformation related to the Rimae Doppelmayer on the Moon

The optical stereo-images (5 m/pixel resolution) captured by the Terrain Mapping Camera-2 (TMC-2) on board the Chandrayaan-2 Lunar orbiter[1] and digital elevation models (10 m/pixel resolution prepared from these images) help understand the morphology of the structural features on the surface of the Moon.

The Rimae Doppelmayer (RD) within the Mare Humorum in the nearside of the Moon is a NNW–SSE-trending, ~130 km long graben system (Figure 1 *a* and *b*). The topographic profiles across the RD resemble those of typical lunar grabens[2,3] (Figure 1 *c*). Despite its prominent presence in the available images of the Moon, detailed morphometric studies of the RD are lacking. The very high-resolution TMC-2 image of this graben system, though a partial coverage of its length, has provided an opportunity for morphometric estimates to understand and quantify the crustal deformation related to this graben and also the age of its formation.

The Mare Humorum is Nectarian in age with low titanium basalts[4], mainly pigeonite- and augite-rich[5], and belonging to the Imbrian–Eratosthenian periods[6,7]. Compressional features such as wrinkle ridges, lobate scarps and extensional features such as grabens and collapsed lava tubes/rilles are common in the basin. The rilles and grabens are proposed to be a combined effect of dykes and extensional faulting beneath the mare. Rilles are also assumed to be positioned as hinge areas of tilting or subsiding basins[6].

TMC-2 has photographed the southern 30 km of the NNW–SSE-trending RD (Figure 1 *a*(ii)). In the present study, age extension across the RD and longitudinal strain was estimated using the TMC-2 image. Age has been estimated by the crater size frequency distribution method[8] using the buffered crater counting technique, with 1.5 times the crater radius[9]. The CraterTools add-on in ArcGIS was used for the crater size–frequency measurements, whereas CraterStats II was used for age determination. Crater statistics obtained by crater counting was fitted with the crater production function for the Moon and to deduce the absolute age, crater frequency for certain crater sizes was combined with the chronology function for the Moon[10]. Craters present on the graben floor may be older than the event of graben formation and, therefore, were not considered for age estimation. Extension across the RD and the longitudinal strain accumulated were estimated using established formulae related to the graben morphology[11,12]

$$\text{Total extension } (D) = d1/\tan\alpha_1 + d2/\tan\alpha_2, \quad (1)$$

where $d1$, $d2$ are the graben depths on two sides and α_1, α_2 are the dip angle of the graben (considered as 60° in the absence of subsurface data[13]) (Figure 1 *b*).

$$\text{Regional longitudinal strain } (e_{reg}) \text{ along the profile} = D/L_0, \quad (2)$$

where D is the total extension and L_0 is the original length of the profile (Figure 1 *b*).

Extension across the graben ranged from 81 to 344 m, with an average of 188.4 m (Table 1). The regional longitudinal strain was between 0.07 and 0.27, with an average of 0.14 (Table 1). The age of the RD was estimated to be ~1.9 Ma (Figure 2 *a* and *b*). This deformation corroborates with those of other studies on recent geological activities like faulting and moonquakes[14,15]. Near the RD, volcanic domes and a ~NE–SW-trending prominent lobate scarp oblique to it are present[16] (Figure 1 *a*(i)). However, the absence of any convincing arcuate or radial fractures in the immediate vicinity of the volcanic domes suggests that the origin of the RD was not influenced by volcanic

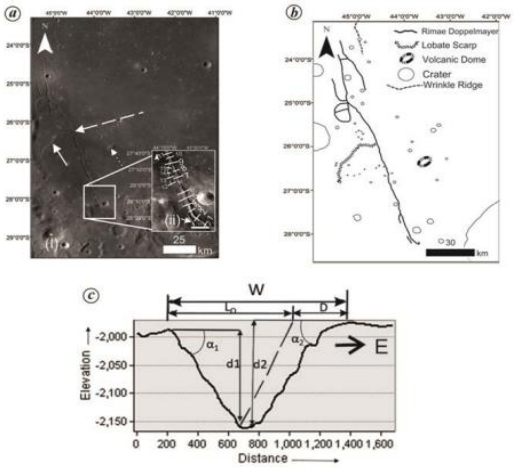

Figure 1. ***a***, (i) LROC WAC image of the Rimae Doppelmayer (RD) on the Moon (indicated by the broken white arrow) and a lobate scarp (indicated by white solid arrow) oblique to it within the Mare Humorum, a volcanic dome to the east of the RD marked by the dotted arrow (almost at the central part of the image) (image ID: Lunar_LRO_LROC-WAC_Mosaic_global_100m_June2013 with 100 m/pixel resolution). (ii) Southern part of the RD. Numbered lines are traces of section planes. Arrows indicate relic pit craters (image ID: ch2_tmc_ndn_20200209T0032589097_d_oth_gds.tif). ***b***, Trace map of geomorphological features of the RD and its surroundings. ***c***, A representative topographic profile (profile 3) across the RD showing the parameters used in eqs (1) and (2)[13].

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Imprints of vehicular pollution in roadside dust from Kolkata, India: insights from magnetic susceptibility, geo-statistical and SEM studies

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The present study aimed to determine the magnetic susceptibility of roadside dust collected from different parts of Kolkata city, West Bengal, India. The average value of susceptibility was 4.96×10^{-6} m^3/kg, the highest being 19.6×10^{-6} m^3/kg and the lowest being 1.2×10^{-6} m^3/kg. The frequency-dependent susceptibility value (average = 2.19) indicated the dominance of stable-single domain grains with a low concentration of superparamagnetic grains at a few locations. SEM analysis showed morphological diversity of road dust – irregular, aggregate, angular and cloudy. Energy dispersive X-ray spectroscopy analysis of the dust particles revealed that Ca-rich, Na-rich and Fe-rich particles were abundant. Compositions were variable with the morphology. The mapping of magnetic susceptibility indicated that the susceptibility values were higher in areas with heavy vehicular traffic and other polluting sources. However, some areas with high pollution had open spaces, indicating the dispersion of magnetic pollutants. The study indicated the degradation of the environment due to anthropogenic activities.

Keywords: Anthropogenic activities, magnetic susceptibility, morphological study, roadside dust, vehicular pollution.

INDUSTRIALIZATION coupled with high population density in the Indian subcontinent has led to a contaminated milieu, especially in large cities like Kolkata in West Bengal. This is due to vehicular traffic and industrial emissions associated with fly-ash particles[1–6]. Most of these environmental contaminants of varied sources and origins are magnetic[7]. Also, magnetic grain size and composition are important to identify the precise source of magnetic contaminants[1]. The contribution of anthropogenic contaminants in metropolitan cities due to vehicular traffic globally dominates over natural causes[1–3,6–9].

Environmental magnetism can act as a dependable non-destructive tool for assessing pollution[10–13]. The principle behind the application of magnetic techniques in the study of environmental pollution is to measure the magnetic properties (magnetic susceptibility in the present case) of the samples under consideration. It is well known that magnetite is a common component of roadside dust. Thereby a positive correlation develops between the concentration of magnetite and toxic elements[14,15]. Magnetite in road dust comes from several sources. The emission from automobiles caused by burning fossil fuels is the most prominent of them. Smelting, abrasion of asphalt-top roadways and vehicle brake systems contribute to magnetic contaminants.

Thompson and Oldfield were the pioneers in research on environmental magnetism[16–19]. Subsequently, Kapicka *et al.*[8] and Hoffman *et al.*[2] carried out magnetic susceptibility mapping in the Czech Republic and Tuebingen, Germany respectively. These studies brought out an interesting association between pollutants and magnetic particles. Boyko *et al.*[7] carried out magnetic susceptibility measurements of the topsoil for validating pollution intensity studies over the long term. In India, Goddu *et al.*[1] reported the magnetic characteristics of road dust from Visakhapatnam city in Andhra Pradesh and Mondal *et al.*[20] from the Bandel–Triveni area in West Bengal. In the present study, we demarcate the degree of environmental pollution by mapping the magnetic susceptibility from road dust samples collected in different parts of Kolkata.

Materials and methods

Study area

Kolkata extends in a roughly north–south direction along the eastern bank of the Hooghly River in eastern India[21]. As a part of the Indo-Gangetic Plains, the soil of the study area is of alluvial origin. According to the geologic setting, Kolkata is located in the peri-cratonic Tertiary Bengal Basin[22]. The climate is tropical wet and dry, which can be designated as 'Aw' under Koppen climatic classification[23]. Kolkata city, which is under the jurisdiction of the Kolkata Municipal Corporation (KMC), has an area of 185 sq. km. The western boundary is marked by the Hooghly River

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Increasing primary productivity in the oligotrophic Tethyan coastal ocean during the Paleocene-Eocene warming episode

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ABSTRACT

The coastal upwelling zones, occupying only ~0.5% of the global ocean, account for ~10% of the global primary productivity. The CO_2 fixation by primary producers amplifies in the upwelling zones during global warming due to the higher nutrient supply. Based on the presumption that the nutrient-deficient coastal ocean is less productive, the state of the oligotrophic coastal ocean is often neglected in the productivity-climate change studies. The present study investigated the changes in the primary productivity, redox condition, and nutrient content, using algal abundance, total organic carbon, and various major, trace, and rare earth elements and yttrium (REY) proxies, of the oligotrophic equatorial eastern Tethyan coastal ocean across the Paleocene-Eocene Thermal Maximum (PETM), a prominent paleo-global warming event. Despite the lower nutrient (lower Ni_{EF}, Cu_{EF}, and Zn_{EF}) contents, and invariable salinity, *p*H, and light conditions, the PETM interval shows extensive growth of coralline red algae in the hypoxic-oxic water column. Based on these observations, and inferences drawn from the previous laboratory experiments, conducted on the algal growth in varying pCO_2 by others, we postulate that the increased atmospheric CO_2 concentrations during the PETM probably enhanced the primary productivity of the oligotrophic Tethyan coastal ocean. If so, then the oligotrophic coastal ocean may be considered as an effective CO_2 sink and likely to play a pivotal role in carbon cycle-climate connection studies.

1. Introduction

About half of the total primary production on the Earth is contributed by the tiny phytoplankton in the oceans (Antoine et al., 1996; Field et al., 1998; Falkowski, 2012). The phytoplanktons fix a humongous amount of atmospheric CO_2*via.* photosynthesis and play a vital role in controlling the global carbon cycle and climate (Field et al., 1998). Acting as an effective CO_2 sink, their abundance is crucial during global warming, when there is excess CO_2 in the atmosphere. However, the warmer oceans during global warming are likely to hinder the phytoplankton growth by increasing the ocean thermal stratification and reducing the vertical mixing of the nutrients from the sub-surface layers to the upper layer of the ocean (Riebesell et al., 2000; Polovina et al., 2008; Boyce et al., 2010). On the contrary, phytoplanktons are likely to flourish in the coastal oceans, especially in the upwelling zones, where the intensified wind (due to the enhanced land-sea temperature gradients) accelerate the coastal upwelling and thereby, the nutrient content of the coastal waters (Bakun, 1990; Gregg et al., 2005; Boyce et al., 2010; Sydeman et al., 2014; Xiu et al., 2018). Thus, the upwelling zones, covering ~0.5% of the global ocean, probably act as major CO_2 sinks during global warming episodes (Bauer et al., 2013).

Except for the upwelling zones, significant areas of the coastal ocean are nutrient deficient or oligotrophic. Since oligotrophic coastal oceans are less productive in terms of phytoplankton growth, they have been grossly overlooked in the carbon cycle and climate change studies. Therefore, it is not well known whether the oligotrophic coastal ocean would remain less productive or become fertile during the global warming episodes (Barnet et al., 2020). The Paleocene-Eocene boundary (~56 Ma) witnessed one such extreme short-lived (~170 ± 30 Ka) warming episode (5–10 °C), popularly known as the Paleocene-Eocene Thermal Maximum (PETM; Dunkley Jones et al., 2013; Zeebe and Lourens, 2019; Stokke et al., 2020; Teng et al., 2021). The addition of an enormous amount of depleted greenhouse gases (CO_2 and CH_4) to the ocean-atmosphere system, recorded as negative carbon isotope

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A simple but improved protocol for measuring carbon and oxygen isotope ratios of calcite in calcite-dolomite mixtures

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ABSTRACT

The extraction of stable carbon and oxygen isotope ratios ($\delta^{13}C$ and $\delta^{18}O$) of primarily precipitated calcite from partially dolomitized limestone is of prime interest because the $\delta^{13}C$ and $\delta^{18}O$ values of primary calcite are widely used in paleoclimate research. The differential acid extraction method (DAE) has been widely used to separate CO_2 evolved during the calcite-orthophosphoric acid reaction from CO_2 evolved from the dolomite-orthophosphoric acid reaction. However, the various laborious offline methods with inevitable uncertainties make DAE very challenging. We proposed a fully automatic-online DAE method in the present study, using an autosampler-GasBench II-Isotope Ratio Mass Spectrometer (IRMS). The results show that δ-values of calcite can be obtained from the mixture (grain size between 180 and 250 μm) having >50% calcite after ~15–100 min of reaction with orthophosphoric acid at 30 °C. Further, both the precision and the accuracy of the measurement using the autosampler-GasBench II-IRMS can be improved by attaching micro-vibrators to the sample tray.

1. Introduction

The carbon and oxygen isotopic composition ($\delta^{13}C$ and $\delta^{18}O$) of marine and non-marine carbonates have long been used to decipher the past climate, ecology, and vegetation history (Zachos et al., 2001; Sanyal et al., 2004; Song et al., 2013). However, primarily precipitated marine and non-marine carbonates are very susceptible to post-depositional alterations (Murray and Pray, 1965; Bathurst, 1983), thereby restricting their wide use in geologically old samples. The initially precipitated calcite ($CaCO_3$) in a limestone, upon the presence of Mg-rich fluids, re-precipitates as dolomite ($CaMg(CO_3)_2$), and therefore mild/partially dolomitized limestones are ubiquitous in sedimentary environments (Degens and Epstein, 1964; Murray and Pray, 1965; Fritz and Smith, 1970; Bathurst, 1983; Boggs, 2014). The co-existence of calcite and dolomite in an altered limestone makes it challenging to decipher the paleo-environmental signatures using the $\delta^{13}C$ and $\delta^{18}O$ values of the bulk limestone (using conventional acid-digestion) because the $\delta^{13}C$ and $\delta^{18}O$ values of the bulk limestone gives mixed signals coming from both initially precipitated calcite and re-precipitated/diagenetic dolomite.

Because of their similar physical properties, the physical separation of admixed calcite and dolomite is considered a herculean task. The futile attempts at the physical separation of calcite and dolomite inspired the development of a chemical separation method known as the differential acid extraction (DAE) method, first suggested by Epstein et al. (1964). The DAE method uses the differences in calcite and dolomite's reaction rates with orthophosphoric acid (H_3PO_4; referred to as acid at places). Since calcite reacts faster with acid, the CO_2 produced from the calcite will contribute more during the early stage of the reaction. However, it is not as simple as it seems since the reaction rates of calcite and dolomite overlap, depending upon many parameters, e.g., grain size, reaction temperature, dolomite stoichiometry, and possible interference resulting from isotopic kinetic/non-equilibrium fractionation during partial/incomplete acid reaction (Al-Aasm et al., 1990; Baudrand et al., 2012; Liu et al., 2019).

Many studies proposed various reaction protocols for separating calcite and dolomite from mixtures of varying proportions (Epstein et al., 1964; Wada and Suzuki, 1983; Walters et al., 1972; Matsumoto and Matsuda, 1988; Al-Aasm et al., 1990; Pleydell et al., 1990; Böttcher et al., 1998; Ray and Ramesh, 1998; Kyser et al., 2002; Yui and Gong, 2003; Liu et al., 2019; Du and Song, 2020) by constraining the grain size, reaction temperature, and dolomite stoichiometry. The plethora of DAE methods indicates the difficulty in proposing one DAE method acceptable to all varieties of altered limestones, which is quite understandable, considering the possible chemical and mineralogical variations resulting

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ORIGINAL PAPER

Comparison of Pretreatment Methods for Organic-matter Removal and their Effects on the Hydrogen Isotope (δ^2H) Composition of Kaolinite

Arpita Samanta · M. K. Bera · Sruthi P. Sreenivasan · Anindya Sarkar

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Abstract The hydrogen isotopic composition (δ^2H) of authigenic clay minerals has been used extensively in paleoclimate studies. The separation of clay minerals from sediments/soils, using various chemicals, is a prerequisite for isotope ratio measurements, where carbonate, Fe-(oxyhydr)oxides, and organic matter are removed successively from the sediments for a greater clay yield. The commonly adopted organic matter-removal method using hydrogen peroxide (H_2O_2) is thought to either alter directly the pristine δ^2H values of the smectite clay minerals or to introduce organic hydrogen-bearing impurities through the ineffective removal of organic matter. The objective of the present study was to test whether H_2O_2 treatment can alter the δ^2H values of kaolinite (Kln) by comparing two organic matter-removal methods, namely, H_2O_2 and disodium peroxodisulfate ($Na_2S_2O_8$) combined with a neutral buffer. In doing so, kaolinite-rich, old (~56 Ma) sediment samples and pure kaolinite internal laboratory reference materials were used to understand the effectiveness and suitability of the above-mentioned methods in clay-sample preparation for δ^2H measurements. The δ^2H values of the H_2O_2-treated aliquots show smaller δ^2H values than those for the $Na_2S_2O_8$-treated aliquots. Estimated ambient water $\delta^{18}O$ values (−4‰) from the $Na_2S_2O_8$-treated aliquots agreed well with the bio-phosphate (fish vertebrae) based environmental water $\delta^{18}O$ estimation (−3.3‰). The present study indicated, therefore, that δ^2H values obtained after $Na_2S_2O_8$ treatment are likely to be more realistic for paleoclimate reconstruction.

Keywords δ^2H · Early-Eocene equatorial precipitation · Kaolinite · Organic matter-removal method

Introduction

The geochemistry of authigenic (both neoformed and transformed; Pozo & Calvo, 2018) clay minerals, particularly oxygen ($\delta^{18}O$) and hydrogen (δ^2H some time referred to as δD) isotopic compositions, is a potential tool for quantitative reconstruction of past climates (Andrzejewski & Tabor, 2020; Bukalo et al., 2019; Gilg, 2000; Gilg et al., 2004; Girard et al., 2000; Oyebanjo et al., 2018; Tabor & Montañez, 2005). Complete removal of organic matter from the soil/sediment samples without affecting the mineral phase is a prerequisite for studying the structure, physicochemical

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Spectacular Soft-Sediment Deformation Structures in Sedimentary Rock Outcrops of Damodar Valley Basin, West Bengal, India: A Field Guide

Arpita Samanta and Abhik Kundu

Abstract This chapter deals with a few outcrops of sedimentary rocks present in the Damdor River valley, West Bengal. These outcrops preserve different types of soft sedimentary deformation (SSD) structures in a fluvial set up. As preservation potential is very low for sedimentary rocks, outcrops with good quality of primary sedimentary structures and SSDs are rare for training of process-based sedimentology. Moreover, these SSDs of Mesozoic time are of aseismic origin, which are less explored and reported. This chapter presents some glimpses of SSDs formed in the Gondwanaland mainly during the early Triassic Period which considered as the most unstable interval of the Phanerozoic Eon. SSDs, such as convolute-laminations, chevron folds, overturned cross stratifications, sand volcanoes, and load casts produced by different mechanisms but possibly by the same autokinetic force are preserved in these sections. This chapter will be a helpful guide in field for recognition of different types of SSDs generated by autocyclic rearrangement processes.

1 Introduction

Sedimentary rocks preserve excellent clues for understanding the evolving Earth system. Sediments spread in wide range of environments that characterize dynamics of physical (e.g., Dasgupta & Mukherjee, 2020; Mukherjee & Kumar, 2018) as well as biological processes on the Earth's surface. Like every other domain of Earth science, the knowledge on sedimentary rocks and ideas about processes of their evolution have been changing and expanding continuously; field observation and primary data collection from the field still remain as basic building block of every study on sedimentary rocks. Any study of sedimentary rocks begins with a systematic observation of rock outcrops or drill-core samples. Sediment provenance as well as the nature of transport and depositional processes can be inferred directly

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The Rock Outcrops at Raghunathdi, SE of Ghatsila (Jharkhand, India): a Spectacular Preservation of Polyphase Folding

Srinanda Ganguly, Arpita Samanta, and Abhik Kundu

Abstract The present chapter describes and illustrates an interesting outcrop of rock from a location near Ghatsila, Jharkhand. This outcrop exposes spectacular preservation of signatures of multiple phases of folding. It is an ideal site for studying superposed fold interference patterns and relations between axes and axial surfaces of different generations of folds. Teachers of structural geology from eastern India, along with their students, are frequent visitors of this outcrop; they consider this outcrop as a museum of superposed fold interference patterns. This place is an easy reach as the Ghatsila town is well connected with major cities of India by both railway and road. We expect that this chapter will encourage teachers from all over to bring their students here in order to teach how to study and map a multiple folded terrain.

Keywords Superposed fold · Pucker axis lineation · Recumbent fold · Hook interference pattern · Raghunathdi

1 Introduction

The well-known rock outcrop of Paleo-Proterozoic Chaibasa Formation (Table 1) in the Raghunathdi (alias Sushnikalmi) area, 4.4 km to the southeast of Ghatsila town in the East Singbhum District, Jharkhand preserves very complex fold geometry formed due to multiple phases of folding. The outcrop (22°33′40.65″N, 86°30′30.69″E, Fig. 1) is overall trends NE–SW, with ~255 m^2 area. This outcrop, popularly known as the *'Tentuldanga outcrop'*, is extensively studied by structural geologists especially from eastern India (Ghosh & Sengupta, 1990, Sengupta & Ghosh, 1997). This is one of the most favourite outcrop for teachers of structural geology to train their students the styles and manifestations of superposed folding. Therefore, this outcrop has been visited by a very large number of geologists for almost last four decades (or even more). However, except in one field guide on Ghatsila and neighbouring area published by the Department of Geological Sciences, Jadavpur University, India

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ORIGINAL PAPER

Comparison of Pretreatment Methods for Organic-matter Removal and their Effects on the Hydrogen Isotope (δ^2H) Composition of Kaolinite

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Abstract The hydrogen isotopic composition (δ^2H) of authigenic clay minerals has been used extensively in paleoclimate studies. The separation of clay minerals from sediments/soils, using various chemicals, is a prerequisite for isotope ratio measurements, where carbonate, Fe-(oxyhydr)oxides, and organic matter are removed successively from the sediments for a greater clay yield. The commonly adopted organic matter-removal method using hydrogen peroxide (H_2O_2) is thought to either alter directly the pristine δ^2H values of the smectite clay minerals or to introduce organic hydrogen-bearing impurities through the ineffective removal of organic matter. The objective of the present study was to test whether H_2O_2 treatment can alter the δ^2H values of kaolinite (Kln) by comparing two organic matter-removal methods, namely, H_2O_2 and disodium peroxodisulfate ($Na_2S_2O_8$) combined with a neutral buffer. In doing so, kaolinite-rich, old (~56 Ma) sediment samples and pure kaolinite internal laboratory reference materials were used to understand the effectiveness and suitability of the above-mentioned methods in clay-sample preparation for δ^2H measurements. The δ^2H values of the H_2O_2-treated aliquots show smaller δ^2H values than those for the $Na_2S_2O_8$-treated aliquots. Estimated ambient water $\delta^{18}O$ values (−4‰) from the $Na_2S_2O_8$-treated aliquots agreed well with the bio-phosphate (fish vertebrae) based environmental water $\delta^{18}O$ estimation (−3.3‰). The present study indicated, therefore, that δ^2H values obtained after $Na_2S_2O_8$ treatment are likely to be more realistic for paleoclimate reconstruction.

Keywords δ^2H · Early-Eocene equatorial precipitation · Kaolinite · Organic matter-removal method

Introduction

The geochemistry of authigenic (both neoformed and transformed; Pozo & Calvo, 2018) clay minerals, particularly oxygen ($\delta^{18}O$) and hydrogen (δ^2H some time referred to as δD) isotopic compositions, is a potential tool for quantitative reconstruction of past climates (Andrzejewski & Tabor, 2020; Bukalo et al., 2019; Gilg, 2000; Gilg et al., 2004; Girard et al., 2000; Oyebanjo et al., 2018; Tabor & Montañez, 2005). Complete removal of organic matter from the soil/sediment samples without affecting the mineral phase is a prerequisite for studying the structure, physicochemical

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