

# Structural and electronic factors relating to the stability of imidazolidine nitroxide radicals

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## ABSTRACT

Fifteen imidazolidine nitroxide radicals were synthesised,and their stabilities against ascorbate were investigated. Among them, it was found that radicals bearing OH groups exhibited improved stabilities. In addition, density functional theory calculations, evaluation method of steric shielding effect around nitroxide radical reaction center based on molecular volume within a virtual ball, multiple regression analysis showed that the half-lives of these radicals were influenced both by steric effects and by the charge on the ring nitrogen atom.

**Keywords:** imidazoline nitroxide, radical, stability, density functional theory, multiple regression analysis

# Analytical and bio-analytical methods of rofecoxib: A comprehensive review

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## ABSTRACT

A selective COX-2 inhibitor Rofecoxib it is a non-steroidal anti-inflammatory (NSAIDs) medicines work by inhibiting the COX enzyme, which is a mediator of inflammation. Rofecoxib is used to treat rheumatoid arthritis, osteoarthritis, and primary dysmenorrhea. The main objective of this study is to examine Rofecoxib in pharmaceutical and biological formulations both qualitative and quantitative. In this review paper, we have outlined the approaches based on UV/Vis spectroscopy, High-performance liquid chromatography (HPLC), High-performance thin layer chromatography (HPTLC) and Liquid chromatography-mass spectrometry (LC-MS) for estimating rofecoxib. We have also discussed the bioanalytical methods used to analyse RFX. In conclusion, this review paper will aid researchers in developing new techniques for drug estimation in biological fluids and pharmaceutical dosage forms.

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## 1. Introduction

Non-steroidal anti-inflammatory drugs (NSAIDs) are commonly used to treat pain and inflammation in rheumatoid arthritis. Their analgesic and anti-inflammatory effects, as well as some of their chemo preventive effects, are attributed to their inhibition of cyclooxygenase (COX) enzymes, which turn arachidonic acid into prostaglandins. <sup>1</sup> Rofecoxib is chemically 3-phenyl-4-(p-methylsulphonyl)-phenyl-(5H)-furan-2-one is a highly selective cyclooxygenase-2 (COX-2) inhibitor. <sup>2</sup> Cyclooxygenase-1 (COX-1) and cyclooxygenase-2 (COX-2) are the two types of the enzyme. Normal physiological processes mediated by prostaglandins, such as platelet aggregation and gastric cytoprotection, are controlled by COX-1. Gastric damage and platelet inhibition have been linked to nonselective NSAID's COX-1 inhibition.

It has been established that COX-2 plays a key role in the production of prostanoid mediators of pain and inflammation. <sup>2</sup>

In addition to treating acute migraine episodes with or without auras, rofecoxib is also used to treat adult cases of primary dysmenorrhea, rheumatoid arthritis, osteoarthritis, and acute pain. <sup>3</sup>

## 2. Mechanism of Action

The suppression of prostaglandin production appears to be the cause of the anti-inflammatory, analgesic and antipyretic actions of NSAIDs. These effects appear to be achieved by inhibiting the COX-2 isoenzyme at the sites of inflammation, which then results in a decrease in the manufacture of certain prostaglandins from their arachidonic acid precursors, however the precise mechanism of action has not yet been established. The COX-2 enzyme, which is crucial for the regulation of pain

## RECENT ADVANCEMENT OF BIOACTIVE COMPOSITE COATED TITANIUM FOR BIOMEDICAL APPLICATIONS

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### Abstract

The growth in senior population has led to a rising need for greater quality of life promoting utilisation of implant materials. The requirement in procedures such as hip replacement, knee replacement, etc., is predicted to witness a manifold growth in future. The essential need of any implant (Ti, Mg, Steel, etc) is to operate effectively inside the human body for the desired application i.e., the implant material and the tissue environment of the body should not endure any unwanted or poisonous consequence. Titanium (Ti) and its alloys are frequently utilised as implant materials owing to their outstanding biocompatibility, strength, corrosion resistance and longevity compared to other alloys such as 316, 316L stainless steel, Mg and Co-Cr steels. Nevertheless, Ti and its alloys are bio-inert in nature. The inclusion of Ti in the body as implant material is followed with stress shielding effect at the implant interface owing to its difference in mechanical characteristics compared to the host bones. The mismatch between the Young's modulus of Ti implant and host bones produces adverse resorptive bone remodelling, wearing, loosening and thus failure of the implant. Additionally, the bio-inert Ti surfaces are not adequately bioactive and so surface modification is necessary to promote the bioactivity and osseo integration with bone tissues. The primary objective of this work is to develop PPy bioactive composite coating by incorporating Chitosan (CHI) and Graphene oxide (GO) in PPy matrix using electrical and chemical methods for enhancing the biocompatibility and augmentation of the corrosion resistance property of Ti for biomedical applications.

**Keywords:** *Titanium, stainless steel, Surgeries, Chitosan, Young's modulus and alloy.*

### 1. Introduction

**IoT based Smart Irrigation System using Soil Moisture Sensor and ESP8266 NodeMCU**

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**Abstract:**

We are going to construct a smart agricultural monitoring system which can collect crucial agricultural data and send it to an IoT platform called Ubdots Clouds in real time where the data can be logged and analyzed. IoT based Smart agriculture system is an developing technology, where its data from small to large scale and its surrounding are collected using smart electronic sensors. It also helps minimize depletion by using solenoid valves which are automatic controlled by IoT technology. IoT is a shared network of objects or things which can interact with each other provided the Internet connection. Using IoT we can directly send the collected data to a central server in real time. This complete system works only when this embedded device interacts with smartphone Ubdots cloud application. When programming the device, we can include id and password in it. This id and password should match with id and password of smart phone wifi id and password. Then only system can work and information transmission is possible in between embedded device and Ubdots cloud. Since we have automated the date collection, the data integrity is assured and since the data processing is done using computers, experts may get advanced analytical software tools to draw most accurate predictions. The collected data are analyzed by experts and local farmers to draw short term and long term conclusion on weather pattern, soil fertility, current quality of crops, amount of water that will be required for next week to a month etc.

Keywords: Node MCU, IoT, Ubdots Clouds, Relay section, Soil moisture sensor, Submersible pump

**I. Introduction:**

IoT plays an important role in agriculture industry which can feed 10 billion people on the Earth by 2050. We can take smart farming a step further by automating several parts of farming, for example smart irrigation and water management. We can apply predictive algorithms on microcontrollers or SoC to calculate the amount of water that will be required today for a particular agriculture field. As a part of the system development, few sensors applied such as: a soil moisture sensor to detect the water level in soil; These sensors are connected to a Wi-Fi

## Perfluorinated pinacol promotes efficient amidination of 2-aminophenylboronic acid

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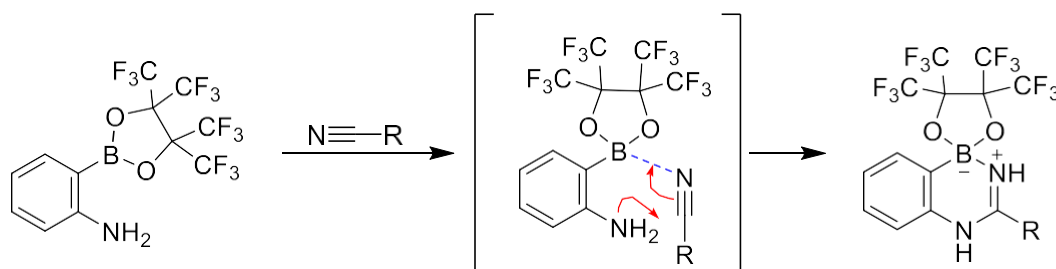
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### Abstract

This work reports the use of halogenated alcohols in catalyzing a unique amidination reaction using 2-aminophenylboronic acid. Trials using acetonitrile as the reactant nitrile showed that the amidination efficiency increased from 33% with salicylic acid, to 78% with 2,2,2-trifluoroethanol and finally quantitative yields with perfluorinated pinacol. This protecting group proved to be highly efficient for amidination of several different nitrile groups with only mild heating.



**Keywords:** Amidination, boronic acid, fluorine, Lewis acid, nitrile

## Gold-NHC-*N*-naphthamide complexes

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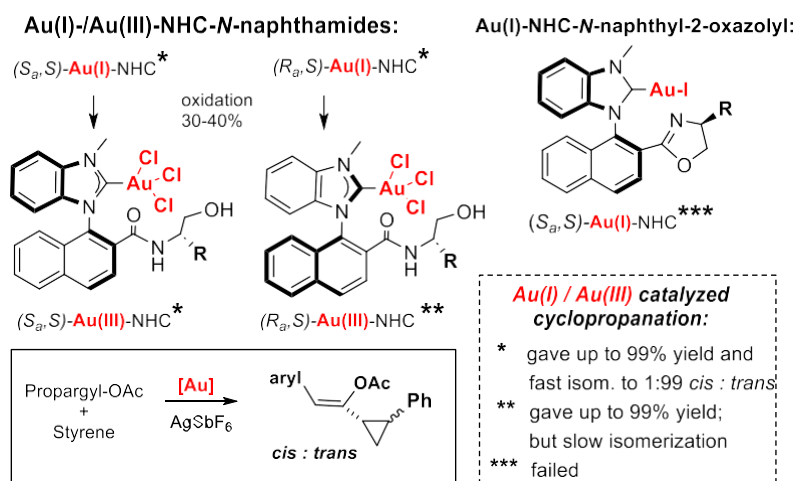
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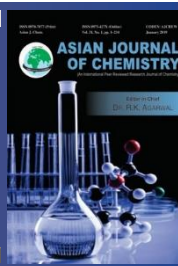
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### Abstract

Pure *S<sub>a</sub>S* and *R<sub>a</sub>S* atropisomeric Au(I)- and Au(III)-NHC-complexes with benzimidazolyl *N*-(2-naphthamide) frameworks were prepared from appropriate axially chiral pre-ligands. The catalytic capacity of gold-NHC-*N*-naphthyl complexes was studied in cyclopropanation reactions. In contrast to corresponding unsuccessful Au(I)-NHC-*N*-naphthyl-oxazolyl complexes, all tested *S<sub>a</sub>S* and *R<sub>a</sub>S* diastereomers of Au(I) and Au(III)-NHC-*N*-naphthamide complexes were excellent catalysts to give both successful cyclopropanation (up to 99%, 15 min), as well as subsequent rapid *in situ cis*-to-*trans* isomerization. The results demonstrate that the new axially chiral Au(I)-/Au(III)-NHC-benzimidazolyl-*N*-naphthamide complexes represent an interesting group of gold catalysts with specific properties, affording fast cyclopropanation, excellent product yields and predictable *trans*-stereoselectivity (>99% yield; >99% *trans* in 15 min).



**Keywords:** Gold-NHC-naphthamide; Au(I)/Au(III) complexes; catalytic active, cyclopropanation



## A New Synthetic Route for Preparation of Enantiomers of Gossypol and Apogossypol from Racemic Gossypol

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The paper described the preparation of enantiomers of gossypol and apogossypol from racemic gossypol *via* a two-step procedure. In the first step, D-tryptophan methyl ester was used as an effective agent to resolve racemic gossypol into (–)-gossypol and (+)-gossypol. Next, the deformylation reaction of the corresponding (–)-gossypol and (+)-gossypol was conducted in sodium hydroxide solution, followed by sulfuric acid neutralization in inert atmosphere and the resulting precipitate was filtered and washed with water to give (–)-apogossypol and (+)-apogossypol, respectively in high yields and in high enantiomeric excesses.

**Keywords:** Racemic, (–)-Gossypol, (+)-Gossypol, D-Tryptophan methyl ester, (–)-Apogossypol, (+)-Apogossypol.

### INTRODUCTION

Gossypol (**1**) isolated from cotton seed has recently received the increasing attention because it possesses a wide range of biological activities, including anticancer [1-4], contraceptive [5], antiviral [6-8] or antimicrobial activities [9]. Due to hindered rotation about the 2,2'-binaphthyl bond, gossypol exhibits two optically active forms, *R*-or (–)-**1** and *S*-or (+)-**1**. Research in both *in vitro* and *in vivo* showed that the (–)-enantiomer is more potent than the (+)-enantiomer and the racemic mixture (**1**) [10]. It was also hypothesized the selective action at low doses of the (–)-gossypol and a nonselective action from higher doses of either enantiomer [10]. Regarding the mechanism of action, the (–)-gossypol targets Bcl-2, Bcl-xL and Mcl-1 proteins with higher affinities than (+)-gossypol. It is now in clinical trials as an orally administered agent for the treatment of several types of human cancer [11]. However, the application of gossypol as a therapeutic agent was limited because of the presence of the aldehyde group in its structure, resulting a number of side effects [12].

Apogossypol (**2**) is a reduced product of gossypol (**1**). Preclinical *in vivo* data show that apogossypol (**2**) has superior efficacy and markedly reduced toxicity compared to gossypol (**1**) [13]. In addition, the evaluation of the single-dose pharma-

cokinetic characteristics of compound **2** in mice indicated that compound **2** displays superior blood concentrations over time in comparison with compound **1** because it has slower clearance, indicating that compound **2** could be a promising lead compound for cancer therapy in the future [14]. Thus, significant attention has been focused on potential therapeutic value of apogossypol (**2**) and apogossypol derivatives as a promising starting point for the development of antitumor derivatives for medicinal applications with enhanced bioactivity and reduced side effects [15-18].

To understand the mechanism by which apogossypol exhibits its broad biological activities, the preparation of the enantiomer of gossypol and apogossypol in high chemical yield and enantiomeric purity is highly desirable.

So far, a number of methods for the preparation of optically active (–)-gossypol and (–)-apogossypol from racemic mixture have been studied and reported [19]. However, the reported methods lack its feasibility in practical preparation. As a result, the development of a practical method for the production of (–)-gossypol and (–)-apogossypol in large quantities is important from both application and scientific view points. Intrigued by this practice, this paper presents a simple and improved method for the preparation of (–)-gossypol and (–)-apogossypol from racemic gossypol.



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# Melaleuca (Myrtaceae): Biogeography of an important genus of trees and shrubs in a changing world



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## ABSTRACT

The number of naturalised and invasive woody plant species has increased rapidly in recent decades. Despite the increasing interest in tree and shrub invasions, little is known about the invasion ecology of most species. This paper explores the global movement of species in the genus *Melaleuca* (Myrtaceae; here including the genus *Callistemon*). We assess the global introduction history, distribution and biogeographic status of the genus. Various global species occurrence databases, citizen science (iNaturalist), and the literature were used. Seventy-two species [out of 386 *Melaleuca* species; 19%] have been introduced to at least 125 regions outside their native range. The main regions of global *Melaleuca* introductions are Southeast Asia, the southern parts of North America, south-eastern South America, southern Africa and Europe. The earliest record of a *Melaleuca* species outside of the native range of the genus is 1789. First records of *Melaleuca* species outside their native range were most commonly recorded in the 1960s, with records from all over the world. The main reasons for *Melaleuca* introductions were for use in the tea tree (pharmaceutical value) and ornamental horticulture industries. *Melaleuca* introductions, naturalizations and invasions are recent compared to many other woody plant taxa. Experiences in Florida and South Africa highlight the potential of *Melaleuca* species to spread rapidly and have significant ecological impacts. It is likely that the accumulating invasion debt will result in further naturalization and invasion of *Melaleuca* species in the future.

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## 1. Introduction

The introduction of species to areas beyond their native distribution ranges by humans and their subsequent proliferation, spread and interaction with native species has greatly affected biodiversity globally, especially in the last few centuries (Pyšek et al., 2020a). Humans have moved thousands of plant species out of their native range for centuries. All types of plants have been moved around the world and species from almost all taxonomic and functional groups have become invasive (Hulme, 2009). Until recently, however, woody plant species (trees and shrubs) have been under-represented in invasive floras (Richardson and Rejmánek, 2011). In recent decades, the number of naturalised and invasive woody plant species has increased rapidly. Despite the increasing interest in tree and shrub invasions (Richardson et al., 2011) little is known about the invasion ecology of most species. Comparing the performance of species in different parts of the world is important for developing protocols for

screening new introductions for invasiveness and for managing species which may become or are already invasive (Potgieter et al., 2014; Canavan et al., 2017). Studying the invasion ecology of certain taxonomic groups is useful for finding cross-taxon generalizations and principles (Pyšek et al., 2008).

There can be substantial time lags between phases depicted in the introduction-naturalization-invasion continuum (Kowarik et al., 1995; Richardson and Pyšek 2012), especially for trees and shrubs, as their fecundity and overall propagule pressure scales tremendously with age (Botella et al., 2022) and residence time (Richardson et al., 2015). These lags create a phenomenon known as “invasion debt” which defines the extra extent of invasion in a specific region that could occur in the future due to processes already set in motion, even if no further introductions take place (Rouget et al., 2016). In some cases, species are introduced into an area and several decades may go by without the species becoming invasive. In the meantime, the species builds up its population, propagule pressure and seed banks and then, much later, becomes invasive.

Many species of Australian trees and shrubs have been widely disseminated around the world, notably species in the genera *Acacia*

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# Calcrete Bontveld bushclumps are *de novo* thicket islands

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## ABSTRACT

Calcrete Bontveld is a mosaic vegetation type found on calcareous flat-topped ridges in the Eastern Cape, South Africa. The mosaic is comprised of thicket clumps (bushclumps) scattered in a grassy dwarf shrubland matrix. The bushclumps appear to function as islands, yet their close resemblance to the adjacent Valley Thicket suggests that they could be remnant thicket patches. This study utilised the Island Biogeography Theory to determine the insularity of bushclumps. We specifically tested if they were indeed isolated communities or remnant thicket patches. Linear regression was used to obtain the slopes of the species-area curves, which indicated that the bushclumps, at all three known Calcrete Bontveld sites, were indeed isolated communities. Whilst the bushclumps of Calcrete Bontveld may mirror the appearance of the adjacent Valley Thicket, they are not remnant thicket patches but have rather developed *de novo*.

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## 1. Introduction

The Albany Thicket biome is considered to be one of floral transition and complexity (Dyer, 1937). Thicket is classified into a biome-scale hierarchy (Vlok and Euston-Brown, 2002) comprising Dune Thicket and Mainland Thicket at the highest order of the classification. Mainland Thicket can be subdivided into regional thickets, each containing Thicket, Arid Thicket and Valley Thicket (Vlok et al. 2003), which, in turn, may occur either as Solid Thicket or Mosaic Thicket. One of the types of Mosaic Thicket is Bontveld, which was defined as “Thicket clumps that occur in a fine grained pattern in a matrix vegetation that usually consists of elements typical of several (e.g. Fynbos, Grassland, Succulent Karoo) vegetation type” (Vlok and Euston-Brown, 2002). Meyer-Milne (2013) subsequently demonstrated that Calcrete Bontveld forms an ecosystem structurally and functionally different from those Bontveld vegetation types not on calcrete. The physiognomy of the Calcrete Bontveld is driven by the geological morphology on which it is found (Meyer-Milne, 2013).

For mosaics, the origins and mechanisms of the establishment of bushclumps or trees in a grassy or shrubby matrix have been contested over the past few decades. Originally, patch formation was considered to originate on termite mounds (Fleming and Loveridge, 2003; Tinley, 1977). Alternately, mechanisms for patch formation that yield mosaic vegetation include alternate succession pathways (Yarranton and Morrison, 1974), herbivory (Hester et al.,

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## The Amaryllidaceae, a chemically and biologically privileged plant family

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The guest editors in conjunction with the publishers of South African Journal of Botany (SAJB) at Elsevier take pleasure in bringing its patrons this special issue dedicated to the plant family Amaryllidaceae. Since an undertaking of such breadth has never prior been attempted in any form of print media and given the significant interest in the Amaryllidaceae today, the guest editors are particularly honored to have facilitated proceedings. Indeed, there have been collections on various aspects of the Amaryllidaceae, but these have either been highly thematic accounts or accounts in conjunction with other plant families. The wide array of aims and objectives conceived for this special issue also happen to coincide with the wide appeal of the SAJB audience today. These may be summarized as follows: phytochemistry, pharmacology, toxicology, traditional medicine, molecular biology, biotechnology, plant growth regulation, ecology, taxonomy and conservation. We are delighted that each of these categories in some shape or form has been represented in this issue. Furthermore, contributions from several of the leading exponents in the field today, who can vouch that such a commission is somewhat overdue, also lend credence to this seminal collection.

The family Amaryllidaceae J.St.-Hil. is found in tropical and subtropical habitats around the globe (Bastida et al., 2006). With nearly 1000 species in about 80 genera, it is amongst the most abundant of bulbous flowering plants (Bastida et al., 2006). In spite of this diversity its members are prominent in three main locations notably, Andean South America, the Mediterranean basin and South Africa (Bastida et al., 2006). Roughly a third of the global complement of its taxa are found in South Africa, particularly in the winter-rainfall region of the Western Cape Province (Viladomat et al., 1997). Although the Amaryllidaceae (also commonly referred to as 'Amaryllids') has been widely addressed in all of the niche categories described above, four of its attributes are particularly striking (Bastida et al., 2006). Firstly, its members, such as *Narcissus pseudonarcissus* L. ('wild daffodil'), *Galanthus nivalis* L. ('common snowdrop') and *Leucojum aestivum* L. ('summer snowflake'), have highly attractive and desirable floral traits (Bastida et al., 2006). These now support a vibrant floriculture industry, with Britain leading European daffodil flower production with annual sales totalling 30 million USD (Fig. 1) (Briggs, 2002). On the other side of the Atlantic, over 20 million cut daffodils are sold annually from the Puyallup River Valley of Washington State (USA) (Briggs, 2002). Secondly, members of the Amaryllidaceae have a

significant presence in traditional systems of medicine stretching from the Americas all the way to China (Nair and van Staden, 2013). For example, over 50 individual taxa are known for their usage against infectious diseases and perhaps an even higher number are used in the remediation of inflammatory conditions (Nair and van Staden, 2013). More importantly, the age-old usage of some Amaryllidaceae plants for cancer and motor-neuron diseases has led

# Attitudes to science when doing kitchen chemistry at science clubs

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## ABSTRACT

The South African grade 9 Natural Sciences curriculum suggests the use of everyday science to introduce the usefulness and the relatability of science to learners. Many learners, however, seem to have a negative attitude towards science learning and science as an entity. This study is an intervention that sought to ascertain the attitudes of grade 8 and 9 learners in under-resourced schools in South Africa after they had carried out kitchen chemistry hands-on practical activities at science clubs in under-resourced township schools. The learners were interviewed about their experiences, and university student volunteers at the science clubs were also interviewed. An inductive-deductive thematic approach was used to analyse the qualitative interview data. The findings of the study revealed that the learners had a more positive attitude toward science after they had been engaged in the kitchen chemistry hands-on practical activities. Additionally, the integration of everyday knowledge promoted conceptual understanding and improved the performance of the learners. The interviews with the student volunteers revealed aspects that they thought would improve learners' attitudes to science. Science clubs run by university student volunteers could assist in promoting a positive attitude to science among learners.

## KEYWORDS

kitchen chemistry; acids and bases, attitudes, science clubs, volunteers

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## INTRODUCTION

A plethora of research has highlighted a decline in the number of learners choosing science subjects in secondary schools across the world, such as in the United Kingdom,<sup>1</sup> Europe,<sup>2,3</sup> in India<sup>4</sup> and Australia.<sup>5</sup> In South Africa, there has been a marginal increase in the number of learners writing the National Senior Certificate (NSC) examinations over the past five years (Table 1).<sup>6</sup> However, in 2021, only 23% of a total of 733 917 learners who sat for the NSC examination, <sup>7</sup> wrote Physical Sciences. Of those who wrote Physical Sciences in 2021, 53 378 (27.1%) achieved 50% and above (as calculated by the author from the graph on page 211 in the NSC Diagnostic report). <sup>6</sup> A significant factor, which influences the way learners perform in Science, Technology, Engineering and Mathematics (STEM) subjects is the learners' attitude towards science. It has been shown that learners' attitudes towards these subjects have declined.<sup>8,9</sup>

Learners' attitudes towards science are influenced and developed through their experiences with science. Thus, to ensure that learners perform well in science and are interested in pursuing it, it is important to develop programmes that will help them build positive associations with science.<sup>8</sup> These programmes should promote positive associations such as motivation, enjoyment and helping the learners see the relevance and applicability of science to everyday life.<sup>10</sup> In response to the declining attitude of learners towards science, and therefore a decline in the achievement in science-related subjects, a number of interventions have been developed to influence positive learner attitudes towards science.

One of the most common programmes developed and used, is science clubs.<sup>11</sup> It is not the science clubs *per se*, but rather the activities at the science clubs that play a significant role in bringing excitement, enjoyment and motivation to do science. At science clubs, learners can engage in, for example, hands-on practical activities which can stimulate interest and excitement.<sup>12</sup>

In the study described in this article, the aim was essentially to influence township school learners' attitudes towards science using hands-on practical activities in out-of-school science clubs. The activities involved

kitchen chemistry, and the science clubs were run by Rhodes University student volunteers who were knowledgeable in science concepts. Kitchen chemistry refers to the chemistry of the everyday activities performed in households, such as cooking and cleaning.<sup>13</sup>

## LITERATURE REVIEW

### Attitudes

Attitudes towards science refer to the perceptions of the usefulness or the applicability of science, based on one's opinions or beliefs.<sup>14</sup> This is related to whether one can see the link between science as an entity and the scientific tools used to solve real-life problems.<sup>15</sup>

It has been found that attitudes towards science and science achievement were directly proportional to each other.<sup>16, 17</sup> The reason for this is that a positive attitude towards science sparks interest and cultivates motivation to engage actively with the science.<sup>18</sup>

### Out-of-school science clubs

Science clubs provide learners with informal spaces to engage in science activities and with support that promotes a positive attitude toward science.<sup>19</sup> Science clubs also promote enjoyment of science and foster a positive attitude towards science by incorporating activities which show how science is related to the everyday life of the learners.<sup>20</sup>

Out-of-school science clubs can be instrumental in making science more accessible to learners from disadvantaged socio-cultural

**Table 1:** National Senior Certificate achievement rates in Physical Sciences<sup>6</sup>

Year	No. wrote	No. achieved at 40% and above	% achieved at 40% and above
2017	179 561	75 736	42.2
2018	172 319	84 002	48.7
2019	164 478	85 034	51.7
2020	174 310	73 982	42.4
2021	196 968	88 164	44.8

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# Future of chemistry in the presence of artificial intelligence

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### ABSTRACT

Science-related subjects including chemistry, physics, mathematics, engineering, and medicine have all benefited greatly from advanced technology, particularly Artificial Intelligence (AI). Recently, the significance of AI in promoting chemistry research to improve the chemical industry has evolved. The goal of the researchers is to advance drug development by creating novel medications at a minimal cost. AI assists in achieving this goal. Other areas of chemistry that will benefit from AI include compound solubility, optimizing reaction conditions, and providing production methods for challenging target molecules. Researchers from Massachusetts Institute of Technology (MIT) have discovered a potent new antibiotic molecule using a machine-learning system. Typically, AI may produce ten times more antibody sequence clusters than a lab-based approach alone. Systems containing hundreds of interacting ions and electrons can now be modeled using an approximation of the physical laws. This is because modern algorithms and supercomputers make these applications possible.

### KEYWORDS

AI, designing molecules, detection of molecules, drug discovery, molecule, properties of molecules

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### INTRODUCTION

AI has enabled computers to function and think like human by creating software or machines that are based on human intelligence. Google Maps is among the most useful examples of AI.<sup>1</sup> The AI has developed into a helpful tool in many sectors since the early 2000s. The development stages have ranged from developing games and speech recognition to autonomous vehicle operation and spaceships. As reported, the idea of AI started in the middle on 20th century. The notion of creating an artificial brain sparked discussions among scientists from a variety of disciplines, including mathematics, psychology, engineering, biology, etc., in the first half of the 20th century, which led to a rise in popularity for this fascinating concept. John McCarthy first used the phrase "Artificial Intelligence" in 1956 at the Dartmouth conference, which served as the official birthplace of AI as a field of study. Nine notable AI-driven biotech companies were established in 2021.<sup>2</sup> Recently, the application of artificial intelligence in chemistry has developed dramatically. This can be a surprise for many people to know that AI and chemistry have very strong connection. Drug discovery and the development of the healthcare industry are major applications of artificial intelligence in the field of chemistry. Due to the highly developed technology and equipment employed by scientists, this technology has also been a result of cutting-edge pharmaceutical industry research and development. AI can be effectively applied to a variety of tasks, because complex correlations frequently exist in datasets. For instance, theoretical calculations or equations based on empirical data can both be used to forecast the solubility of a new molecule. An AI software that has learned structure-solubility connections through training on a large number of molecules with known solubilities may also predict solubility.<sup>2</sup> AI is now commonly employed for tasks like property prediction because of the quick rise in processing capacity, the accessibility of open-source machine learning frameworks, and chemists' developing data literacy. By facilitating laboratory automation, forecasting the biological effects of novel medications, enhancing reaction conditions, and offering production techniques for specific target molecules.<sup>3-10</sup> AI implementations have demonstrated their ability to significantly reduce design and experimental effort.<sup>11</sup> In the areas of Analytical Chemistry,

Synthetic Chemistry, and Physical Chemistry, new methods using AI have been developed to complement analytical data, automate flow chemistry, improve retrosynthetic planning, and predict reaction outcomes. Additionally, it was reported that a technique combining AI with physics-based approaches such density functional theory may improve calculation accuracy. User-friendly computing tools were also developed. According to the McKinsey Global Institute, society's workplace culture will undoubtedly undergo significant changes as a result of the rapid breakthroughs in AI-guided automation.<sup>12,13</sup> Systems with hundreds of interacting ions and electrons can now be represented using approximations to the physical rules that govern the world on the atomic scale, this is due to contemporary algorithms and supercomputers.<sup>14-17</sup> The field of computational chemistry has expanded in the 21st century, and its applications include the creation of catalysts for the conversion of greenhouse gases, the identification of materials for energy harvesting and storage, and the development of computer-aided pharmaceuticals.<sup>18</sup> Chemical engineers have also utilized machine learning to speed up and conserve resources by searching the solution space of potential reactions.<sup>19-23</sup> Shields et al.'s study demonstrates how Bayesian optimization can be utilized in synthetic chemistry to fine-tune neural networks. In this study, they show how Bayesian optimization can be viewed as a self-sufficient technique for reducing human biases.<sup>24</sup> Gale and Durand's assessment of reaction prediction techniques demonstrates how machine learning in chemistry has a lot of room for improvement and is actively being researched in practically every field.<sup>25</sup> They discuss a number of significant issues, including the requirement for datasets to produce both negative outcomes and error-free responses. They talk about how challenging it is to encode chemical information in a way that is machine-readable. An encoder and decoder type neural network can be utilized to represent a continuous chemical latent space, as demonstrated by the work of Iovanac et al. To forecast the features of distinct pKa predictions of moderately sized molecular species, their research employs both actual and projected models from density functional theory.<sup>26</sup>

### AI APPLICATIONS IN CHEMISTRY

Although AI has many applications in the area of technology, it also

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# Hydrogen and ethanol are produced by microorganisms from wastes containing glycerol that are discharged from a biodiesel fuel production plant in a bioelectrochemical.

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**ABSTRACT:** H<sub>2</sub> and ethanol production from glycerol-containing wastes discharged from a biodiesel fuel production plant by *Enterobacter aerogenes* NBRC 12010 was demonstrated in bioelectrochemical cells. Thionine as an exogenous electron transfer mediator was reduced by *E. aerogenes*, and was re-oxidized by a working electrode applied at 0.2 V against a Ag/AgCl reference electrode by a potentiostat (electrode system). At the initial glycerol concentration of 110 mM, 92.9 mM glycerol was consumed in the electrode system with 2 mM thionine after 48 h. On the other hand, the concentration of glycerol consumed was only 50.3 mM under the control conditions without thionine and the electrodes (normal fermentation). There are no differences in the yields of H<sub>2</sub> and ethanol against glycerol consumed between the control conditions and the conditions with the electrode system. A pH of 6.0 was suitable for the H<sub>2</sub> production in the range between pH 6 and pH 7.5 in the electrode system. At pH values of 7.0 and 7.5, H<sub>2</sub> production decreased and formate was remarkably produced in the reaction solution. The rates of both glycerol consumption and the H<sub>2</sub> and ethanol production increased as the thionine concentration and the surface area of the working electrode increased. After 60 h, 154 mM of the initial 161 mM glycerol concentration in the wastes was consumed in the electrode system, which is a 2.6-fold increase compared to the control experiment.

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**KEYWORDS:** glycerol; hydrogen production; ethanol production; mediator; thionine; bioelectrochemical reactor

## Introduction

It is expected that the use of alternative fuels from biomass, such as bioethanol and biodiesel fuel (BDF), will reduce CO<sub>2</sub> emissions. BDF consists of simple alkyl esters of fatty acids from vegetable oils, used food oils, and animal fats, etc. The most common method is the transesterification of fatty acids with a simple monohydric alcohol such as methanol or ethanol using an alkali catalyst, acid catalyst, lipase, or supercritical methanol (Fukuda et al., 2001; Lotero et al., 2005; Saka and Kusidiana, 2001). Under all these conditions, glycerol is simultaneously produced as a by-product, and is a high proportion of the discharged wastes after the production process for BDF. If virgin oils such as rapeseed oil and sunflower oil are used for the BDF production, pure glycerol can be recovered from the reaction solution and utilized as a chemical material. However, most of BDF in Japan is produced from used food oils, and the glycerol-containing wastes are treated as industrial wastes. In addition, it is expected that the production of BDF will dramatically increase in Japan and other countries in the near future. This will cause an excess supply of glycerol in the world markets. Therefore, developing new methods to treat the wastes containing glycerol are needed.

Several biological treatments of glycerol-containing wastes have been reported. Suehara et al. (2015) have investigated the treatment of glycerol wastes using an oil-degradable yeast *Rhodotorula mucilaginosa*. The biological conversion of glycerol wastes into various materials such as butanol (Andrade and Vasconcelos, 2003), lipids (Papanikolaou and Aggelis, 2002), and 1,3-propanediol (1,3-PD) (González-Pajuelo et al., 2004) has also been investigated.

# Dye-Sensitized Hydrobromic Acid Splitting for Hydrogen Solar Fuel Production

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✧ Supporting Information

**ABSTRACT:** Hydrobromic acid (HBr) has significant potential as an inexpensive feedstock for hydrogen gas (H<sub>2</sub>) solar fuel production through HBr splitting. Mesoporous thin films of anatase TiO<sub>2</sub> or SnO<sub>2</sub>/TiO<sub>2</sub> core-shell nanoparticles were sensitized to visible light with a new Ru<sup>II</sup> polypyridyl complex that served as a photocatalyst for bromide oxidation. These thin films were tested as photoelectrodes in dye-sensitized photoelectrosynthesis cells. In 1 N HBr (aq), the photocatalyst undergoes excited-state electron injection and light-driven Br<sup>-</sup> oxidation. The injected electrons induce proton reduction at a Pt electrode. Under 100 mW cm<sup>-2</sup> white-light illumination, sustained photocurrents of 1.5 mA cm<sup>-2</sup> were measured under an applied bias. Faradaic efficiencies of 71 ± 5% for Br<sup>-</sup> oxidation and 94 ± 2% for H<sub>2</sub> production were measured. A 12 μmol h<sup>-1</sup> sustained rate of H<sub>2</sub> production was maintained during illumination. The results demonstrate a molecular approach to HBr splitting with a visible light absorbing complex capable of aqueous Br<sup>-</sup> oxidation and excited-state electron injection.

Conversion of sunlight into electrical power using photovoltaics has shown significant potential to provide sustainable energy while minimizing greenhouse gas-producing fossil fuel usage.<sup>1</sup> However, the inability to generate power at night and inconsistent day-to-day photovoltaic performances present their own unique challenges. Through catalytic reactions, solar energy can be converted into chemical bonds that can serve as solar fuels.<sup>2</sup> One means of generating solar fuels is through hydrohalic acid (HX) splitting. Similar to water splitting, HX splitting is the concurrent reduction of H<sup>+</sup> to H<sub>2</sub> and oxidation of X<sup>-</sup> to X<sub>2</sub>. HBr splitting in particular has many advantages, including the largest theoretical solar-to-hydrogen efficiency and its use in high-performance fuel cells and flow batteries.<sup>3–8</sup> Thus, Br<sup>-</sup> is not a sacrificial reductant, but a regenerative fuel source that complements H<sub>2</sub> production in ways that other hydrohalic acids cannot. A molecular approach to designing an appropriate Br<sup>-</sup> oxidation photocatalyst provides significant control over the photophysical and electrochemical properties of the catalyst.<sup>9</sup> Ruthenium polypyridyl complexes are an attractive photocatalyst choice due to their visible-light absorption with high extinction coefficients, tunable redox potentials, and acid stability.<sup>10–13</sup> Herein it is reported that visible light excitation of a new Ru<sup>II</sup> polypyridyl complex allows for Br<sup>-</sup> oxidation and subsequent Br–Br bond formation for sustainable HBr splitting while simultaneously

providing electrons for the reduction of protons to yield H<sub>2</sub> gas in a dye-sensitized photoelectrosynthesis cell (DSPEC).<sup>14</sup>

Similar to a dye-sensitized solar cell<sup>15,16</sup> the DSPECs utilized a dye-sensitized mesoporous nanocrystalline thin film, but produced fuels in compartments of an H-cell separated by a Nafion proton exchange membrane that can be collected and stored. The mesoporous thin films were either anatase TiO<sub>2</sub> or SnO<sub>2</sub>/TiO<sub>2</sub> core-shell (CS) nanostructures, which consisted of SnO<sub>2</sub> nanoparticles with a 4.5 nm thick amorphous ALD-deposited TiO<sub>2</sub> shell as previously described.<sup>14</sup> Unless otherwise stated, 100 mW cm<sup>-2</sup> white-light illumination truncated with a 400 nm long-pass filter to inhibit semiconductor direct bandgap excitation was utilized in 1 N HBr aqueous solutions sparged with N<sub>2</sub> and kept under an inert atmosphere with an external bias of +0.6 V vs NHE.

The light absorber and photocatalyst employed was [Ru(btmbf)<sub>2</sub>P]<sup>2+</sup>, where btmbf is 4,4'-bis(trifluoromethyl)-2,2'-bipyridine and P is 2,2'-bipyridyl-4,4'-diphosphonic acid, abbreviated herein as Ru(btmbf)<sub>2</sub>P (Figure 1a). The absorption



Figure 1. (a) Ru(btmbf)<sub>2</sub>P photocatalyst. (b) Density of states for ground and excited states of surface-bound Ru(btmbf)<sub>2</sub>P photocatalyst (blue), the one-electron Br<sup>-</sup> redox couple (brown), and the mesoporous thin acceptor states of TiO<sub>2</sub> and SnO<sub>2</sub>/TiO<sub>2</sub> CS (gray).

and photoluminescence spectra measured in 0.1 M HClO<sub>4</sub> (aq) are given in Figure S1, displaying a characteristic metal-to-ligand charge transfer (MLCT) band centered at 460 nm. Light excitation into the MLCT transitions resulted in room temperature photoluminescence (PL). Pulsed light excitation yielded exponential PL decays with a lifetime  $\tau = 510$  ns. A PL quantum yield ( $\Phi_{PL}$ ) of 0.021 enabled the radiative and nonradiative rate constants to be extracted (Table 1). Mesoporous thin films of TiO<sub>2</sub> and SnO<sub>2</sub>/TiO<sub>2</sub> CS were sensitized to visible light by overnight reactions with Ru(btmbf)<sub>2</sub>P and are abbreviated as Ru(btmbf)<sub>2</sub>P|TiO<sub>2</sub> and Ru(btmbf)<sub>2</sub>P|CS, respectively. A plot of the Nernstian density

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1 Full Length Article

## 2 Luminescence and spectroscopic investigations on Gd<sup>3+</sup> doped ZnO 3 nanophosphor

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### 19 abstract

The present paper describes the synthesis of 0.1 mol% Gadolinium (Gd) doped Zinc oxide (ZnO) nanophosphor by solution combustion method using Oxalyl dihydrazide (ODH) fuel. Powder X-ray diffraction (PXRD) peaks are well matched with the standard hexagonal wurtzite structure of ZnO (JCPDS card no. 36-1451). SEM and TEM analysis reveals porous morphology of as formed sample with particles having narrow size distribution in the range ~60–70 nm, in good agreement with XRD data. The PL spectrum of Gd doped ZnO sample exhibits an extra blue emission at 441 nm (~2.81 eV) in addition to the emission bands from undoped ZnO. From the TL data of ZnO:Gd nanophosphor with UV irradiation, it is observed that considerable amount of re-trapping is taking place in all the TL second order peaks. The EPR spectrum exhibits a number of resonance signals suggesting that Gd<sup>3+</sup> ions are experiencing different crystal field strength and Zeeman interactions.

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## 20 1. Introduction

Zinc oxide (ZnO) is a wide band-gap (3.37 eV) compound semiconductor that is suitable for short wavelength optoelectronic applications. The high exciton binding energy (60 meV) in ZnO crystal can ensure efficient excitonic ultraviolet (UV) emission at room temperature. Rare earth (RE) ion doped ZnO nano systems have been extensively investigated as electroluminors. The luminescence can be tuned from UV to red by changing the concentration of RE ions in ZnO which enables it to be used to design many optoelectronic devices. RE ions doped diluted magnetic semiconductors (DMS) have also invoked great interest since the colossal magnetic moment of Gd in GaN was reported by Dhar et al. [1]. Nano ZnO particles are particularly more appealing because theoretical studies predicted and experiments verified that nano ZnO doped with transition metals and RE ions exhibit room temperature ferromagnetism [2].

In the past few years, many efforts were made in the field of synthesis of ZnO to devise an approach that is simple, low cost and compatible with the current device fabrication technologies. There are many chemical techniques that were used to prepare nano ZnO, such as sol-gel, co-precipitation, solid state synthesis, hydrothermal method and etc. Some of these methods require calcination of the products post calcination in order to enhance the crystallinity of the samples. However, calcination leads to the agglomeration and increase in the crystallite size that retards the application of the products synthesised. Therefore, in recent years many new methods have been adopted to avoid the use of high temperature synthesis conditions and agglomerations in the samples. Realizing the fact that simplicity, time required for the synthesis and cost involved in the preparation are the key factors which decide its application in commercial scales search for new chemical route is very crucial. Considering these factors self-propagating combustion route offers best choice among other methods [3–5]. The advantage of this method is that the desired phase can be achieved with better control over stoichiometry with a relatively simple experimental setup. The obtained product properties like crystal size, surface area, surface morphology, agglomeration can be tuned by the nature of fuel used for the combustion synthesis [5,6].

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## Experiments examining the conduction mechanism, magnetization, and electrochemical properties of nanocomposites made of polythiophene and cobalt.

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### ABSTRACT

Polythiophene (PTh) was prepared by chemical oxidation and cobalt nanoparticles (Co-nps) by modified polyol process. The nanocomposites were prepared by mixing mechanically the PTh and Co-nps in the weight percentage, PTh<sub>100-x</sub>Co<sub>x</sub>, x = 10, 20, 30, 40 and 50. XRD of these nanocomposites showed amorphous nature. DC conductivity variation with temperature in the range from 303 K to 473 K indicated semiconducting behavior. Conduction mechanism was found to be small polaron hopping at high temperature and 3D variable range hopping at low temperatures. Conductivity and activation energy values points out that addition of Co-nps to the PTh induces electrically insulating effect. The SQUID magnetometer measurements at 10 K and 300 K showed perfect ferromagnetic nature and magnetically softness of the composites. Cyclic voltammetry study has been carried out on all the composites and in that a composite having 30% of Co-nps measured Specific Capacitance (SC) value as high as 583.20 F/g. This can be the best candidate for capacitor applications. This is for the first time that PTh-Co nanocomposites have been thoroughly probed for structure, conduction mechanism, magnetization and supercapacitor applications.

### 1. Introduction

Polythiophene (PTh) is an intrinsically conducting polymer and it has been studied extensively for its electronic properties and applications like light emitting diode, supercapacitors, field effect transistor, DNA detection, etc., [1-5]. On the reinforcement of inorganic nano material in to the matrix induces changes in its properties [6]. For example, improvement in conductivity was observed in polythiophene-silver [7], polyaniline-silver [8] and polyaniline-gold [9]. The dispersion of ferromagnetic metal nanoparticles in a polymer matrix is of great interest due to the combined effect of the magnetic and electric properties of the individual elements. Nanocomposites prepared using conducting polymer and ferromagnetic metal nanoparticles such as polythiophene-nickel by electrochemical method exhibited good electrical conductive response [10]. Increase of saturation magnetization and decrease in electrical conductivity with respect to Fe content were noted for polyaniline-Fe nanocomposites [11]. Super paramagnetic behavior and microwave absorption application for the polyacrylonitrile/Ni/Co/Ni-Co nanocomposites were proposed in [12]. Thermal conductivity increased in nickel doped polypyrrole composites [13]. Incorporation of cobalt in polypyrrole exhibited resistive switching and magnetism [14] and showed utility in the application of electromagnetic wave absorption [15]. Of the three prominent ferromagnetic metals, cobalt has always been considered to be special as it has high saturation magnetization and Curie temperature [16]. Also, it is known for its allotropic forms of fcc, hcp, epsilon and bcc [17]. Many researchers have reported study on the magnetic properties of the cobalt nanoparticles synthesized via different methods [18–21]. Cobalt nanoparticles have shown some potential applications like microwave absorption [22] adsorption ability [23] and high energy product [24]. To the best of our knowledge there are no reports on thorough analysis of electrical properties and magnetization of polythiophene-cobalt (PTh-Co) nanocomposites. It is also interesting to study electrochemical behavior of such nano composites.

Keeping in view of this, we experimentally investigated XRD, electrical conductivity as a function of temperature, magnetization and voltammetry

on PTh-Co nanocomposites and results obtained are presented in this paper.

### 2. Experimental Methods

Analytical grade chemicals were used to synthesize polythiophene and cobalt nanoparticles. Polythiophene (PTh) has been synthesized by chemical oxidation method using FeCl<sub>3</sub> as an oxidizing agent. The polymerization was carried out for 24 hours at the temperature of 275 K. Black precipitate of polythiophene obtained was filtered and washed several times with methanol and double distilled water and, the resulted powder was dried in an oven. The complete procedure of polythiophene preparation is described in reference [25].

To prepare cobalt nanoparticles, the modified polyol process was followed in which cobaltous chloride hexahydrate (CoCl<sub>2</sub> · 6H<sub>2</sub>O) and sodium hydroxide (NaOH) were dissolved in 1,2-propanediol separately. Both solutions were stirred and mixed and, then treated with hydrazine hydrate (N<sub>2</sub>H<sub>4</sub> · H<sub>2</sub>O) 80%. The reduction was carried out in the temperature range from 328K to 333K. The dark grey colour cobalt particles formed were collected and washed several times with double distilled water and acetone. Finally, the powder was dried in an electric oven [26].

As prepared PTh and Co particles were mechanically mixed well in pestle mortar in the weight percentages defined as PTh<sub>100-x</sub>Co<sub>x</sub>, where, x = 10, 20, 30, 40 and 50 and the composites were labeled as PTh-CO1, PTh-CO2, PTh-CO3, PTh-CO4 and PTh-CO5 respectively. The powder composites were pelletized using hydraulic press by applying a pressure of 20 kg/cm<sup>2</sup> for conductivity measurement. The composites have been investigated for structure by means of XRD, dc conductivity measured by two probe method in the temperature range from 303 K to 473 K. A constant voltage, V has been applied across two side silver painted pellet. Current, I through the pellet has been measured. Resistivity, ρ has been calculated and conductivity, σ has been determined using the relation σ = 1/ρ. Magnetization of the powder nanocomposites was measured in the field range from -1T to +1T in a SQUID magnetometer (MPMS-XL, Quantum Design) at temperatures 10K and 300K. Cyclic voltammetry measurement of the PTh-CO nanocomposites were carried out using electrochemical analyzer (CH instruments model CHI 6112D) with

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# The conduction mechanism, magnetization, and electrochemical properties of nanocomposites made of polythiophene and cobalt were examined in experiments.

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on PTh-Co nanocomposites and results obtained are presented in this paper.

## 2. Experimental Methods

Analytical grade chemicals were used to synthesize polythiophene and cobalt nanoparticles. Polythiophene (PTh) has been synthesized by chemical oxidation method using FeCl<sub>3</sub> as an oxidizing agent. The polymerization was carried out for 24 hours at the temperature of 275 K. Black precipitate of polythiophene obtained was filtered and washed several times with methanol and double distilled water and, the resulted powder was dried in an oven. The complete procedure of polythiophene preparation is described in reference [25].

To prepare cobalt nanoparticles, the modified polyol process was followed in which cobaltous chloride hexahydrate (CoCl<sub>2</sub> · 6H<sub>2</sub>O) and sodium hydroxide (NaOH) were dissolved in 1,2-propanediol separately. Both solutions were stirred and mixed and, then treated with hydrazine hydrate (N<sub>2</sub>H<sub>4</sub> · H<sub>2</sub>O) 80%. The reduction was carried out in the temperature range from 328K to 333K. The dark grey colour cobalt particles formed were collected and washed several times with double distilled water and acetone. Finally, the powder was dried in an electric oven [26].

As prepared PTh and Co particles were mechanically mixed well in pestle mortar in the weight percentages defined as PTh<sub>100-x</sub>Co<sub>x</sub>, where, x = 10, 20, 30, 40 and 50 and the composites were labeled as PTh-CO1, PTh-CO2, PTh-CO3, PTh-CO4 and PTh-CO5 respectively. The powder composites were pelletized using hydraulic press by applying a pressure of 20 kg/cm<sup>2</sup> for conductivity measurement. The composites have been investigated for structure by means of XRD, dc conductivity measured by two probe method in the temperature range from 303 K to 473 K. A constant voltage, V has been applied across two side silver painted pellet. Current, I through the pellet has been measured. Resistivity, ρ has been calculated and conductivity, σ has been determined using the relation  $\sigma = 1/\rho$ . Magnetization of the powder nanocomposites was measured in the field range from -1T to +1T in a SQUID magnetometer (MPMS-XL, Quantum Design) at temperatures 10K and 300K. Cyclic voltammetry measurement of the PTh-CO nanocomposites were carried out using electrochemical analyzer (CH instruments model CHI 6112D) with

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1 Full Length Article

## 2 spectroscopic investigations on Gd<sup>3+</sup> doped ZnO<sub>3</sub> nanophosphor

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### a b s t r a c t

The present paper describes the synthesis of 0.1 mol% Gadolinium (Gd) doped Zinc oxide (ZnO) nanophosphor by solution combustion method using Oxalyl dihydrazide (ODH) fuel. Powder X-ray diffraction (PXRD) peaks are well matched with the standard hexagonal wurtzite structure of ZnO (JCPDS card no. 36-1451). SEM and TEM analysis reveals porous morphology of as formed sample with particles having narrow size distribution in the range ~60–70 nm, in good agreement with XRD data. The PL spectrum of Gd doped ZnO sample exhibits an extra blue emission at 441 nm (~2.81 eV) in addition to the emission bands from undoped ZnO. From the TL data of ZnO:Gd nanophosphor with UV irradiation, it is observed that considerable amount of re-trapping is taking place in all the TL second order peaks. The EPR spectrum exhibits a number of resonance signals suggesting that Gd<sup>3+</sup> ions are experiencing different crystal field strength and Zeeman interactions.

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### 25 1. Introduction

26 Zinc oxide (ZnO) is a wide band-gap (3.37 eV) compound semi-conductor that is suitable for short wavelength optoelectronic applications. The high exciton binding energy (60 meV) in ZnO crystal can ensure efficient excitonic ultraviolet (UV) emission at room temperature. Rare earth (RE) ion doped ZnO nano systems have been extensively investigated as electroluminors. The luminescence can be tuned from UV to red by changing the concentration of RE ions in ZnO which enables it to be used to design many optoelectronic devices. RE ions doped diluted magnetic semiconductors (DMS) have also invoked great interest since the colossal magnetic moment of Gd in GaN was reported by Dhar et al. [1]. Nano ZnO particles are particularly more appealing because theoretical studies predicted and experiments verified that nano ZnO doped with transition metals and RE ions exhibit room temperature ferromagnetism [2].

41 In the past few years, many efforts were made in the field of synthesis of ZnO to devise an approach that is simple, low cost and compatible with the current device fabrication technologies. There are many chemical techniques that were used to prepare nano ZnO, such as sol-gel, co-precipitation, solid state synthesis, hydrothermal method and etc. Some of these methods require calcination of the products post calcination in order to enhance the crystallinity of the samples. However, calcination leads to the agglomeration and increase in the crystallite size that retards the application of the products synthesised. Therefore, in recent years many new methods have been adopted to avoid the use of high temperature synthesis conditions and agglomerations in the samples. Realizing the fact that simplicity, time required for the synthesis and cost involved in the preparation are the key factors which decide its application in commercial scales search for new chemical route is very crucial. Considering these factors self-propagating combustion route offers best choice among other methods [3–5]. The advantage of this method is that the desired phase can be achieved with better control over stoichiometry with a relatively simple experimental setup. The obtained product properties like crystal size, surface area, surface morphology, agglomeration can be tuned by the nature of fuel used for the combustion synthesis [5,6].

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# Cloud-Based Solar Panel Cleaning System using Texas Instruments

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**Abstract**— Solar energy in recent decades gained high demand as it produces green and sustainable energy sources. Most countries with semi-arid areas choose solar energy as a possible way to generate clean energy for rural and urban households. The dominant obstacle for solar energy is a dense accumulation of atmospheric contaminants such as debris, solid dirt, and, dwelt particles causing the shadow that decreases its working performance. This constraint routed for the necessity of intermittent cleaning of the surface of Solar panels. Currently, cleaning techniques of the photovoltaic panels through labor are extravagant in time. To overcome this problem, a fully automated IoT-Based solar panel cleaning system is proposed. The developed system includes the CC3200 first on-chip Wi-Fi Texas instruments microcontroller, and sensors to sense the respective parameters. A servo motor and relay system is used to control the wiper speed and rotations. The collected data is uploaded to the ThingSpeak cloud and can be monitored in real-time time. GeoTagging approach is utilized to track the location of solar panels with debris and the alert is generated to the user using the GSM module. The result shows that the developed IoT-based kit effectively cleans the solar panel surface and enhances the output of current and maximum power by 50% after the panel is cleaned.

**Keywords**— Solar Energy, CC3200, Cloud computing, Internet of Things (IoT), Geo Tagging

## I. Introduction

The recent era is marked by an increase in photovoltaics usage in both research and industrial upturn. Renewable sources of energy, in particular photovoltaics, are considered a prime contribution to the decarbonization of the environment. However, areas with a heavy degree of irradiation and sun-blet region usually endure more dust and deficient water resources. The degradation of debris, and birds dropping pollen, onto the solar panel mirror surface leads to the loss of power as it minimizes the solar energy obtained from the collector by consuming (or) dissipating the sunlight[1].In addition to these factors, the working competence of solar panels subsides along with time, and many external factors like fallen leaves, heavy snow, solid dust, and water patches. Hence, several attempts have been carried out to minimize the panel cleansing strategies consisting of wet and dry cleaning techniques, automatic (or) manual cleanse mechanisms, distinct brushes and fabrics, and also definite chemical additives[2]. Apart from all the cleaning mechanisms, another dust reduction strategy is the usage of natural cleaning techniques such as wind and rain. In regions having less rainfall and more humidity like dry and semi-desert areas, dust eviction by which considered a natural cleaning mechanism[3]. Alternatively, various works have been carried out to develop anti-soiling coating.

*A.Methods of Dust removal from PV:* Various techniques[4] have been suggested and utilized for automatic self-cleaning for photovoltaic panels like motor brushing, using electric

wipers, sprayers, robots, electrostatic cleaning, and piezoelectric methods.

*Rainfall Cleaning methods:*

This technique does not cost anything as it is unable seasonally. The reliability of this method is less especially in the countries having less intensity of rain like Iraq.

*Manual cleaning method:*

Laborers should clean the surface of solar panels as it is like cleaning windows of the building with separately designed brushes to avoid surface scratching.

*Mobile cleaners' method:*

This method includes machinery and also requires a storage container to supply water to the cleaning system.

Keeping the facts above in view, the article focuses on cleaning solar panels using IoT and Cloud computing. The designed intelligent system includes four components sensory module, a Microcontroller system, a Motor and cleaning module, and d user interface as shown in “Fig. 1”.

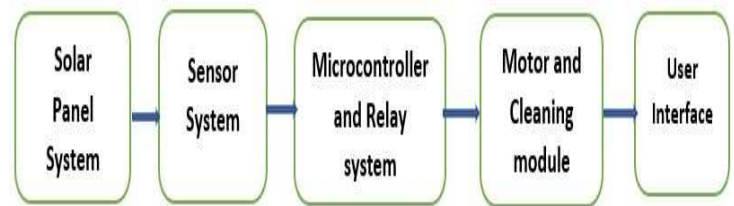


Fig. 1. Block Diagram of the developed System

## II. Literature review

Various Automatic self-cleaning methods have been developed to reduce the problems rises from manual and traditional cleaning procedures to prohibit the lack in productivity of solar energy due to dust. Numerous works have been presented across the globe for automatic self-cleaning for Photovoltaic cells.

Article[5] presented an Automated robot machine for cleaning the surface of the solar panel. It includes an Arduino microcontroller to detect the robot moment while cleaning. A water pump system equipped with a rough sponge is used. Paper[6] presented a method that controls photovoltaic surface cleaning and its power generation. Arduino UNO is used to monitor the cleansing task along with the windscreen wiper tool. In [7] an economical, automatic, and waterless solar panel cleaning system using an Arduino microcontroller that includes a two-step mechanism composed of an exhaust fan that acts as a blower and an automatic wiper to wipe the debris from the surface of a panel. Article [8] presented an IoT-based Robot for solar panel cleaning that systematically cleans PV. The automated robot is controlled and monitored and also the developed robot is auto-powered it enhancing the maximum power generation. A preliminary design [9] of a water sprayer solar cleaning device is designed and to rotate

## Crystallographic axis of Induction-welded and Heat Pipeline Steel

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**Keywords:** crystallographic texture; pipeline steel; induction welding; induction heat-treatment.

**Abstract.** Large-diameter steel pipes are produced by induction seam-welding followed by induction-assisted heat treatment. The microstructure and distribution of crystal orientations have been studied and related to the mechanical properties of the welded regions. The welding and heat-treatment process leads to a microstructure, a simple observation of which can not explain the observed variations in toughness in the vicinity of the welding joint, because the crystallographic grain size, which represents the scale of similarly oriented adjacent grains, is much coarser than the ordinary grain size. Furthermore, heating the affected zone into the austenite phase field followed by cooling does not completely eliminate the coarse regions of similarly oriented grains. The consequences of this on mechanical properties are discussed.

### Introduction

Pipes for oil and gas transmission are made from low-alloy steels designated X60, X65, X70 etc. depending on the strength and toughness required and the intended application [1–3]. One method of fabricating pipes from these materials is by high-frequency induction seam-welding. Pipes some 18 m in length, 500 mm in diameter and 12.7 mm in thickness are routinely manufactured in this way [4]. The toughness of line pipes is paramount in their suitability for application [5–7]. The joint resulting from induction welding is quite narrow, with a central 2 mm wide region, but it represents a source of weakness, so the welding process is immediately followed by induction heat treatment. The intention of the latter is to refine the microstructure by reaustenisation at a lower temperature than the peak temperature achieved during welding. Although the heat-treatment improves the toughness of the welded region, the increase is not as large as might be expected from the reduction in the scale of the microstructure. The purpose of the present work was to understand this insensitivity of the toughness to heat-treatment.

### Experimental Procedures

The chemical composition of the steel is Fe–0.041C–1.1Mn–0.18Si wt% with micro-alloying of Nb and V. Details of the heat-treatment are proprietary, but it involves rapid heating to above a temperature at which austenite can form, and subsequently fast cooling.

Specimens were obtained from different stages of the manufacturing process: the unaffected base metal, the pipe just after welding, and finally, the pipe after welding and heat-treatment. Samples were cut normal to the welding direction which is parallel to the rolling direction of the steel and to the length of the pipe. Some were flattened to make non-standard cross-weld Charpy test specimens of size  $55 \times 6.7 \times 10$  mm. The tests were conducted according to the standard ISO 148-1.

Metallographic specimens were prepared in the usual way by grinding, polishing and etching (using 2% nital). Orientation imaging requires scratch-free surfaces so the metallographic samples were finished using colloidal silica. Scanning electron microscopy was conducted on a Camscan



## Interspersed Myths: Indian English Fictions

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### ABSTRACT

Man always goes back to the past in search for answers. History, Philosophy, Myth proves to be great sources of all answers. To find the real truth man takes up a journey to the path which he left behind years ago. Writers often possess a strange link between their works and the myths and folklores of their culture. The influence of Greek and Roman myth is huge in English literature. In Indian English literature, the use of Hindu mythology is like literary tradition. Indian myths have an extended history resolving all kind of social, political, spiritual apprehensions. These majestic tales give a certain freedom to the writers to put his thoughts in a grand fashion. We can find a collaboration of higher truth, fiction and reality all together in Indian novels. Indian myths help in deeper understanding of mankind as well as instruct and preach about the perfect way of human life. Indian novelists make the fullest use of myth symbolically and metaphorically. The present study explores the mythical world in Indian fictions.

**Keywords-** Myth, Fiction, Revisionist writings.

Myths are the stories which are narrated in an imaginative and symbolic manner, emphasizing on the truth of the cosmos. These complex sagas cannot be explained in terms of ordinary connotation. Because myth holds history, customs, ancient faiths and traditions. Indian mythology is certainly a significant part of Indian culture. Myth often fused with legends chronicles and folklores in order to shape believe of the common people. The West maintained the rich tradition of using myth and folklores in literary works. Greek myth and biblical stories are present in every genre of English literature to add profoundness to the meaning of illustrated works. This tradition continued till this modern age. The modern artists, poets and novelists such as T.S. Eliot, W.B. Yeats, James Joyce and William Golding etc. used legends and myths extensively in their works.

Particularly in India, we find myths and folklores have its own heritage. Indian writers inherited myth and cultivated it in every form of literature as Indian myth proved to be a generous background. Indian English literature is enriched with stories and themes drawn from *Vedas*, *Upanishad*, *Ramayana*, *Mahabharata* and various Buddhists scriptures. The truths of Hindu culture are founded by a large number of myths such as Vedic texts, Epics and Puranas. Indian Mythology enriches Indian culture and makes it a unique one in the world. From generation to generation, Indian mythology has been passed by the word of mouth as in the form of stories. The presence of myth is clearly evident in every Indian regional literature. Explaining the importance of myth Elina Helander-Renvall says-



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EARLY FEMINIST THEMES IN THE WORKS OF BRONTE SISTERS

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**ABSTRACT**

Although feminism in literature began in early 1960's, there were many writers who had been preparing for it since long. In English fiction the first few names that come to mind in that respect are Bronte sisters who gave much more power to the woman characters than known earlier. This aspect of their writing has not been explored fully by the critics and scholars. This paper is focused on the elements of feminism in their fiction which paved way for later generation authors and inspired them to present the women characters in more meaningful ways in their literary works.

**Key words:** Feminism, Bronte Sisters, Victorian literature, Charlotte Bronte, Emily Bronte, Anne Bronte

"This has always been man's world"<sup>1</sup> laments Simone de Beavouir. She goes on speaking about the suppressive character of this world where man is always the subject and woman "the object, the other."<sup>2</sup> It is in this context she goes on explaining the social conditioning going on since centuries, because of which she finally concludes that one is not born a woman, but becomes one. Another feminist critic also speaks of the age old practice "to acculturate woman to tradition roles"<sup>3</sup> so that, as C.P. Gilman points out, woman's world are confined to four C's- cooking, children, church and clothes.<sup>4</sup> As soon as a baby girl is born, she is subjected to a series of moral lessons to become a dutiful daughter, a devoted wife, and finally a sacrificing mother. This pattern of social life is reflected in literature too. Literature has been a true mirror of man's idea of woman and not vice versa. So, history has become in reality "his history".<sup>5</sup> Because of the Biblical fall of Adam on account Eve's greed to taste the forbidden fruit, woman was supposed to be, in the western mind, as "woe-man".

In the first stage of feminism during the 50's-60's, woman writers object to this male mind-set, this androcentric or male-centred principles. The feminist moves towards gynocentric (woman centred) criticism that a woman has as much right as man to lead and express her life. Male writers in the past wrote novels with central figure of a man or hero, and a subordinate female character was also created just to add romance to the life of the hero. In the novels of the past, woman characters had to play only second fiddle to their male counterparts. Not only this bias was resented by the feminists, they also questioned the very validity of truly reflecting a woman's experience by male writers. Even when the caption of the novel was based on heroines- as *Pamela* by Samuel Richardson and *Clarissa Harlowe* by Henry Fielding, the character of the heroine was yet modelled on the male concept of virtue. Jane Austen, particularly in the characters of Elizabeth in *Pride and*



## Exploring Identity and Cultural Diversity in Indian Diaspora Literature

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### ABSTRACT

Indian diaspora fiction in English must be regarded as a sub-genre of Indian English diaspora literature written by the Indian Diaspora writers. Diaspora emphasise catastrophic origin of people and uncomfortable outcomes. Diasporic writers attempt to write in relation with the culture of their homeland and at the same time adopt and negotiate with the cultural space of the host land. Migration takes place due to various reasons and in the Indian context the migratory movements were governed by social, economical problems, higher education, better prospects and marriage. This paper looks into the concept of identity and cultural difference in selected novels of Anitha Desai and Kiran Desai.

Key Words: Diaspora, identity, cultural difference.

### INTRODUCTION

Anita Desai, a famous woman novelist whose novels deal with feminist problems, painful sufferings of women. In all her novels, Desai has proved herself as novelist who gives importance for the concept of identity and cultural difference through her female protagonist, uncovering the layers of women psyche. She has defined the term Diaspora in her novels very well.

Anita Desai's novel *Bye-Bye Black Bird* deals with an authentic study of human relationship and cultural encounters. Desai highlights the physical and psychological issues of Indian immigrants and explores the adjustment difficulties that they face in England. Desai reads the minds and understands the fact that they are suffering from alienation. It is said that the novel is very close to her personal experience as an immigrant. Dev, Adit and Sarah are three important characters of the novel, who face the problem of defining their identity and cultural difference.

Dev the chief character of the novel who comes to London to pursue his studies, he shows his strong dislike towards men and manners of England. He feels alienated in London. He stays with Adit Sen and his English wife, Sarah. He finds it difficult to adjust with silences and emptiness and never wants to live in a country where he is insulated and unwanted. However Dev takes his final decision not to return to India and adjust to the new environment. His friend Adit Sen came from India lives in England with his English wife Sarah. After coming to England Adit worked as a teacher and finally accepted a little job at *Blus skies*. He is happy with his job but he always feels a sense of cultural affinity as an anonymous in England. He frankly



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## Exploring Language Through Literature

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### ABSTRACT

Language through literature is a highly effective way of knowing, learning and mastering any language. Instead of enhancing the skills of language like listening, speaking, reading and writing through exercises, like gap filling, multiple-choice questions, matching the words etc., it would be appropriate to provide a literary text to acquire the language skills. That is, instead of filling in the blanks which would only provide the clue about a particular language skill or concept, it would be better to provide a literary content which would convey the usage of that particular concept. So what makes the difference is the interest of the reader or the learner; he would be more interested to read the literary texts and so the language concepts would get into his mind very easily rather than filling in the blanks. This study of learning a language through literature is dealt in Sidney Sheldon's *Are You Afraid of Darkness?* (2004).

### Introduction

Language is an art or skill which can only be learnt through practice. The basic purpose of learning any language is to communicate in that particular language to its native speakers. The reason for learning a language varies from person to person. A person may learn a language for existence in a new place, for studies, business etc. Hence the sort of conversations, vocabulary, grammar and the sense that a reader comes across a literary text is basically known to him and actually practiced by him, and this practice would help him to converse and communicate in real time situations with flow, good vocabulary, proper grammatical structures and expressions which are effective, stylish and in a standard way.

Using literature to learn a language basically interests a reader and it also enhances the reader's reading speed and writing style. While reading a literary text, the reading speed complements the better understanding of the flow of thought in the literary text and in the case of writing style, the reader could know the proper punctuations, capitalization, order of words, sentence structure etc. to put in brief, learning a language through literature makes the process very easy, enjoyable and effective.

In this paper the study is done in one of Sidney Sheldon's novel *Are You Afraid of Darkness?* Which was written in 2004. It is the last novel of Sheldon which is taut with suspense and vivid characterization. It is the story of two women, Kelly Harris and Diane Stevens, the widows of two of the deads. They find their life in risk and are thrown together in fear. Meanwhile they suspect if there is any mystery behind their husband's death. Finally they found that Tanner Kingsley, the chief executive of an international Think Tank, is behind everything and he had an amazing discovery which would influence the world and make him rich and powerful. So Kelly and Diane had to outwit the men of the biggest Think Tank in the world and have to expose the truth of the



# Language Learning, ESL with Literature is No more Drudgery

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## Abstract

Effective learning needs the use of language since it is the means through which learners construct their ideas and interact with the ideas of others. Literature has been a unique source for learning a language for many years, according to experts. This paper focuses on how to make a learner acquire knowledge and life skills with language as a tool. In this paper, we see how the Norwegian playwright Henrik Ibsen in his three-act play, lucidly presented the bitter truths of society through characters like Nora Helmer, Torvald Helmer, their children and Krogstad. He tried to portray the role of women taking new turns, and the audience was awe-inspired by the first ending, which jerked the entire Victorian-era audience. Now a learner can improve his vocabulary through Literature. Example: The idiomatic expression is the “Achilles’ heel” whose inner meaning is “weakness” if a learner has no touch with Literature, they will not be able to understand the hidden meaning. So, the present paper throws light on Literature and language to show that teaching has shifted from a Herculean task to a facile one. Therefore, any learner, irrespective of his branch of academics, must have a touch with Literature to enhance his “communication skills”; indeed, his exposure towards the Global language grows automatically.

**Keywords:** Language, Literature, Life skills, Vocabulary, Idioms and Communication skills.

## Introduction:

The English language has constantly been influencing people worldwide. In some countries where English is not the native language, it is taught as ESL (English as a second language) for non-native speakers of English. Most individuals throughout the globe would benefit from taking the time to study English as a second language so that they can integrate into international society more quickly. As students of one class speak a different native language, teaching English to them is a great challenge. Proper instruction in reading comprehension may boost reading, improving instruction quality and learning in English [1]. A student, irrespective of the branch he is studying in or the area of his interest, must have touch with Literature to know the basic idioms and vocabulary. “Literature is a Reflection of society” [2]. By reading Literature, we come to know that people have different mindsets. The author in [3] discussed the merits and drawbacks of utilising Literature in ESL courses. Suppose literary works are to be utilised effectively in the classroom. In that case, the author believes, they must be picked with care and addressed in a way that encourages an aesthetic engagement between the reader and the text. A case study of one possible way to engage with a literary work was presented in his study.



## Symbolism in Anita Desai novels

Syeda Ayesha Jahan

### Abstract

Anita Desai is a well-known post-colonial Indian English writer whose works have been well praised. As a result, she is revered as a literary icon both on and off Indian coasts for her contributions to the modern Indian English novel. It's noteworthy that she's breaking new ground in the field of fiction writing by taking a fresh look at the pressing concerns facing Indian culture today, in both rural and urban settings. Her characters' conflicts are well-captured in Desai's works, and much more fascinating is the way she scours their thoughts, allowing her to investigate the psychological subtleties of human beings. It is the goal of this research paper to analyze the book *The Village by the Sea* by Anita Desai, one of her most notable works. This work tells the narrative of an Indian rural family that overcomes a time of adversity to reconcile in the end owing to the endurance of the two heroic children, Hari and Lila, in a very interesting manner. The work under review examines the writer's most crucial theme: how to survive and adapt to a new environment. Desai's book, *The Village by the Sea*, also explores a number of other controversial problems in current Indian culture. The novel's popularity may be attributed to the liveliness of her themes and her strong focus on the complexity of human life, as well as her outstanding storytelling skills, which demonstrate her quality and distinctiveness as a novelist.

**Keywords:** *The Village by the Sea*, Anita Desai, thematic concerns, contemporary society, adaptation and survival

### Introduction

Indian “author Anita Mazumdar Desai was born on June 24, 1937, in Mussoorie, India, and has been nominated for the Man Booker Prize for Fiction three times. In 1978, she received a Sahitya Academy Award from the Indian National Academy of Letters for her work, *Fire on the Mountain*. A distinguished jury of British children's authors evaluated the 1983 Guardian Children's Fiction Prize for *The Village by the Sea*, which she won. For Desai, English is the language of literature, and she uses it as a means of self-expression. In spite of her lifelong

## **Dylan Thomas Exploration of Mortality in His Poetry**

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### **ABSTRACT**

My research paper focuses upon the treatment of the theme of death in Dylan Thomas' poetry in a positive way. Dylan Thomas has not adopted a pessimistic attitude in dealing with the theme of death. Unlike other poets, Dylan has accepted death as a part of life cycle and has not portrayed it as a monster gobbling up human lives. His poems have encouraged the readers to come to terms with death and confront it directly. My paper also throws light upon the bad effects of World wars which had made people of that age fearful of death. In such a scenario, Dylan Thomas' poetry brought a wave of hope among the humans who were gripped by the fear of death and loss. Dylan himself was a part of that decaying world and therefore he could well understand the psychology of the people of his time. His poetry records a movement from darkness to light. His poetry, thus, emerges from his own perception of the outside world and therefore, his poetry is much closer to the reality of that time.

Death is a recurring theme in Dylan's poetry. Death and life constitute the human cycle. Whosoever is born on this Earth is bound to die. In Romantic tradition, the poets generally avoid



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## Enhancing Language Skills Through Smartphone Integration: Listening, Speaking, Reading, and Writing

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### ABSTRACT

Smart Phones provide a smarter way to learn anywhere, any time for the present generation learners. These devices with smart technologies cater to the diverse needs of the learners. To integrate Smart Phones into English Language Learning challenges the Zero Tolerance policy towards the use of smart phones in academic environment. With the availability of many apps as well as internet connectivity enables learning and teaching beyond classrooms. This paper explores the various apps and facilities Smart phones which provide the learners to hone their Listening, Speaking, Reading and Writing skills. These portable Smart phones gives access to wide range of sources available on the web for imparting various skills of language learning. The smart phones also ensure Self-Assessed Language Learning (SALL) that provides the learner with autonomy and encourages him/her to do things his/her way and reflect on the work and take greater responsibility. Key Words: Smart Phones, Self-Assessed Language Learning, Apps

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Smart Phones provide a smarter way to learn for the present generation of learners. Smart phones with features like Newspapers, books, grammar reference, exercises, camera, audio and video recording, notepads, Mp3 player and the internet are potentially useful for language learning in and outside the classroom.

The global Smart phone audience surpassed two billion mark in 2014 and majority of our learners own a smart phone. The zero Tolerance policy towards the use of mobile phones during the class time as the device is mainly used for updating the social media site like face book, chatting on Whats app. These phenomena can be changed by using the phones for academic purposes.

English Language Learning can be made more effective by the integration of Smart Phones; this potential device also ensures Self-Assessed Language Learning (SALL). The Self Assessed Language Learning provides the learner with autonomy and encourages him/her to do things his/her way and reflect on the work critically and

## Examining Mulk Raj Anand's Novels through a Humanistic Lens: Understanding Social Discord

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### Abstract

Mulk Raj Anand has comparatively eased himself of the reformist zeal, which has been a major obsession with him and had turned his attention to re-mythicalise contemporary reality. But curiously, accepting the first short novel, the old woman and the cow, the accepting the first short novel, the deficient in gravitas and lack the sustained vital of myth. Anand becomes resented the charge that he is a committed writer, and rightly so. He feels that he is realist, defining the body soul drama in terms of a real drama of individuals and in their fictional enactment. This, however, does not make him absolved of the charge of commitment, but rather confirms his left wing affiliations. A closer of Anand fictional corpus, reveals that Anand commitment comes out unobtrusively by the very nature of his themes he has set on hand. A lack of control or a proper restraint over his material mars Anand fiction, though one concedes that he remains a consummate artist in spite of these minor blemishes. Anand's fictional world i.e. peopled by the individuals who have obvious choice of their own; they grope for identity in a world of pitiless cynicism, and social regimentation. Mulk Raj Anand was one of "the founding fathers" of Indian English fiction for whom the art of fiction was as important as the communication it sought to convey. This was a form which soon established itself as best suited to the Indian sensibility and as one to which Indian writers have made amazing contributions. In her essay, 'Mulk Raj Anand and the Thirties Movement in England' Gillian Packham perceptively notes that Anand became an essentially 'thirties' man in thought and sensibility and was markedly influenced by Marxism. Anand, Confining himself to Indian social ground, he makes a case in an indignant reformist way for those subjected to inhumanities perpetrated by grinding poverty, discriminating caste and class assertions and injustices meted out to women, orphans, urban labourers and the so-called "Untouchables." It is the predicament of such characters that Anand seeks to depict in his novels. Anna Rutherford categorizes Anand's characters in his novels into three classes, namely the victims, oppressors who oppose change and progress, and the good. It is the "victims" who are generally the protagonists in his novels and in fighting for them, despite his perceptible propagandist inclinations, he often proves to be a writer of considerable power.

**Keywords:** Mulk Raj Anand, power, social regimentation, communication, Indian sensibility, contributions

### 1. Introduction

Anand's pre-Independence novel deal with the problems of industrial labour and with several aspects of social reform, including the pathetic conditions of the Untouchables who were cruelly discriminated against [2-4]. A novel approach to the works of Anand is that of Dieter Riemenschneider, who, in his essay, 'The Function of Labour in Mulk Raj Anand's novels' explores the socio-literary implications of human labour as presented in literary works may provide an important insight into the ideological as well as the aesthetic aspects of such works. Labour, according to the author, is a free activity of man because its objectives are determined by man himself. Thus, as Riemenschneider puts it, "labour means self-realization of man, an act of real freedom," but labour, as it is always performed in society, is necessarily a social activity as well. In literature, when man is considered as a member of a particular species, what defines him fully by presenting his essential nature is the totality of His social activities and relations [1]. In Anand's novels the problem of labour is aesthetically presented through character and event. All the main characters in his major works are 'forced to sell their labour in order to survive.' By portraying these characters, not only does Anand demonstrate his interest in

their individual lives but also conveys the economic and social changes taking place in India under colonial rule and depicts the gradual transformation of a feudal society into a capitalistic one [5].



Mulk Raj Anand (1905-2004)

He believes that evil forces have to be identified and contained--eradicating if possible--and obscurantism has to be resolutely uprooted if the individual has to grow and progress [6]. His denunciation of violence arising from caste/class politics could be related to the entire humanity in the context of the World War in which his character, Lalu

## **Joyce’s Linguistic Experimentation in “*A Portrait of the Artist as a Young Man*”**

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Technology

### **Abstract**

As a novelist James Joyce surpasses his predecessors in the experimental use of the use of stream of consciousness technique and the interior monologue. The most impressive and innovative method in the art of Joyce’s novel writing is found in his use of epiphany, and in his symbolic parallels drawn from history, mythology and literature. As a modernist, he is also a great exponent in the brilliant and innovative use of language in the literature of the 20<sup>th</sup> century. The present paper is an attempt to make a study of Joyce’s experimental use of language in his novel 1916 novel *A Portrait of the Artist as a Young Man*.

**Keywords-** James Joyce, Irish, Modernism, Language, Style

### **Introduction**

James Joyce, the Irish novelist, poet, playwright and critic, was the towering figure of the literature of the modern period. He was one of the pioneers in the experimentations of the theme and style in the literature of the 20<sup>th</sup> century. He brought a new approach in technical innovations and the use of language, and breathed new sensibility to the art of writing novel representing a breakthrough from the traditional naturalistic novels of the 18<sup>th</sup> and the 19<sup>th</sup> centuries of Henry Fielding, Daniel Defoe, Charles Dickens, Gustave Flaubert and others. The innovative style and literary technique of Joyce predominantly include his use of the interior monologue or the stream of consciousness narration method. His most impressive innovative method in the art of novel is found in his use of epiphany, and in his use of the symbolic parallels drawn from history, mythology and literature. He has created a language of his own through the invented words, puns and the allusions. Joyce’s linguistic experimentation is extensively found in his early novel *A Portrait of the Artist as a Young Man* (1916), and it reached its pinnacle in the outright avant-gardism in the later novels like *Ulysses* (1922) and *Finnegan’s Wake* (1939). It was Edward Albert who calls Joyce as ‘A ceaseless experimenter’

DOI: <https://doi.org/10.53032/tcl.2022.2.5.24>**"Khushwant Singh's Skill in Depicting both the Bright and Dark Aspects of Sikhism in his Fiction: A Brief Overview"?****C.MANASA**  
Assistant Professor of English  
G.Pullaiah College of  
Engineering and Technology**Abstract**

This paper is an attempt not only to project Khushwant Singh as one of the most distinguished writers in the field of contemporary Indian English fiction but also to show him as an adept in picturizing both the positive and negative images of Sikhism rather effectively in his fictional world, bringing home the point that as a brilliant novelist, story writer, historian and distinguished journalist, his literary achievements are far-ranging through publication of his two novels namely *A Train to Pakistan* and *I Shall Not Hear the Nightingale* as the finest realistic novels of Post-War-II of English fiction. It beautifully analyses Khushwant Singh's literary and fictional art which gets deep rooted in the Punjabi soil and Sikh religion and his genuine passion and concern for his community and his healthy attachment to Sikhism in his fictional world.

**Keywords-** *Sikhism, Literary Art, Fictional World, Realistic Novel***Introduction**

Khushwant Singh is one of the most significant authors in the field of Contemporary Indian–English Fiction. As a brilliant novelist, story writer, historian and distinguished journalist, his literary achievements are far-ranging. He is famous for his two novels – *A Train to Pakistan* and *I Shall Not Hear the Nightingale*. *Train to Pakistan* is considered one of the finest realistic novels of post-war II of Indian English Fiction. Even though Khushwant Singh's literary and fictional art gets deep rooted in the Punjabi soil and Sikh religion, he has genuine passion for his community. Despite his claim as an agnostic, his claims to be an agnostic seem to vanish with the significance he does attach to Sikhism in his fictional world. Religion is not only for spiritual purposes but it also helps to improve art. In Khushwant

**Identity Crisis in Women's Perspective in Manju Kapur's  
*Difficult Daughters***

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G. Pullaiah College of Engineering and Technology**  
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**Abstract**

The concept of women's thinking is nothing but the development of a movement which began in the late 1960s as a force, which began as an attempt to describe and interpret the experiences of women's lives. And we see their problems highlighted in literature especially in the form of novel. It also began as an attack towards male ideas about women as seen in literature. It rejects the ideas of men about women. It denounces the patriarchal society's control over women. Therefore, feminism is an attempt at removing the small space, and insignificant positions women were given by the male members of society, including male writers.

**Keywords:** Feminism, women's predicament, freedom and Socio-Cultural prejudice, male dominance.

**Freedom for Women's Expression of Their Thoughts**

Feminism had its inception as early as 1869 when Mary Wollstone Craft wrote **A Vindication of the Rights of Women** and later came Virginia Woolf who wrote *A Room of one's own* in 1929. The most powerful book that brought into focus the gender bias was Simone de Beauvoir's *The second sex* in 1949. In the 1970s Elain Showalter's essay towards feminist poetics distinguishes literature written by women for women, about woman, as they really are, by calling it Gynocriticism. However, feminism is also considered as a cultural, economic and political movement that thought about the freedom, security and complete equality of women. In Indian writings in English, feminism has been used for evaluating the real picture of the woman



# Utilizing Untranslatable Lexicons as a Literary Device

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## Abstract

This paper intends to analyse the writings of Indian novelists and find out how they make use of untranslatable dictions as a literary device. Indian writers often choose Indian situations or Indian themes while resorting to create a literary piece in English. One can find Indianism in the writings of all the Indian English authors. We come across many novelist of early period as well as the present period choose a theme familiar to them by place, culture and acquaintance and build their characters and stories so that the stamp of Indianism is imprinted in their writings. While going through the writings of Indian authors, of early period such as R. K. Narayan, Ahmad Ali, Raja Rao and Mulk Raj Anand and the present day Arundathi Roy, Anita Nair, Amish Tripathi, Chetan Bagat, Sudeep Nagarkar and others, we can observe that they codify English to suit their intention of narrating stories with Indianism. They resort to a unique deviation at all the levels of language structure such as discourse level, syntactic level, lexical level, morphological level and phonological level. Code mixing is the major strategy they adopt. They make use of untranslatable dictions to present before their readers an Indian menu to consume. The outcome of their efforts becomes artificial or artificially code mixed. The language spoken by their characters may not exist in the real world. So they make a distinction between the textual world and real world. The textual world allows the use of artificial English loaded with cultural terms or untranslatable items.

**Keywords:** Indianism, untranslatability, code mixing, lexical deviation, morphological deviation, syntactic deviation, discourse deviation, phonological deviation, cultural translation

## 1. Introduction

The question of untranslatability arises when the translator is unable to find out a translation equivalent for the source language unit in the target language. It is difficult to say that an item or unit is exclusively translatable or exclusively untranslatable. The degree of difficulty in translating one into another depends upon the nature of the source text and also on the skill of the translator. Generally an item is said to be untranslatable if the translator finds it out as a lacuna or lexical gap in the target language. It is very difficult to say that there is always one-to-one correspondence between the source and the target language for all the units under consideration. A number of translation procedures are available to a translator to overcome this lacuna. Therefore, untranslatability or difficulty of translation does not always carry deep linguistic relativity implications. Denotative meaning can be easily carried from source language to target language. But connotative meaning is difficult to transfer from source to target language.

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## **Social Commentary in Charles Dickens' Great Expectations**

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### **Abstract**

Charles Dickens' novels mirror his age. His purpose was to focus attention on the various evils of his time. Dickens has described in his novels the bitter issues of life, especially those of children. He has attacked the prevailing evils of his day as a satirist. He has thrown light on the dark haunts of vice, crime and suffering. He has lime lighted the poor state of education, the miserable condition of jails, injustice, bureaucracy, nepotism, laissez faire, acquisitive worldliness and many others evils. He is specially the novelist of the London life, and has described the disparity of life- the life of the slums and the life of the wealthy persons in whom the wealth of the nation is concentrated.

*Keywords- Child life, Wealth, Education, Crime, Injustice*

### **Introduction**

Charles Dickens believes not in art for art sake but in art for life sake. He would not write a single line without any purpose. He is a social critic. He has thrown light on various aspects of Victorian age, some of which transcend his age. They serve as the themes of his novels. Some of the important issues of his novels are child suffering, education, wealth, crime and punishment, justice and cruelty. Let us discuss them briefly.

### **Child Life**

One of the important themes of Dickens in almost all his novels is child life. Dickens has depicted in Great Expectations the depression, alienation and isolation of Pip, who is the protagonist of the novel. Nowhere else has he expressed the overwhelming and intense poignancy of a child more fully than he has done in *Great Expectations*. It is a matter of great irony that the orphan Pip runs away in fear from both, the convict and his own real sister. Once, Pip went to churchyard where he met a convict. He gets scared of the convict when he asks him to bring for him victual and file on

# Nonlinear Regression Models with Applications in Insurance

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**Abstract:** Two possible applications of nonlinear regression models in insurance are discussed. The first part deals with modelling IBNR reserves when a cubic approximation to the solution locus is used instead of linear or quadratic ones. A formula is given for construction of improved confidence regions for parameters in such models. Using this approach IBNR reserves for a data set are computed. In the second part a method is proposed of how to measure the influence of additive perturbations on nonlinear regression model parameters. An example is given which shows how this method can be used to preserve privacy of sensitive data in insurance business.

**Keywords:** Nonlinear regression models, confidence regions, additive perturbations, IBNS reserves, privacy of data.

## 1. INTRODUCTION

Due to the latest developments in insurance and reinsurance industries nonlinear regression models became more popular with steadily increasing importance. Let us mention two up-to date applications: nonlinear credibility estimation and nonlinear modelling of IBNR reserves (i.e. reserves for incurred but not reported losses).

De Vylder [1] extended Hachemeister's linear regression credibility model to a nonlinear regression model by assuming that observations are an arbitrary function  $f(\beta(\theta))$  of the unknown vector  $\beta(\theta)$ . This model lacks of robustness of credibility estimators. Pitselis [2] applied robust statistics to De Vylder's nonlinear credibility estimation and presented an application to Hachemeister's data.

The process of IBNR modelling and estimation has been studied by actuaries for many years since both RBNS (reported but not settled) and IBNR reserves are the largest liabilities of insurance companies. Recall that incurred but not reported loss or IBNR is the difference between ultimate loss and reported loss. Thus quantifying the uncertainty in estimation of IBNR plays the important role in insurance business. The classical approach makes use of run-off triangles (e.g. the chain-ladder method and its modifications). There exist also direct methods for computing or modelling of IBNR, for instance those using copulas and indirect methods based on estimation of loss development factors. For instance, Stelltjes [3] presents a model for predicting losses as a function of exposures, calendar period and development age. Typically, then a nonlinear regression model is used for estimating the 95% confidence interval of IBNR loss for an accident period. However using the quadratic approximation

of the model function may lead to inaccurate confidence regions for parameters of the model.

Consider the usual nonlinear regression model

$$y_a = f(x_a, \theta) + e_a \quad a = 1, \dots, n \quad (1)$$

$Y = (y_1, \dots, y_n)'$  denotes the vector of observations, the function  $f(\theta) = (f(x_1, \theta), \dots, f(x_n, \theta))$  has a known form dependent on  $p$  unknown parameters  $\theta = (\theta_1, \dots, \theta_p)'$ ,  $x_a$  are known vector-valued variables,  $e_a$  are independent and normally distributed random errors with zero mean and variance  $\sigma^2$ .

The problem of finding acceptable confidence regions for  $\theta$  has been discussed by many authors, see e.g. [4-6]. Cook and Goldberg [7] showed examples of models for which the Bates-Watts methodology based on quadratic approximations did not work. On the other hand Clarke [8] presented a method of constructing regions with higher precision. However, his investigations deal with a single parameter  $\theta_i$ , not with the whole vector  $\theta$ . The aim of our paper is to construct confidence regions based on cubic approximation which are more accurate than those currently used.

In what follows pre- and post-, square bracket and  $\otimes$ -multiplications of a three-dimensional array  $U_{ij}^a = (U_{ij}^a)$  or a four-dimensional array  $U_{ijk}^a = (U_{ijk}^a)$  by a matrix  $E$  mean summation over the indexes  $i, j, a, k$ , respectively. The reader is recommended to consult Table 1 for better understanding of these operations. Recall that if  $U_{ij}^a = (U_{ij}^a)$ ,  $a=1, \dots, n$ ,  $i=1, \dots, p$ ,  $j=1, \dots, q$  is an  $n \times p \times q$  array, then its  $a$ -th face is  $p \times q$  matrix  $(U_{ij}^a)$  and its  $ij$ -th column  $(U_{ij}^1, \dots, U_{ij}^n)'$  is  $n$ -vector.

## Percentile Double Ranked Set Sampling

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**Abstract:** In this paper, percentile double ranked set sampling (PDRSS) method is suggested for estimating the population mean. The PDRSS method is compared with the simple random sampling (SRS), ranked set sampling (RSS), median ranked set sampling (MRSS) and the extreme ranked set sampling (ERSS) methods. When the underlying distribution is symmetric, it turns out that PDRSS produce unbiased estimators of the population mean and it is more efficient than SRS, RSS, MRSS and ERSS based on the same sample size. For asymmetric distribution considered in this study, it is shown that PDRSS has a small bias and it is more efficient than RSS, MRSS and ERSS for most cases considered in this study.

**Key words:** Ranked set sampling, simple random sampling, percentile, unbiased estimator.

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### INTRODUCTION

Ranked set sampling (RSS) is a cost effective sampling procedure when compared to the commonly used SRS in the situations where visual ranking of units can be done easily but the exact measurement of the units is difficult and expensive. McIntyre<sup>[4]</sup> proposed the sample mean based on RSS as an estimator of the population mean. He found that the estimator based on RSS is more efficient than SRS. Many modifications on RSS have been done since McIntyre<sup>[4]</sup>. Takahasi and Wakimoto<sup>[7]</sup> provided the necessary mathematical theory of RSS. Samawi and Muttlak<sup>[6]</sup> suggested RSS method for estimating the population ratio. Al-Saleh and Al-Kadiri<sup>[1]</sup> suggested double ranked set sampling method (DRSS) for estimating the population mean and they showed that the ranking at the second stage is easier than the ranking at the first stage. Muttlak<sup>[5]</sup> proposed percentile ranked set sampling (PRSS) for estimating the population mean. Jemain *et al.*<sup>[3]</sup> suggested multistage median ranked set sampling (MMRSS) for estimating the population median.

### SAMPLING METHODS

**Ranked set sampling:** The RSS consist of selecting  $m$  random samples each of size  $m$  units from the population. The  $m$  units in each sample are ranked visually or by any inexpensive method with respect to the variable of interest. From the first set of  $m$  units, the smallest ranked unit is measured. From the second set

of  $m$  units, the second smallest ranked unit is measured. The process is continued until from the  $m$ th set of  $m$  units the largest ranked unit is measured. Repeat the process  $n$  times if needed to obtain a set of size  $mn$  from initial  $m^2n$  units.

**Percentile ranked set sampling:** In the percentile ranked set sampling (PRSS) procedure, select  $m$  random samples of size  $m$  units from the population and rank the units within each sample with respect to a variable of interest. If the sample size is even, select for measurement from the first  $m/2$  samples the  $(p(m+1))$ th smallest ranked unit and from the second  $m/2$  samples the  $(q(m+1))$ th smallest ranked unit, where  $q=1-p$  and  $0 \leq p \leq 1$ . If the sample size is odd, select from the first  $(m-1)/2$  samples the  $(p(m+1))$ th smallest ranked unit and from the other  $(m-1)/2$  samples the  $(q(m+1))$ th smallest ranked unit and select from the remaining sample the median for that sample for actual measurement. The cycle may be repeated  $n$  times if needed to get  $mn$  units. These  $mn$  units are form the PRSS data.

**Double ranked set sampling:** The double ranked set sampling (DRSS) procedure can be described as follows: Identify  $m^3$  units from the target population and divide these units randomly into  $m$  sets each of size  $m^2$ . The procedure of ranked set sampling is applied on these sets to obtain  $m$  ranked set sampling each of size  $m$ , again apply the ranked set sampling procedure on the  $m$  ranked set sampling sets to obtain a DRSS of size  $m$ .

# Numerical Solution of $n$ -th Order Fuzzy Linear Differential Equations by Homotopy Perturbation Method

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## ABSTRACT

This paper targets to investigate the numerical solution of  $n$ -th order fuzzy differential equations with fuzzy environment using Homotopy Perturbation Method (HPM). Triangular fuzzy convex normalized sets are used for the fuzzy parameter and variables. Obtained results are compared with the existing solution depicted in term of plots to show the efficiency of the applied method.

**Keywords**  $n$ -th order fuzzy linear differential equations, Fuzzy Number, Triangular Fuzzy Number, Homotopy Perturbation Method (HPM).

## 1. INTRODUCTION

Theory of fuzzy differential equations plays an important role in modeling of science and engineering problems because this theory represents a natural way to model dynamical systems under uncertainty. There exist a large number of papers dealing with fuzzy differential equations and its applications in the open literatures. Some of are reviewed and cited here for better understanding of the present analysis. Chang and Zadeh [15] first introduced the concept of a fuzzy derivative, followed by Dubois and Prade [16] who defined and used the extension principle in their approach. The fuzzy differential equation and fuzzy initial value problems are studied by Kaleva [28, 29] and Seikkala [36]. Various numerical methods for solving fuzzy differential equations are introduced in [1, 2, 6, 31, 32, 37]. Very recently Tapaswini and Chakraverty [37] have proposed a new method to solve fuzzy initial value problem. Bede [11] described the exact solutions of fuzzy differential equations in his note in an excellent way. Buckley and Feurin [14] applied two analytical methods for solving  $n$ -th order linear differential equations with fuzzy initial conditions. Similarly many authors studied various other methods to solve  $n$ -th order fuzzy differential equations in [3, 4, 5, 7, 26]. Based on the idea of collocation method Allahviranloo et al. [5] investigated the numerical solution of  $n$ -th order fuzzy differential equations. Abbasbandy et al. [3] applied Runge-Kutta method for the numerical solution of  $n$ -th order fuzzy differential equations. The analytical method (eigenvalue-eigenvector method) for  $n$ -th order fuzzy differential equations with fuzzy initial value is also discussed by Allahviranloo et al. [7]. Abbasbandy et al. [4] and Jafari et al. [26] used variational iteration method for solving  $n$ -th order fuzzy differential equations recently. Besides the above approaches Homotopy Perturbation Method (HPM) is also found to be a powerful tool for solving the fuzzy differential equations. The HPM was first developed by He [20, 21] and many authors applied this method to solve various linear and non-linear differential equations of scientific and engineering problems. The solution is considered as the sum of infinite series, which converges rapidly to accurate solutions. In the homotopy technique (in topology), a homotopy is constructed with an embedding

parameter which is considered as a "small parameter". Very recently HPM has been applied to a wide class of physical problems [10, 12, 13, 17, 22, 23, 24, 25, 30, 33, 34, 39, 40, 41, 42, 43]. In these papers the parameters and variables are considered as crisp (exact). Few researchers have also investigated the solution of fuzzy differential equations using HPM [8, 9, 18, 38]. Allahviranloo et al. [8, 9] applied homotopy perturbation method (HPM) to solve fuzzy Fredholm integral equations and fuzzy Volterra integral equations. Numerical solution of fuzzy initial value problems under generalized differentiability by HPM is studied by Ghanbari [18]. The example problems solved in [18] only consider the positive coefficients of the fuzzy differential equations. Also, the author did not described how to tackle the  $n$ -th order fuzzy differential equations by using HPM. Recently, Tapaswini and Chakraverty [38] used HPM for solving fuzzy quadratic Riccati differential equations. As regards in the present analysis, HPM is used to handle the numerical solution of  $n$ -th order fuzzy differential equations with fuzzy initial conditions respectively. Here the exact solutions of the respective systems are also found by the authors for the comparison. In the following sections preliminaries are first given. Next, numerical implementation of HPM for  $n$ -th order fuzzy differential equations with fuzzy initial conditions is discussed. Lastly numerical examples and conclusions are given.

## 2. PRELIMINARIES

In this section, we present some notations, definitions and preliminaries which are used further in this paper [19, 27, 35, 44].

### Definition 2.1. Fuzzy number

A fuzzy number  $\tilde{U}$  is convex normalised fuzzy set  $\tilde{U}$  of the real line  $R$  such that

$$\{\mu_{\tilde{U}}(x) : R \rightarrow [0, 1], \forall x \in R\}$$

where,  $\mu_{\tilde{U}}$  is called the membership function of the fuzzy set and it is piecewise continuous.

### Definition 2.2. Triangular fuzzy number

A triangular fuzzy number  $\tilde{U}$  is a convex normalized fuzzy set  $\tilde{U}$  of the real line  $R$  such that

- There exists exactly one  $x_0 \in R$  with  $\mu_{\tilde{U}}(x_0) = 1$  ( $x_0$  is called the mean value of  $\tilde{U}$ ), where  $\mu_{\tilde{U}}$  is called the membership function of the fuzzy set.
- $\mu_{\tilde{U}}(x)$  is piecewise continuous.

Let us consider an arbitrary triangular fuzzy number  $\tilde{U} = (a, b, c)$ . The membership function  $\mu_{\tilde{U}}$  of  $\tilde{U}$  will be define as follows

# Traffic Control Problems using Graph Connectivity

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## ABSTRACT

In modern day automobile traffic the problem of traffic congestion calls for the design of efficient control strategies. In this paper it is argued that in order to have efficient and systematic solutions to a traffic control problem at an intersection, graph theoretic models of the problem are quite appropriate for its exploitation. Connectivity of compatibility graph of a traffic intersection can be used to study the most efficient route or the traffic control system to direct the traffic flow to its maximum capacity using the minimum number of edges or the minimum number of vertices. This result has got application in traffic control problems at an arbitrary intersection so as to minimize the waiting time of the traffic participants and the cost of locating the sensors in order to collect traffic data.

## Keywords

Compatibility Graph, Edge Connectivity, Intelligent Transportation System, Traffic Control, Traffic Sensors, Vertex Connectivity.

## 1. INTRODUCTION

Traffic theory is a physical phenomenon that aims at understanding and improving automobile traffic, and the problem associated with it such as traffic congestion [1]. The traffic control problem is to minimize the waiting time of the public transportation while maintaining the individual traffic flow optimally [2]. Significant development of traffic control systems using traffic lights has been achieved since the first traffic controller was installed in London in 1868. The first green wave was realised in Salt Lake City (U.K.) in 1918, and the first area traffic controller was introduced in Toronto in 1960. At the beginning, electromechanical devices were used to perform traffic control. Then Intelligent Transportation System (ITS) is used extensively in urban areas to control traffic at an intersection [3]. The traffic data in a particular region can be used to direct the traffic flow to improve traffic output without adding new roads. In order to collect accurate traffic data semi conductor-based controllers known as sensors were placed in different places to collect traffic information are used in traffic control system [3], [4], [5]. Nowadays, microprocessor based controller are used in Traffic Control Systems. The combinatorial approach to the optimal traffic control problem was founded by Stoffers [6] in 1968 by introducing the *Compatibility Graph* of traffic streams.

One of the main uses of traffic theory is the development of traffic models which can be used for estimation, prediction, and control related tasks for the automobile traffic process. In this paper graph theoretic model of a traffic control problem at an intersection is used for its solution. The resulting compatibility graph of the intersection and its connectivity is used to study the most efficient route or the traffic control system to direct the traffic flow to its maximum capacity using the minimum number of edges or the minimum number of vertices.

## 2. INTELLIGENT TRANSPORTATION SYSTEM

The term Intelligent Transportation System (ITS) refers to information and communication technology applied to transport infrastructure and vehicles, that improves transport outcomes such as transport safety, transport productivity, transport reliability, informed traveller choice, environmental performance etc. [7], [8].

ITS mainly comes from the problems caused by traffic congestion and synergy of new information technology for simulation, real time control and communication networks. Traffic congestion has been increased world wide as a result of increased motorization, urbanization, population growth and changes in population density. Congestion reduces efficiency of transportation infrastructure and increases travel time, air pollution and fuel consumption.

At the beginning of 1920, in United States large increase in both motorization and urbanization led to the migration of the population from sparsely populated rural areas and densely packed urban areas into suburbs (sub urban areas). Recent governmental activity in the area of ITS specially in the United States is motivated by an increased focus on homeland security. Other parts of the developing world, such as China, remain largely rural but are rapidly urbanizing and industrializing. The urban infrastructure is being rapidly developing, providing an opportunity to build new systems that incorporate ITS at early stage.

Intelligent Transport Systems vary in technologies applied, from basic management system such as car navigation; traffic signal control systems; container management system; variable message sign; automatic number plate recognition or speed cameras to monitor applications; such as security CCTV systems; and to more advanced applications that integrate live data and feedback from a number of other sources, such as parking guidance and information systems; weather information etc. Additional predictive techniques are being developed to allow advanced modeling and comparison with historical data. The traffic flow predictions will be delivered to the drivers via different channels such as roadside billboards, radio stations, internet, and on vehicle GPS (Global Positioning Systems) systems. One of the components of an ITS is the live traffic data collection. To collect accurate traffic data sensors have to be placed on the roads and streets to measure the flow of traffic. Some of the constituent technologies implemented in ITS are namely, Wireless Communication, Computational technologies, Sensing technologies, Video Vehicle Detection etc. Sensing technologies, which is the present interest, mean briefly the following:

The technological advances in telecommunication and information technology, coupled with microchip, RFID (Radio Frequency Identification), and inexpensive intelligent beacon sensing technologies, have enhanced the technical capabilities that will facilitate safety of the traffic participants for intelligent transportation system globally. Sensing systems for ITS are vehicle- and infrastructure based

## Distribution of Records Defined on Ordered Words Representing Lattice Paths

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**Abstract: Problem statement:** Let the sequence  $i_1, i_2, \dots, i_n$ , denoted by  $S_n^n$  be an increasing ordered word of length  $n$  taken from the set of the  $n$  positive integers  $S = \{1, 2, \dots, n\}$ ,  $m, n \in \mathbb{N}^+$ ,  $m \geq n$ .

**Approach:** That is  $1 \leq i_1 \leq i_2 \leq \dots \leq i_n \leq n$ . Treating  $S_n^n$  as a sequence of weak records  $\{L_j = i_j\}$ ,  $i, j = 1, 2, \dots, n$ , the distribution of the single weak record as well as the joint distribution of weak records were found before. **Results:** By defining the notion of strong records on the sequence  $\{L_j = i_j\}$ , the distribution of a single strong record was found for  $m=n$ . In another aspect, it can be shown that the lattice path in the plane from  $(0,1)$  to  $(m, n)$ , consisting of unit segments up and to the right, can be represented by a sequence  $i_1, i_2, \dots, i_m$  where  $1 \leq i_1 \leq i_2 \leq \dots \leq i_m \leq n$ ,  $m, n \in \mathbb{N}^+$ ,  $m \geq n$ . That is, such lattice paths can be represented, in one to one correspondence, by ordered increasing words of length  $m$  taken from the set  $S$ . **Conclusion/Recommendations:** In this article, we are going to extend the notion of weak and strong records to these sequences representing lattice paths for  $m > n$  and obtain their distributions. This result allows us to study lattice paths via ordered words of non negative integers.

**Key words:** Lattice paths, increasing ordered words, random variables, probability distribution

### INTRODUCTION

An ordered word of length  $m$  taken from the set  $S = \{1, 2, \dots, n\}$  Alahmadi (2009), is a set of  $m$  integers  $i_1, i_2, \dots, i_m$  such that  $1 \leq i_1 \leq i_2 \leq \dots \leq i_m \leq n$ ,  $m, n \in \mathbb{N}^+$ . For  $n=m$ , the element  $i_j$ ,  $i, j=1, 2, \dots, n$ . is denoted by the weak record  $L_i$  the probability distribution of a single  $L_j$  as well as the joint probability distribution of  $L_1, L_2, \dots, L_k$ , where  $1 \leq i_1 \leq i_2 \leq \dots \leq i_k \leq n$ , were given by the following theorem, for other results on ordered sequences El-Faheem and Mahmoud (2010), Khidr and Radwan (2000).

**Theorem 1:** Let  $P(L_i = j)$  be the probability that the integer  $j$  falls in the  $i^{\text{th}}$  place in the sequence  $j_1 j_2 \dots j_n$ ,  $i = 1, 2, \dots, n$ . then we have Eqn. 1:

$$P(L_i = j) = \binom{i+j-2}{j-1} \binom{2n-i-j}{n-j}, j=1, 2, \dots, n \quad (1)$$

Similarly, if  $P(L_{i_1} = j_1, L_{i_2} = j_2, \dots, L_{i_k} = j_k)$  be the the probability that the numbers  $j_1, j_2, \dots, j_k$  falling in the locations  $i_1, i_2, \dots, i_k$ , respectively, then Eq. 2:

$$P(L_{i_1} = j_1, L_{i_2} = j_2, \dots, L_{i_k} = j_k) = \binom{i_1+j_1-2}{j_1-1} \binom{i_2+j_2-i_1-j_1-1}{j_2-j_1-1} \dots \binom{i_k+j_k-i_{k-1}-j_{k-1}-1}{j_k-j_{k-1}-1} \binom{2n-i_k-j_k}{n-j_k} \quad (2)$$

In the case  $m > n$ , similar expressions are given for  $P(L_{i_1} = j_1, L_{i_2} = j_2, \dots, L_{i_k} = j_k) \leq j_1 \leq j_2 \leq \dots \leq j_k \leq n, \leq k \leq m$ .

We notice that  $1 \leq L_{i_1} \leq L_{i_2} \leq \dots \leq L_{i_k} \leq n$ , thus they form some kind of weak records, the strong record on the sequence  $j_1 j_2 \dots j_n$  or alternately on  $L_{i_1}, L_{i_2}, \dots, L_{i_k}$  was introduced as a parallel to record values in the continuous case. For records from continuous distributions, Ahsanullah and Ragab (2006) Ahsanullah (1995) for discrete records, Dembinska (2007).

### MATERIALS AND METHODS

**Definition 1:** For  $m \geq n$ .

Let  $R(1)=1$  and  $R(i+1) = \min\{k > R(i): L_k > X_{R(i)}\}$  when  $L_k$  exists, otherwise  $R(i+t) = R(i)$ ,  $t=1, 2, \dots, m-i$ , then  $X_{R(1)}, X_{R(2)}, \dots, X_{R(m)}$  are called the strong record values on  $L_1, L_2, \dots, L_m$ . and  $P(X_{R(1)} = k)$  is given by the following theorem Eqn. 3.

# Sum of Orthogonal Bimatrices in $R_{n \times n}$

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## Abstract

Let  $F \in R, C, H$ . Let  $\mathcal{U}_{n \times n}$  be the set of unitary bimatrices in  $F_{n \times n}$ , and let  $\mathcal{O}_{n \times n}$  be the set of orthogonal bimatrices in  $F_{n \times n}$ . Suppose  $n \geq 2$ . we show that every  $A_B \in F_{n \times n}$  can be written as a sum of bimatrices in  $\mathcal{U}_{n \times n}$  and of bimatrices in  $\mathcal{O}_{n \times n}$ . let  $A_B \in F_{n \times n}$  be given that and let  $k \geq 2$  be the least integer that is a least upper bound of the singular values of  $A_B$ . When  $F=R$ , we show that if  $k \leq 3$ , then  $A_B$  can be written as a sum of 6 orthogonal bimatrices; if  $k \geq 4$ , we show that  $A_B$  can be written as a sum of  $k+2$  orthogonal bimatrices.

**Keywords:** Orthogonal matrix, bimatrix, orthogonal bimatrix, unitary bimatrix, sum of orthogonal bimatrices, sum of unitary bimatrices.

**AMS classification:** 15A09, 15A15, 15A57.

## 1. Introduction

Matrices provide a very powerful tool for dealing with linear models. Bimatrices are still a powerful and an advanced tool which can handle over one linear model at a time. Bimatrices are useful when time bound comparisons are needed in the analysis of a model. Bimatrices are of several types. We denote the space of  $n \times n$  complex matrices by  $\mathcal{C}_{n \times n}$ . For  $A \in \mathcal{C}_{n \times n}$ ,  $A^T, A^{-1}, A^\dagger$  and  $\det(A)$  denote transpose, inverse, Moore-Penrose inverse and determinant of  $A$  respectively. If  $AA^T = A^T A = I$  then  $A$  is an orthogonal matrix, where  $I$  is the identity matrix. In this paper we study orthogonal bimatrices as a generalization of orthogonal matrices. Some of the properties of orthogonal matrices are extended to orthogonal bimatrices. Some important results of orthogonal matrices are generalized to orthogonal bimatrices.

## Basic Definitions and Results

### Definition 1.1 [7]

A bimatrix  $A_B$  is defined as the union of two rectangular array of numbers  $A_1$  and  $A_2$  arranged into rows and columns. It is written as  $A_B = A_1 \cup A_2$  with  $A_1 \neq A_2$  (except zero and unit bimatrices) where,

$$A_1 = \begin{bmatrix} a_{11}^1 & a_{12}^1 & \cdots & a_{1n}^1 \\ a_{21}^1 & a_{22}^1 & \cdots & a_{2n}^1 \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1}^1 & a_{m2}^1 & \cdots & a_{mn}^1 \end{bmatrix} \text{ and } A_2 = \begin{bmatrix} a_{11}^2 & a_{12}^2 & \cdots & a_{1n}^2 \\ a_{21}^2 & a_{22}^2 & \cdots & a_{2n}^2 \\ \vdots & \vdots & \ddots & \vdots \\ a_{m1}^2 & a_{m2}^2 & \cdots & a_{mn}^2 \end{bmatrix}$$

' $\cup$ ' is just for the notational convenience (symbol) only.

### Definition 1.2 [7]

Let  $A_B = A_1 \cup A_2$  and  $C_B = C_1 \cup C_2$  be any two  $m \times n$  bimatrices. The sum  $D_B$  of the bimatrices  $A_B$  and  $C_B$  is defined as

$$\begin{aligned} D_B &= A_B + C_B = A_1 \cup A_2 + C_1 \cup C_2 \\ &= A_1 + C_1 \cup A_2 + C_2 \end{aligned}$$



## The Shortest Path with Intelligent Algorithm

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**Abstract: Problem statement:** Path planning algorithms need to be developed and implemented in a suitable manner to give better understanding about the intelligent system and also stimulates technological supply to enormous demands in an intelligent vehicle industry. **Approach:** This study concerned with intelligent path planning using A\* search algorithm. **Results:** This study introduced intelligent path planning with A\* search algorithm, which use to generate the most efficient path to goal. The algorithm was tested on simulator. **Conclusion:** This study is an implementation of a path planning for an intelligent path planning. The implementations are tested and verified with the simulation software. The path planning algorithms were selected for the implementation and to verify them.

**Key words:** A search algorithm, path planning, Hough transformation

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### INTRODUCTION

For a number of differences navigational control strategies have been adopted by various parties. Consider a highly automated factory where mobile robots pick up parts and deliver them to assembly robots. The robots must find their way to parts, pick them up and move to the assembly stations. An automatic motion planner will relieve the operators from this tedious job and enable them to control at a supervisory level. In turn, this increases efficiency by eliminating human errors. All these motions have to be executed without colliding with Objects and other robots. Without a motion planner for the robots and arms, human operators have to constantly specify the motions. The need for collision avoidance and efficient motions leads to the problem of motion planning. There are two approaches for the path planning, global path planning and local path planning (Czarnecki and Rotten, 1995). In real world applications of mobile robots both global and local maps are used. Global maps should decompose hierarchically into local maps to allow easy movement between the two. One obvious advantage of this structure is a reduction in the use of local memory without loss of detail because the computer in the robot has to store only the global map and a detail local map for the area it is in not a detailed map of its whole universe. This assumes that local maps can be retrieved from secondary storage, or a host computer, at any time.

**Global path planning:** Thy roadmap method consists of capturing the connectivity of the robot s free space.

In a network of one dimensional curve, called the roadmap, a sub path combined in the roadmap and a sub path connector the roadmap to the goal configuration (Sotelo and Rodriguez, 2004). A visibility roadmap is obtained by generating all line segments between pairs of obstacle region vertices. Any line segment that lies entirely in the free space is added to the roadmap. When a path planning is given the initial position and goal position are also treated as vertices. This generates a connectivity graph that can be searched for a solution. The sweep-line principle can be applied to yield a more efficient algorithm. This diagram is the set of ah the free configurations whose minimal distance to the obstacle region. The advantage of this diagram is that it yields free paths which tend to maximize the clearance between the robot and the obstacles. Cell Decomposition methods are perhaps the motion planning methods which have been the most extensively studied so far. They consist of decomposing the robot's free space into simple region called cell, such that a path between any two configurations in a cell can be easily generated. A non directed graph representing the adjacency between the cells in then constructed and searched. This graph is called the connectivity graph. Its node is the cell extracted from the free space and two nodes are connected by a link if and only if the two corresponding cells are adjacent. The outcome of the search is a sequence of cells caned a channel.

**Local path planning:** The reduction of the calculation time for planning is decisive for the controlling concept (Everett, 1995). Between the planning steps a

Original Article

# Evaluation of Fourier Series for Signal Processing Application

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**Abstract** - Computational topology combines theoretical topological methods with efficient algorithms to analyse data and solve problems in some fields of computer science. In this article we look at the various application of computational or applied topology in computer science with reference to the following fields: Artificial Intelligence, Robotics, Machine learning, and Computer Graphics or Image Processing. We realized that there has been a fast boost in the application of Topological Data Analysis in the above stated areas. This paper seeks to collect and summarize the most recent works connecting the application of Topological Data Analysis to computer science and the various methods used to incorporate the tools of Topological Data Analysis into various applications in computer science.

**Keywords** - Topological Data Analysis, Machine learning, Robotics, Artificial intelligence, Persistent homology.

## 1. Introduction

The concept of topology is widely known as a branch of mathematics that takes its root from geometry. Topology is the study of the global and local properties of shapes or objects under continuous deformation. During the early ages of the birth of topology, it was regarded as rubber sheet geometry, because objects or shapes were deformed without changing the underlying properties of such objects or shapes. The detailed understanding of the geometry of surfaces is well illustrated under the concept of topology. According to a topologist, a donut and a torus are the same, because they share some invariant properties. The examples of objects presented in figure 1. are the same but differ geometrically in length, angle of measure, and curvature.

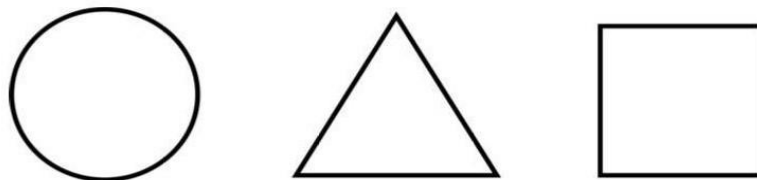


Fig. 1 These shapes are topologically equivalent but geometrically non-identical

While objects are identical through continuous deformation, on the other hand, geometric objects are identical through congruence. Congruent objects have the same lengths of corresponding sides, measures of angles, volume, perimeter, and curvature.

**Definition 1** (Zomorodian, 2005) A topology in a set  $X$  is a subset  $\tau$  belonging to  $2^X$  such that, the following axioms holds.

- I. The empty set and  $X$  are elements of  $\tau$
- II. Finite intersection of elements of  $\tau$  is an element of  $\tau$
- III. Arbitrary union of any elements of  $\tau$  is an element of  $\tau$

Note: The pair  $(X, \tau)$  of the set  $X$  and its topology  $\tau$  is a called a topological space.

**Definition 2** (Kinsey, 1997) An equivalence relation  $\simeq$ , on a set of objects is a relation on the set such that;

- I. For each  $a$  in the set,  $a \simeq a$  (reflexivity property)
- II. If  $a \simeq b$ , then  $b \simeq a$  (symmetric property)
- III. If  $a \simeq b$ , and  $b \simeq c$ , then  $a \simeq c$  (transitivity property)

## Solving Second Order Ordinary Differential Equations In A New Approach

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**Abstract:** A new approach is presented to solve second order linear differential equations with variable coefficients and some illustrative examples are given.

**Key words:** Second order equations, general solution, homogeneous and nonhomogeneous equations

### INTRODUCTION

Consider the second order linear ordinary differential equation

$$y'' + P(x)y' + Q(x)y = G(x) \quad (1)$$

where, P, Q and G are continuous functions. It is known that the power series method is a powerful method for solving Eq.(1). However, this method needs a lot of time, space and high concentration during calculations. In this research, we present a new approach which can be used to a wide class of equations either to find a general solution to the associated homogeneous equation or to find a particular solution to Eq.(1) without requiring the general solution or any solution of the associated homogeneous equation as most methods require. For more details, see[1].

### MAIN RESULTS

In this section we introduce our main results.

**Theorem 1:** Consider the equation

$$y'' + P(x)y' + Q(x)y = 0 \quad (2)$$

If  $v(x) = y'(x) + \beta(x)y(x)$ , where  $\beta(x)$  is a solution of the Riccati equation  $\beta'(x) = Q(x) - P(x)\beta(x) + \beta^2(x)$ , then,

$$y(x) = e^{-\int \beta(x) dx} \int e^{\int (2\beta(x) - P(x)) dx} dx \quad (3)$$

is a solution of Eq.(2).

**Proof:** It is easy to show that  $v' = (\beta(x) - P(x))v$ , where Riccati equation has been used and  $v(x) = e^{\int (\beta(x) - P(x)) dx}$ , then the result is achieved.

**Note:** It is known that the substitution  $v(x) = \frac{-y'}{y}$

transfers Eq. (2) to a Riccati equation and  $y = e^{-\int v(x) dx}$  is a solution of the equation. This result is included in the theorem (1) and the formula (3) really gives a second linearly independent solution to Eq. (2) and therefore the general solution is constructed. These facts are illustrated in the following example.

**Example 1:** Find a general solution of the equation

$$x y'' - (1+x) y' + y = 0 \quad (4)$$

**Solution:** Here,  $P(x) = \frac{-(1+x)}{x}$ ,  $Q(x) = \frac{1}{x}$ , so the Riccati equation is

$$\beta'(x) = \frac{1}{x} + \left(\frac{1+x}{x}\right)\beta(x) + \beta^2(x)$$

and  $\beta(x) = -1$  is a solution of the equation, and then  $y_1(x) = e^{\int dx} = e^x$  is a solution of the equation. Thus

$$\begin{aligned} y_2(x) &= e^{\int dx} \int e^{\int \left(-2 + \frac{1+x}{x}\right) dx} dx \\ &= -x - 1. \end{aligned}$$

Hence the general solution is

$$y(x) = c_1 e^x + c_2 (x + 1).$$

By using the same technique, naturally one can get the following result, which can be used to find a particular solution of Eq. (1). In particular, this procedure can be used easily to find a particular solution of second order ordinary differential equations

# Estimation of Size-Biased Generalized Logarithmic Series Distribution

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**Abstract:** In this paper, a size-biased generalized logarithmic series distribution (SBGLSD) is introduced and its moments are obtained. The estimates of the parameters of SBGLSD are obtained by employing the method of moments and a proposed new method of estimation. The new proposed method of estimation uses the non-zero frequency of a variable only up to a finite value. In this method, the estimation of only one parameter is needed and of the other is obtained by the relationship among the parameters by counting the number of non-zero frequency classes. The method is found very simple and quick to apply in practice. Extensive simulations are performed to compare the performances of the proposed and the moment method of estimation mainly with respect to their biases and mean squared errors (MSE's), for different sample sizes and of different parametric values. Comparison has been made among different estimation methods by means of Pearson's Chi-square, Akaike Information Criterion (AIC) and Bayesian Information Criterion (BIC) techniques.

**Key Words:** Size-biased generalized logarithmic series distribution, Non- zero frequency classes, Chi-square AIC, BIC.

## 1. INTRODUCTION

The generalized logarithmic series distribution (GLSD) characterized by two parameters  $\alpha$  and  $\beta$  was defined by Jain and Gupta [1]. The probability function of the GLSD model is given by

$$P[X = x] = \frac{\theta \Gamma(\beta x) \alpha^x (1-\alpha)^{\beta x - x}}{x! \Gamma(\beta x - x + 1)};$$

$$x = 1, 2, \dots, \beta \geq 1 \text{ and } 0 \leq \alpha \leq \beta^{-1}. \quad (1)$$

Where  $\theta = \frac{-1}{\log(1-\alpha)}$ .

The model (1) reduces to the simple logarithmic series distribution when  $\beta = 1$ . The GLSD model is a member of Gupta's [2] modified power series distribution and of Consul and Shenton's [3] Lagrangian probability distributions. The model (1) is also a limiting form of zero-truncated form of Jain and Consul's [4] generalized negative binomial distribution. Patel [5] defined GLSD and obtained the estimates of the parameters by the method of moments. Famoye [6] showed that the GLSD is unimodal and the mode is at the point  $x = 1$ . Some methods of sampling from the model (1) are provided by Famoye [7]. Famoye [8] obtained the moment estimators, Jani and Shah [9] discussed the maximum likelihood and moment method of estimation for two parameter GLSD model. Mishra and Tiwary [10] suggested an

alternative method of estimation based on the first three moments and showed that the GLSD provides a very close fits to the observed data from various fields such as asentomolgy, medicine, engineering etc. Famoye [11] discussed the fitting of GLSD. Tripathi and Gupta [12] studied another generalization of GLSD. A brief list of authors and their works can be seen in Johnson, Kotz and Kemp [13] and Consul and Famoye [14].

The first four moments about origin of GLSD are given as

$$\mu'_1 = \alpha(1-\alpha\beta)^{-1} \alpha. \quad (2)$$

$$\mu'_2 = \theta(1-\alpha\beta)^{-3} \alpha(1-\alpha). \quad (3)$$

$$\mu'_3 = \theta(1-\alpha\beta)^{-5} \alpha(1-\alpha)(1-2\alpha+2\alpha\beta-\alpha^2\beta). \quad (4)$$

$$\mu'_4 = \theta(1-\alpha\beta)^{-7} \alpha(1-\alpha) \left( \frac{1-6\alpha+6\alpha^2+2\alpha\beta}{(4-9\alpha+4\alpha^2)} \right) + \beta^2 \alpha^2 (6-6\alpha+\alpha^2). \quad (5)$$

The recurrence relation among the central moments is given as

$$\mu_{r+1} = \frac{\alpha(1-\alpha)}{1-\alpha\beta} \frac{d\mu_r}{d\alpha} + r\mu_2\mu_{r-1}. \quad (6)$$

Which gives the first four central moments as

$$\mu_2 = \theta(1-\alpha\beta)^{-3} \alpha(1-\alpha-\theta\alpha)(1-\alpha\beta). \quad (7)$$

# Mathematical modeling of a circuit-based battery model employed for automotive applications

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**Abstract-** It is necessary to understand the non-linear dynamics of any kind of a battery model with the help of adopting any type of modeling analysis. Mathematical modeling plays a key role in analyzing the performance of battery along with its state of charge conditions. As it is well known fact that, any electrical based automobile requires a battery for carrying out mobility from one place to another. It is essential to understand the battery working capabilities i.e., the charging and discharging times, life expectancy of battery, and cost effectiveness designing it. All these parameters could be scrutinized only with the aid of mathematical computations and equations. Hence forth, in this paper, emphasis has been given on mathematical treatment on battery model analysis. As a part of example, few simulation graphs also have been included in this paper to analyze the battery charging and discharging time variations.

**Keywords-** Battery model, Mathematical modeling, Non-linear dynamics, State of charge.

## I. INTRODUCTION

It is well known fact that, a battery is defined as an electro-chemical device which basically converts the chemical energy into electrical energy [1]. In general, the characteristic features of battery shall be the rating capacity (termed as Q) and voltage (V) rating. Mathematical prototyping is needed in order to estimate the battery working so that one can develop theoretical as well as the practical related tools to summarize the characteristics of batteries [2]. Many models were proposed and formulated in the past years recently [3-5]. But these models are considered to be composite in nature and tough to utilize them. Thus, a simple model is required to know about the attributes of battery with the help of mathematical based equations.

Conventionally, many battery models are created based upon the battery runtime parameter assessment, computing the efficiency and the capability of the battery. It is indicated that, the various traditional existing mathematical models shall work for a particular type of application [6].

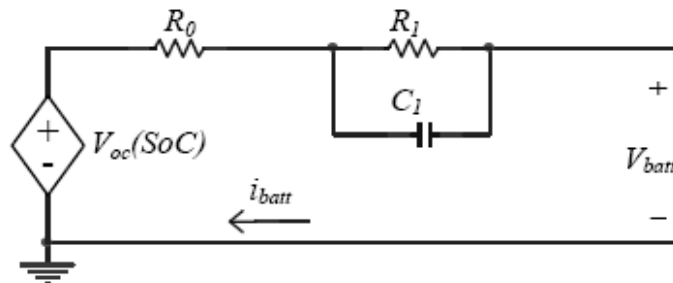


Fig. 1: circuitry based Battery model

## Distribution of Records Defined on Ordered Words Representing Shortest Paths

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**Abstract: Problem statement:** Let the sequence  $i_1, i_2, \dots, i_n$ , denoted by  $S_n^n$  be an increasing ordered word of length  $n$  taken from the set of the  $n$  positive integers  $S = \{1, 2, \dots, n\}$ ,  $m, n \in \mathbb{N}^+$ ,  $m \geq n$ . **Approach:** That is  $1 \leq i_1 \leq i_2 \leq \dots \leq i_n \leq n$ . Treating  $S_n^n$  as a sequence of weak records  $\{L_j = i_j\}$ ,  $i, j = 1, 2, \dots, n$ , the distribution of the single weak record as well as the joint distribution of weak records were found before. **Results:** By defining the notion of strong records on the sequence  $\{L_j = i_j\}$ , the distribution of a single strong record was found for  $m=n$ . In another aspect, it can be shown that the lattice path in the plane from  $(0,1)$  to  $(m, n)$ , consisting of unit segments up and to the right, can be represented by a sequence  $i_1, i_2, \dots, i_m$  where  $1 \leq i_1 \leq i_2 \leq \dots \leq i_m \leq n$ ,  $m, n \in \mathbb{N}^+$ ,  $m \geq n$ . That is, such lattice paths can be represented, in one to one correspondence, by ordered increasing words of length  $m$  taken from the set  $S$ . **Conclusion/Recommendations:** In this article, we are going to extend the notion of weak and strong records to these sequences representing lattice paths for  $m > n$  and obtain their distributions. This result allows us to study lattice paths via ordered words of non negative integers.

**Key words:** Lattice paths, increasing ordered words, random variables, probability distribution

### INTRODUCTION

An ordered word of length  $m$  taken from the set  $S = \{1, 2, \dots, n\}$  Alahmadi (2009), is a set of  $m$  integers  $i_1, i_2, \dots, i_m$  such that  $1 \leq i_1 \leq i_2 \leq \dots \leq i_m \leq n$ ,  $m, n \in \mathbb{N}^+$ . For  $n=m$ , the element  $i_j$ ,  $i, j=1, 2, \dots, n$ . is denoted by the weak record  $L_i$  the probability distribution of a single  $L_j$  as well as the joint probability distribution of  $L_1, L_2, \dots, L_k$ , where  $1 \leq i_1 \leq i_2 \leq \dots \leq i_k \leq n$ , were given by the following theorem, for other results on ordered sequences El-Faheem and Mahmoud (2010), Khidr and Radwan (2000).

**Theorem 1:** Let  $P(L_i = j)$  be the probability that the integer  $j$  falls in the  $i^{\text{th}}$  place in the sequence  $j_1 j_2 \dots j_n$ ,  $i = 1, 2, \dots, n$ . then we have Eqn. 1:

$$P(L_i = j) = \binom{i+j-2}{j-1} \binom{2n-i-j}{n-j}, j=1, 2, \dots, n \quad (1)$$

Similarly, if  $P(L_{i_1} = j_1, L_{i_2} = j_2, \dots, L_{i_k} = j_k)$  be the the probability that the numbers  $j_1, j_2, \dots, j_k$  falling in the locations  $i_1, i_2, \dots, i_k$ , respectively, then Eq. 2:

$$P(L_{i_1} = j_1, L_{i_2} = j_2, \dots, L_{i_k} = j_k) = \binom{i_1+j_1-2}{j_1-1} \binom{i_2+j_2-i_1-j_1-1}{j_2-j_1-1} \dots \binom{i_k+j_k-i_{k-1}-j_{k-1}-1}{j_k-j_{k-1}-1} \binom{2n-i_k-j_k}{n-j_k} \quad (2)$$

In the case  $m > n$ , similar expressions are given for  $P(L_{i_1} = j_1, L_{i_2} = j_2, \dots, L_{i_k} = j_k) \leq j_1 \leq j_2 \leq \dots \leq j_k \leq n, \leq k \leq m$ .

We notice that  $1 \leq L_{i_1} \leq L_{i_2} \leq \dots \leq L_{i_k} \leq n$ , thus they form some kind of weak records, the strong record on the sequence  $j_1 j_2 \dots j_n$  or alternately on  $L_{i_1}, L_{i_2}, \dots, L_{i_k}$  was introduced as a parallel to record values in the continuous case. For records from continuous distributions, Ahsanullah and Ragab (2006) Ahsanullah (1995) for discrete records, Dembinska (2007).

### MATERIALS AND METHODS

**Definition 1:** For  $m \geq n$ .

Let  $R(1)=1$  and  $R(i+1) = \min\{k > R(i): L_k > X_{R(i)}\}$  when  $L_k$  exists, otherwise  $R(i+t) = R(i)$ ,  $t=1, 2, \dots, m-i$ , then  $X_{R(1)}, X_{R(2)}, \dots, X_{R(m)}$  are called the strong record values on  $L_1, L_2, \dots, L_m$ . and  $P(X_{R(1)} = k)$  is given by the following theorem Eqn. 3.

## Numerical Ultimate Ruin Probabilities under Interest Force

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**Abstract:** This work addresses the issue of ruin of an insurer whose portfolio is exposed to insurance risk arising from the classical surplus process. Availability of a positive interest rate in the financial world forces the insurer to invest into a risk free asset. We derive a linear Volterra integral equation of the second kind and apply an order four Block-by-block method in conjunction with the Simpson rule to solve the Volterra equation for ultimate ruin. This probability is arrived at by taking a linear combination of some two solutions to the Volterra integral equation. The several numerical examples given show that our results are excellent and reliable.

**Key words:** Risk theory, ruin probability, volterra integral equation, block-by-block method

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### INTRODUCTION

The problem of finding the probability of ultimate ruin was first considered by Lundberg<sup>[1]</sup>. Since then, the problem has received much attention up to present day. In his thesis, Lundberg considered a surplus model of the type:

Surplus = Initial reserve + Income - outflow. Among the earlier authors who gave a rigorous mathematical basis of Lundberg's work was Cramér<sup>[2,3]</sup>. His contributions were presented in his monograph 'Collective Risk Theory'. Lundberg's model, expounded by Cramér, is termed the Cramér-Lundberg model or the surplus model.

In this model, at time  $t$ , the surplus  $Y_t$  of an insurance company is given by

$$Y_t = y + pt - \sum_{i=1}^{N_t} S_i \quad (1)$$

where,  $y = Y_0 \geq 0$  is the initial reserve,  $p > 0$  is the premium rate,  $\{N_t\}_{t \in \mathcal{R}^+}$  is a Poisson process with intensity  $\lambda$ , modelling the number of claims in  $(0, t]$  and  $\{S_i\}_{i \in \mathbb{N}}$  is an independent and identically distributed sequence of positive random variables (with distribution  $F$ ) independent of  $N$ , modelling the claim sizes. The distribution  $F$  has finite expectation  $\mu$  and finite variance  $\sigma^2$ . In the literature, the process  $Y$  in equation (1) is commonly known as the classical risk model.

A critical look at the process in (1) raises a couple of questions. One question that has received much attention is 'what is the probability that  $Y$  ever becomes negative?' The first time when this happens is termed the time of ruin and the associated probability is the probability of ruin. Ruin is considered as a technical

term. It does not mean that the company is bankrupt. However, if ruin occurs, it is interpreted as meaning that the company has to take action in order to make the business profitable.

The Cramér-Lundberg model serves as a skeleton for more realistic models that have been studied in the insurance literature. This standard model for nonlife insurance is simple enough to calculate probabilities of interest, but too simple to be realistic. For example, it does not include interest earned on the invested surplus. There are several papers treating this model in many directions and forms, all with a view of finding the probability of ruin. By far the majority of these papers are concentrated on the analytical aspects of the problem but there is also a quite considerable number that deal with numerical methods to calculate this probability. More on the history of this problem can be traced from Segerdahl<sup>[4,5]</sup>, Andersen<sup>[6]</sup>, Davidson<sup>[7]</sup>, Thorin<sup>[8]</sup>, Wikstad<sup>[9]</sup>, Gerber<sup>[10]</sup>, Harrison<sup>[11]</sup>, De Vylder<sup>[12]</sup>. For a general background to ruin theory, we refer to Bühlmann<sup>[13]</sup>. In this study, we shall be concerned with ruin under interest force and our emphasis will be on numerical methods.

### THE MODEL AND THEORETICAL RESULTS

All processes and random variables are assumed to be defined on the stochastic basis  $(\Omega, \mathcal{F}, \{f_t\}_{t \in \mathcal{R}^+}, P)$  satisfying the usual conditions, i.e.  $f_t$  is right continuous and  $P$ -complete. Here,  $\Omega$  is an abstract sample space whose elements are denoted as  $\omega$ ;  $\mathcal{F}$  is a  $\sigma$ -algebra on  $\Omega$ ;  $P$  is a probability measure and  $\{f_t\}_{t \in \mathcal{R}^+}$  is a filtration. A filtration means an increasing and right continuous family of sub  $\sigma$ -

# Nanofluid Boundary Layer Analysis in the Presence of Magnetic Lines of Force Being Fixed Relatively to the Plate and the Water-based Nanofluid Containing Copper, Aluminum Trioxide, and Silicon Dioxide Nanoparticles

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**Abstract:** An exact solution to the problem of effects of generation or absorption and natural convective magnetic nanofluid flow past an upright plate, in a case where the magnetic lines are aligned to the plate or the fluid magnetic lines are being associated with liquid (i.e.,  $K=0$ ) and these magnetic force of flux being associate with the plate (i.e.,  $K=1$ ) are investigated. Three types of water-heat transfer-based nanofluids containing copper, aluminum oxide, and titanium dioxide are taken. The dimensionless governing equations involved in the present analysis are tackled with the help of integral transforms. For plotting figures and tables, numerical values are computed for Nanofluid velocity, temperature, heat, and mass flow rates near the adjacent plate boundary.

**Keywords:** exact solution; magnetic nanofluid; natural convective heat transfer; heat transmission rate; boundary layer of the ionosphere.

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## 1. Introduction

The study of heat transfer has attracted many researchers and Gained remarkable attention in the modern era—several engineering processes like transmission of energy in coolant desert towers in water body's surface evaporations. Few applications can be found in manufacturing industries, such as in the electric and power generation industries. One application can be used to generate electricity by extracting power from the motion of the conductive liquid. In moving liquids, the study involves heat generation or absorption, which is most significant in dissociated chemically reacting fluids. The impact of the heat source may change the energy distribution so that further it leads to nuclear reactor particle decomposition, computer chips, and in preparation of semiconductor materials, viz., silicon crystalline used in engineering fabrication of IC circuits, liquid type solar cells, and conventional photo-voltaic. Since few liquids and gases in nature tend to absorb and emit radiation, the fluid temperature distribution and heat flow rate is essential in the presence of a magnetic field because the heat transmission by linear radiation attains a greater impact in concern of some space engineering and higher order temperature applications.

Hence, heat transfer by thermal radiation is becoming of greater importance when we are concerned with space applications and higher operating temperatures. Nanofluids are



## A Note on the Symmetric Hit Problem

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**Abstract.** The symmetric hit problem was introduced for the first time by the author in his thesis ([5]). The aim of this paper is to solve an important open problem posed in ([7]), in a special case, which is one of the fundamental results in the studies of the symmetric hit problem.

**Keywords and Phrases:** Steenrod algebra, hit problem, symmetric hit problem.

### 1. Introduction

In this article we shall confine our attention to symmetric polynomial algebra  $\mathbf{B}(n) = \mathbf{P}(n)^{\Sigma_n}$  over the field of two elements, where  $\mathbf{P}(n) = \mathbb{F}_2[x_1, \dots, x_n]$  is the polynomial algebra in  $n$  variables and  $\Sigma_n$  is the symmetric group on  $n$  letters acting on the right of  $\mathbf{P}(n)$  by matrix substitution ([23]). The Steenrod algebra  $\mathcal{A}$  acts on the left of  $\mathbf{P}(n)$  and commutes with the action of  $\Sigma_n$ . In particular,  $\mathbf{B}(n)$  is a graded  $\mathcal{A}$ -submodule of the left  $\mathcal{A}$ -module  $\mathbf{P}(n)$ . The grading on  $\mathbf{P}(n)$  is by degree of homogeneous polynomials, where the variables  $x_i$  are in degree 1.

The algebra  $\mathbf{P}(n)$  and subalgebra  $\mathbf{B}(n)$  of  $\mathbf{P}(n)$  realize respectively the cohomology of the product of  $n$  copies of infinite real projective space and the cohomology of the classifying space  $BO(n)$  of the orthogonal group  $O(n)$ . Each element of the algebra  $\mathbf{B}(n) = \mathbb{F}_2[\sigma_1, \dots, \sigma_n]$  is a polynomial in the elementary symmetric functions  $\sigma_i$ . The ideal  $\mathbf{L}(n)$  in  $\mathbf{P}(n)$  generated by  $\sigma_n = x_1 \cdots x_n$  can be identified with the cohomology

# Linear and Directional Domains with Probability Distributions

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**Abstract:** The usual domains for Cauchy distributions have been straight lines and unit circles. These domains are closed under arbitrary changes in location and scale, whether done sequentially or simultaneously. Such closure properties have been extended to spherical Cauchy distributions. Higher dimensional Cauchy-based domains are created herein for unit hyperspheres and sets of straight lines of arbitrary dimension, and their Cauchy-like properties are determined and described. Cauchy distributions on these extended domains are shown to be closed under arbitrary transformations of location and scale, done singly or sequentially, but not generally closed when location and scale changes are done simultaneously. Stereographic projections are used to map the curved, finite surface of any hypersphere to a linear, infinite space of the same dimension as that of the hyperspherical surface. These mappings are one-one and onto, with no loss of information. These results show promise for uniting linear and directional mixtures of observations into a common domain—linear or directional.

**Keywords:** Euclidean space, Fisher-von Mises distribution, Generalized stereographic projection, Hyperspheres, Image analysis, Möbius mapping, Pattern recognition.

## 1. INTRODUCTION

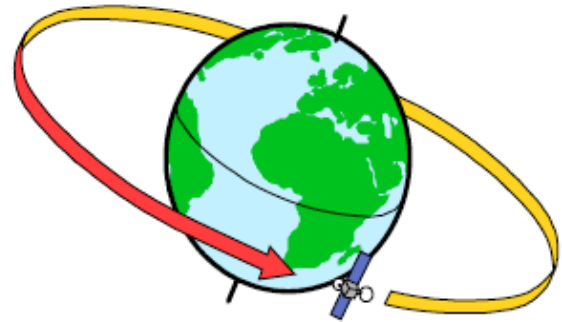
Let  $x_1 \dots x_n$  be a rectangular coordinate system for an *extended* Euclidean space  $E_n$  ( $n$ -space, for short). The "extended" feature means that the  $n$ -space has appended to it the single improper point  $\infty$ . That is,  $-\infty < x_j \leq \infty$  for  $j = 1 \dots n$ . This results, as will be seen, in the ability to transform directional data back and forth between curved and linear spaces with the same dimensionality with no loss of information, via generalized stereographic projection.

Row vectors are used for brevity:  $0 = (0 \dots 0)$  is the  $n$ -vector origin in  $E_n$  and  $x = (x_1 \dots x_n)$  is a typical point of  $E_n$ . The equation  $(x-c)(x-c)^T = r^2$  defines a hypersphere  $E_n$  with center  $c = (c_1 \dots c_n)$  and radius  $r$ .

Our focus is on unit hyperspheres, where  $c = 0$  and  $r = |x| = 1$ . Our aim is to create and describe families of Cauchy-based distributions on linear and spherical surfaces of arbitrary dimension.

Hyperspheres are classified by the dimensionality,  $m$ , of their surfaces. A circle  $C$  has  $m = 1$  but, as a courtesy, it is called a 1-sphere or  $S_1$ . An ordinary sphere with 2-dimensional surface area is a 2-sphere or  $S_2$  with  $m = 2$ , and a hypersphere with generic  $m$ -dimensional surface content is an  $m$ -sphere  $S$  or  $S_m$ .

An  $m$ -sphere needs at least  $m+1$  dimensions to properly display itself and to provide the additional dimension needed for rectangular coordinates (Fig. 1). So, we put  $n = m + 1$ , and let  $n$  vary as  $m$  varies at will. Dimension  $n$  is not to be confused with the non-italicized north pole  $n$  of a sphere or hypersphere.



**Fig. (1).** Satellite orbiting a 2-sphere  $S_2$  in  $E_3$ . A sensor at the center of  $S_2$  can record the spatial direction to the satellite or to any other detectable object in 3-space by the rectangular or spherical coordinates of the point where the "line of sight" from the center of the sphere to the center of the satellite intersects  $S_2$ . Directions in  $n$ -space may be recorded as the coordinates of points on an  $m$ -sphere  $S_m$  in  $n$ -space ( $n = m+1$ ). If the sphere were a 1-sphere  $S_1$  in  $E_3$  instead of a 2-sphere the universe of detectable objects would be limited to those in the plane of  $S_1$ .

The default notation for a circle is  $C$  or  $S_1$ , that for a  $d$ -sphere is  $S_d$  when  $d$  is not  $m$ , and that for an  $m$ -sphere is  $S$  or  $S_m$ .

Geographic terminology is used: to refer to the various hemispheres; to the equator and its equatorial  $m$ -space  $E_m$ ; to the north and south poles  $n = (10 \dots 0)$  and  $s = -n$ ; to the vertical polar axis through the poles and coincident with the  $x_1$ -axis; to colatitude  $\theta$  (the angular deviation of a point  $x$  on an  $m$ -sphere from a special fixed point on the  $m$ -sphere); to the *polar* circles passing through the poles  $n$  and  $s$ , and their horizontal centerlines  $L$  passing through the origin.

The default notation for a single centerline is  $L$  or  $L_1$ , that for a  $d$ -space of centerlines is  $L_d$  when  $d$  is not  $m$ , while that for an  $m$ -space of centerlines is  $L$  or  $L_m$ . This  $m$ -space is a subspace of  $E_n$ , and is therefore itself an extended  $E_m$ .

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# Diameter and Traversability of PAN Critical Graphs

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**ABSTRACT:** A pseudo-complete coloring of a graph  $G$  is an assignment of colors to the vertices of  $G$  such that for any two distinct colors, there exist adjacent vertices having those colors. The maximum number of colors used in a pseudo-complete coloring of  $G$  is called the pseudo-achromatic number of  $G$  and is denoted by  $\psi_s(G)$ . A graph  $G$  is called edge critical if  $\psi_s(G - e) < \psi_s(G)$  for any edge  $e$  of  $G$ . A graph  $G$  is called vertex critical if  $\psi_s(G - v) < \psi_s(G)$  for every vertex  $v$  of  $G$ . These graphs are generally called as pseudo-achromatic number critical graphs (shortly as PAN Critical graphs). In this paper, we investigate the properties of these critical graphs.

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**AMS subject classification number:** 05C70, 05C05

**Keywords:** Pseudo-complete coloring, Pseudo-achromatic number,  $k$ -edge critical graph,  $k$ -vertex critical graph.

## 1. Introduction

By a graph we mean a finite undirected graph without loops, multiple edges and isolated vertices.

An assignment of colors to the vertices of a graph  $G = (V, E)$  is called a *proper coloring*, if any two adjacent vertices receive distinct colors and is called a *pseudo-complete coloring* if for any two distinct colors, there exist adjacent vertices having those colors. A pseudo-complete proper coloring of  $G$  is called a *complete coloring* of  $G$ .

The minimum number of colors used in a proper coloring of  $G$  is called the *chromatic number* of  $G$  and is denoted by  $\chi(G)$ . The maximum number of colors used in a complete coloring of  $G$  is called the *achromatic number* of  $G$  and is denoted by  $\psi(G)$  [6]. The maximum number of colors used in a pseudo-complete coloring of  $G$  is called the *achromatic number* of  $G$  and is denoted by  $\psi_s(G)$  [4]. Several bounds for these coloring parameters were obtained in [4, 5, 6, 7]. A graph which admits a pseudo-complete coloring by  $k$  colors is called a  *$k$ -pseudo complete colorable graph*.

The concept of critical graphs with respect to chromatic number, was introduced by Dirac [2, 3] in a bid to settle the four color conjecture. In [1], Sureshkumar introduced the concepts of criticality in graphs with respect to pseudo-achromatic number and obtained

characterizations of edge critical graphs, critical cycles and critical paths. In this paper, we further investigate the properties of these critical graphs such as degrees, degree sequences, diameter and traversability.

## 2. PAN Critical Graphs

The graphs which are critical with respect to Pseudo-achromatic number are generally called as PAN-critical graphs. Formal definitions are as follows:

**Definition 2.1.** A graph  $G$  is called  $k$ -edge critical if  $\psi_s(G) = k$  and  $\psi_s(G - e) < k$  for any edge  $e$  of  $G$ . A graph  $G$  is called  $k$ -vertex critical if  $\psi_s(G) = k$  and  $\psi_s(G - v) < k$  for any vertex  $v$  of  $G$ .

**Definition 2.2.** Let  $G$  be a graph and  $v \in V(G)$  be a vertex of degree  $d$ . Let  $n$  be a positive integer less than  $d$ . Then an  $n$ -splitting of  $v$  is the replacement of  $v$  by a set of  $n$  new pairwise independent vertices  $\{u_i\}_{i=1}^n$  with  $\deg u_i > 1$ , for all  $i$ ,  $1 < i < n$ ,  $\sum_{i=1}^n \deg(u_i) = d$  and  $N(\{u_i\}_{i=1}^n) = N(v)$ , where for any subset  $S$  of  $V(G)$ ,  $N(S)$  means the set of all neighbors of vertices in  $S$ .

The following simple observations, which are quite useful later, follow directly from the definitions of critical graphs.

**Proposition 2.3.** A graph  $G$  is  $k$ -edge critical if and only if  $G$  is  $k$ -pseudo-complete colorable and  $|E(G)| = \binom{n}{2}$

**Proposition 2.4.** Any  $k$ -edge critical graph is  $k$ -vertex critical.

**Proposition 2.5.** If  $G$  is a  $k$ -edge critical graph and  $H$  is the graph obtained from  $G$  by  $n$ -splitting a vertex of  $G$ . Then  $H$  is  $k$ -edge critical.

**Proposition 2.6.** Let  $G$  be a  $k$ -edge critical graph and  $H$  be the graph obtained from  $G$  by identifying a pair of vertices, having same color with respect to a  $k$ -pseudo-complete coloring of  $G$ . Then  $H$  is  $k$ -edge critical.

**Proposition 2.7.** If  $G$  is  $k$ -edge critical, then  $G + K_n$ , is  $(n+k)$ -vertex critical

**Proposition 2.8.** Let  $k$  be an odd integer.

Then, the cycle of order  $\binom{k}{2}$  is  $k$ -edge critical.

## 3. Diameter and Traversability

**Theorem 3.1.** Let  $G$  be a  $k$ -edge critical graph with  $G \neq K_k$ ,  $k \geq 3$ . Then,  $3 \leq d(G) \leq \binom{k}{2}$  and when  $k$  is even,  $3 \leq d(G) \leq \binom{k}{2} -$

## solving multiplicative discrete and continuous ordinary differential equations

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**Abstract** In this paper, at first the elementary and basic concepts of multiplicative discrete and continuous differentiation and integration are introduced. Then for these kinds of differentiation invariant functions, the general solution of discrete and continuous multiplicative differential equations will be given. Finally a vast class of difference equations with variable coefficients and nonlinear difference and differential equations are investigated and solved by making use of multiplicative difference and differential equations.

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**Keywords.** Multiplicative Continuous calculus, Invariant Functions, Multiplicative Discrete calculus.

### 1. INTRODUCTION

The classical calculus (or Newtonian calculus) was introduced in the 17th century by Isaac Newton and Gottfried Leibniz. This calculus, sometimes called differential and integral calculus, and its beautiful result (differential equations) could solve many problems in physics and engineering. Therefore the 18th century was called the utilization century for Newtonian calculus [7, 13, 15]. As regards that the classical calculus provides very useful and important tools for modeling and solving many physical and engineering problems, but there are several problems in physics and natural phenomena needed to be solved by a different kind of calculus for modeling and solving these problems. Discrete additive and multiplicative calculus were introduced by many mathematicians. In order to get more details, see [4, 13, 15]. In 1978, Jane Grossman, Michael Grossman and Robert Katz introduced a new calculus which is called Non-Newtonian calculus or geometric and bigeometric calculus, see [9, 10, 11, 12]. Afterward, this calculus was named as multiplicative continuous calculus. In recent years, many mathematicians have used this calculus for introducing new kinds of derivative and integration operators. Consequently, new kinds of differential equations were