AEM19

12th November ~ 15th November; 2019

NATIONAL CONFERENCE

ON

Applied Engineering Mathematics

CONFERENCE PROCEEDING

NIT, Bhubaneswar

Nalanda Institute of Technology, Bhubaneswar

Organized by

Department of Basic Science & Humanities

Nalanda Institute of Technology

Bhubaneswar - 752050

Applied Engineering Mathematics

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ABOUT THE CONFERENCE

Science and technology has continuously evolved through decades. AEM- 2019 was organized in Nov – 2019 and was successful in capturing the development of technology in applied mathematics, applied chemistry and applied physics. Department of Basic Science & Humanities, NIT, Bhubaneswar is organizing AEM- 2019 to showcase recent advances in materials processing and applications. In keeping up with the research interest of the materials community, AEM- 2019 will provide an update on scientific and technical aspects covering broad areas of interests in applied engineering.

ABOUT THE DEPARTMENT

The Department of Department of Basic Science & Humanities has been in existence since 2007 with the inception of the college and is producing high quality technical manpower needed by industry, R&D organizations, and academic institutions. The Department has full fledged faculty members who are specialized in the fields of physics, chemistry and mathematics. Laboratories are fully equipped to enhance the knowledge of the student, periodic industry trips and visits to various project sites are arranged. Special lectures and seminars are held on a frequent basis to assist them tailor in their particular areas of interest and trying hard to transform students of even mild talent to professionals. Already more than 700nos of alumni have been produced so far, placed in different Government, private, Public & other sectors and some of them have pursued higher studies. However, with the progress of time, many more frontier areas of physics chemistry and mathematics have been taken up for active research.

ABOUT THE INSTITUTE

Established in the year 2007, Nalanda Institute of Technology (NIT) is one of the premier engineering colleges in the self-financing category of Engineering education in eastern India. It is situated at temple city Bhubaneswar, Odisha and is a constituent member of Nalanda Educational Trust. This reputed engineering college is accredited by NAAC, UGC and is affiliated to BPUT, Odisha. NIT aims to create disciplined and trained young citizens in the field of engineering and technology for holistic and national growth.

The college is committed towards enabling secure employment for its students at the end of their four year engineering degree course. The academic fraternity of NIT is a unique blend of faculty with industry and academic experience. This group of facilitators works with a purpose of importing quality education in the field of technical education to the aspiring students. Affordable fee structure along with approachable location in the smart city of Bhubaneswar makes it a preferred destination for aspiring students and parents.

The Institute works with a mission to expand human knowledge beneficial to society through inclusive education, integrated with application and research. It strives to investigate on the challenging basic problems faced by Science and Technology in an Inter disciplinary atmosphere and urges to educate its students to reach their destination, making them come up qualitatively and creatively and to contribute fruitfully. This is not only its objective but also the ultimate path to move on with truth and brilliance towards success.

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VICE CHAIRMAN MESSAGE

On behalf of the Organizing Committee, it is my great pleasure to welcome you to National Conference on Applied Engineering Mathematics (AEM- 2019). In our endeavour to raise the standards of discourse, we continue to remain aware in order to meet with the changing needs of our stakeholders. The idea tohost the AEM-2019 is to bring together Researchers, Scientists, Engineers, Scholars and Students in the areas of Basic Science And Humanities. The AEM- 2019 Conference will foster discussions and hopes to inspire participants from a wide array of themes to initiate Research and Development andcollaborations within and across disciplines for the advancement of Technology. The conference aims to bring together innovative academic experts, researchers and Faculty in Engineering and Management to provide a platform to acquaint and share new ideas. The various thematic sessions will showcase important technological advances and highlight their significance and challenges in a worldof fast changes. I welcome all of you to attend the plenary sessions and invite you to interact with the conference participants. The Conference Committees will make any possible effort to make sure that your participation will be technically rewarding and a pleasurable experience.

I am looking forward to meeting you in during AEM- 2019 and to sharing a most pleasant, interesting and fruitful conference.

With regards,

Prof. Malaya Kumar Padhi
Vice. Chairman
Nalanda Institute of Technology, Chandaka
Bhubaneswar, Odisha

PRINCIPAL'S MESSAGE

It gives me great pleasure to welcome you to the National Conference on "Applied Engineering Mathematics " (AEM- 2019), which will take place from November 12-15, 2019.

This conference's goal is to spread knowledge among other educated people in addition to discussing current, hot topics in a certain field. Dramatic advancements have been made in engineering and technology over the years. I am hoping that AEM- 2019 will turn out to be the most beneficial national conference devoted to showcasing the newest developments in engineering and technology.

We have asked eminent specialists to participate in the Technical Programs in order to give an exceptional technical level for the conference presentations. Technical seminars and keynote plenary sessions will be held.
I hope AEM- 2019 will make you aware of state-of-the art systems and provide a platform to discuss various emerging technologies in Basic Science And Humanities.

With regards,
Prof. (Dr.) Niranjan Sutar
Principal
Nalanda Institute of Technology,
Chandaka Bhubaneswar, Odisha

CONVENER'S MESSAGE

National Conference on "Applied Engineering Mathematics " (AEM- 2019) is a prestigious event jointly organized by Basic Science And Humanities Department with a motivation to share a progress in recent technologies. The objective of AEM- 2019 is to present the latest research and results of scientists (preferred under graduate and post graduate students, research scholars, post-doc scientists, academicians and working professionals) related to the subjects Basic Science And Humanities. The conference will provide with paper presentations and research paper presentation by prominent speakers who will focus on related state-of-the-art technologies in the areas of the conference.

I wish all the success to the conference AEM- 2019.

With regards,
Prof Bipin Bihari Bhoi

Professor and HOD

Basic Science And Humanities

Nalanda Institute of Technology,
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Contents

Target Aggregation Regression based on Random Forests

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Abstract

Due to the high expense of label collecting and privacy protection policies, the proportion of unlabeled data is expanding as the big data era's data volume grows explosively. As a result, weakly labelled learning has received a lot of attention in the quest to find patterns in real-world data. An new technique in recent years is learning with target aggregation. To our knowledge, no one has ever discussed the target aggregation regression issue. In this study, random forest is used to create regression models for data with aggregate targets. The experiment demonstrates the proposed model's positive outcome.

Keywords: Learning with label aggregation, Weakly labeled learning, Random forests

1. Introduction

As the development of the Internet and mobile devices, the data volume has enjoyed dramatic growth, providing a wide range of information for various fields. In order to make the best use of data, researchers have endeavored to improve the speed and accuracy of machine learning models. However, because of the automatic data collection process and privacy protection policy, the labels for instances cannot be provided in satisfactory quantity and quality.

The lack of instance label makes it unsuitable to utilize supervised learning techniques directly, and raises much attention for weakly labeled learning. Take the presidential election in the United States as an example, the presidential election in the United States usually requires voters from each state to vote for two candidates. For a specific candidate, these voters can be divided into two categories: the first category is the people who will support the candidate no matter what he does, and the second category is the people who decide whether to vote for the candidate according to the policy after he takes office. Due to time and budget constraints, it is very important for candidates to distinguish the second category of supporters. Although the historical election didn’t show the specific voting results of each person, we know the support ratio of different regions for

Benthic Habitat Mapping Using Adaptive Spatial Designs That Reduce The Integrated Bernoulli Variance In Spatial Logistic Regression Models

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ABSTRACT

Monitoring, comprehending, and describing environmental phenomena functioning over a vast spatial area requires the development of effective spatial sample designs. There are many different types of devices that can perform useful sampling in different ways, and time and computational constraints need also be taken into account. Although in-situ sampling is frequently correct, it is typically quite sparse in the enormous spatial areas taken into account for mapping, necessitating the careful creation of experimental sample schemes. The presentation of a mapping criterion for variables with spatial presence-absence. In order to investigate areas where there is greater ambiguity regarding the binary outcomes, the predicted integrated Bernoulli variance criterion is applied. This method creates approximative closed form expressions for the expected integrated Bernoulli variance using a hierarchical Bayesian logistic regression model for the binary variable. For a variety of designs, the approximations can be computed quickly. In the context of sequential spatial exploration with constrained computational resources and operational time, the expressions are expanded to find adaptable architectures. In simulation research, the arduous Monte Carlo sampling techniques are contrasted with approximations. It is demonstrated that for a large geographic grid, approximations are reliable and effective. The presentation of a benthic habitat mapping application. It uses an Australian coral dataset to illustrate the suggested sampling design strategy.

Keywords*:* Adaptive sampling Spatial design ,Integrated Bernoulli variance Spatial GLM ,Underwater robotics Habitat mapping.

An investigation of the big data ethics of aspiring mathematics teachers with a focus on data access

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ABSTRACT

Big Data analysis applications are changing society. New efforts should be made in mathematics education to teach the new technology and to provide a critical and ethical understanding of its consequences in light of the creative ways that mathematics is used in society. This interview study explores the ethical considerations of pre-service teachers in data science environments, concentrating on issues related to access to the data that underpin the technology. Results demonstrate that pre-service teachers present a wide range of ethical justifications for data access that guide their efforts to think critically about oppressive circumstances. Yet, there is also evidence that their ability to reason may be constrained by a lack of knowledge of the relevant data science approach, suggesting that more of this should be covered in mathematics teacher preparation.

Keywords*:*
Teacher education Ethics, Big data analysis, Critical thinking, Social sustainability
Access to data

What is the Mathematics in Mathematics Education?

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ABSTRACT

What is the mathematics in mathematics education? is the question I address in this essay. By giving the word "mathematics" three different frames. Frame 1: The organising of mathematics into systems and structures as well as a collection of ways for drawing conclusions. Mathematics as an abstract body of information and concepts. Frame 2: Mathematics as a contextual, pervasive lens or language to interpret the world. Frame 3: Mathematics as a human activity, a verb, and a component of one's identity. I describe the implications of the frames in relation to a student-centered classroom, environment, and culture after introducing them and looking at how they differ from one another and where they coincide..

Introduction

In this paper I tackle the question of *What is the mathematics in mathematics education?* This question is motivated by discussions I found myself having with other mathematics educators. Typically, in these discussions we struggled to clearly communicate how we defined mathematics to each other. Yet, how we define mathematics determines what we might include/exclude in various contexts. One such example is this special issue in the *Journal of Mathematical Behavior: Mathematics In Society: Exploring The Mathematics That Underpins Social Issue.* We co-editors of *this* special issue struggled sometimes to define what we meant by mathematics to each other. However, what we meant by mathematics was one of the key factors underlying the decisions for inclusion/exclusion in this special issue.

I contextualize the question in an ongoing debate in the field of mathematics education. I follow this with first positioning myself and then introducing the construct of frames to distinguish different meanings for the same word. Then, I introduce three frames for the word mathematics, examine their distinction and their overlap, illustrate the frames with an example, and discuss the implications of each frame on student-centered instruction. I close by examining communication across frames.

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Second-best probability weighting

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ABSTRACT

Prospect theory and other descriptive theories of choice under risk include non-linear probability weighting as a fundamental component. But why do these concrete information processing mistakes exist? Should we try to educate people to avoid the error of overestimating tiny probability and underestimating large ones? In this article, we contend that probability weighting can be viewed as compensating for biases that may already exist when evaluating payoffs. The reverse of S-shaped payoff valuation is known as inverse S-shaped probability weighting. So, probability distortions might have persisted as the second-best answer to a fitness maximisation problem, and it might be harmful to rectify them while maintaining the same value function

Keywords:
Probability weighting Prospect theory Evolution of preferences

Introduction

Prospect theory (Kahneman and Tversky, 1979; Tversky and Kahneman, 1992) is one of the most successful descriptive theories for choice under risk. It rests on two main building blocks for the evaluation of lotteries: an adaptive value function, which captures both loss aversion and different risk attitudes across the domains of gains and losses, and a probability weighting function, which captures systematic distortions in the way probabilities are perceived. Of these ingredients, the probability distortions are particularly remarkable, as they reflect objective errors in information processing: overweighting of small and underweighting of large probabilities, relative to their true magnitudes. The existence of such objective errors gives rise to puzzling questions. For instance, should we help individuals make better decisions by trying to correct their mistakes? Some scholars have argued that this is indeed the case.[1] Also, why do these errors exist in the first place? Evolutionary arguments typically predict that individuals who make systematic mistakes do not survive because they are replaced by more rational types.[2]

Creating A Common Language For Technology Adoption Across The Supply Chain Through Artificial Intelligence And Ethics In The Food Sector

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ABSTRACT

Background: In food supply chains, artificial intelligence (AI) usage is expanding. The context and framing provided by stakeholders contextualises and frames the ethical language associated with food supply and technology. A barrier to technology adoption and a reduction in the value obtained can result from a failure to distinguish between these subtle meanings..

Scope and approach: This review paper's objective is to take into account the embedded ethical language used by stakeholders that work together to implement AI in the food supply chain. This research review is framed by ethical considerations, which also offer a framework for thinking about how to create a dialogue that fosters user and societal benefit when utilising AI in food supply chains..

Key findings and conclusions: Although the nature of data in the food system is much more varied than the personal information covered by the General Data Protection Regulation (GDPR) of the European Union, the ethical concerns for computational and AI systems are comparable and can be thought of in terms of specific aspects, such as transparency, traceability, explainability, interpretability, accessibility, accountability, and responsibility. The results of this research help to provide a more complete understanding of the language used, explore the ethical interactions of aspects of artificial intelligence (AI) used in food supply chains, and identify management activities and actions that can be taken to enhance the applicability of AI technology, foster engagement, and achieve greater performance.

Keywords:

Responsibility ,Accessibility, EXplainability, Accountability, Interoperability ,Artificial intelligence.

Complex equipment system resilience: Composition, measurement and element analysis

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ABSTRACT

This study examines the resilience makeup of sophisticated equipment systems. Three aspects of resilience—structure resilience, resource resilience, and strategy resilience—are examined by taking into account the system as a whole, resources, and the human factor. Structure resilience analyses how subsystems and their interactions affect resilience. Consumable and non-consumable resources are distinguished in resource resilience, and their effects on system resilience are examined in turn
In strategy resilience, the nature of strategy resilience in the resilience process is explored as well as how people affect system resilience. Using the information from the aforementioned research, the three system resilience components are further broken down into five distinct aspects that contribute to system resilience. Then, a more accurate resilience measurement technique for sophisticated equipment systems is presented. The five components of resilience are examined and researched in simulation, correspondingly. This study can provide a deeper understanding of the three elements of system resilience through simulation and thorough examination.

Keywords*:*
Resilience Complex system Structure resilience, Resource resilience Strategy, resilience Resilience composition.

Impact of quarantine on sleep quality and psychological status inCOVID-19 suspected cases in Riyadh, Saudi Arabia

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ABSTRACT

The aim of this study was to examine the effects of stress, anxiety, and depression as well as the quality of sleep in suspected COVID-19 quarantined cases.

The probable COVID-19 cases in quarantine facilities were the focus of this cross-sectional study, which employed an online survey as a method. The individuals' sociodemographic characteristics, sleep patterns, and mental health status were all the subject of data collection. Measures of the psychological impact and mental health status included depression, anxiety, the stress scale, and the Pittsburgh Sleep Quality Index.

Results: Among the 362 respondents, 148 were between the ages of 26 and 35, and 234 (64.6%) of them were men. 65% of study participants were found to regularly have poor sleep. The proportions of people reportingConclusion: Approximately-one-third of quarantine COVID-19 patients had poor sleep quality with mild-moderate depression. Both anxiety and stress scales were prevalent in nearly half of the studied samples.

Keywords:

COVID-19 , Psychological status Quarantine, Saudi Arabia Sleep quality.

Number Pattern Generalisation Techniques Utilised In Algebra By Future Basic Math Teachers

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Abstract

This study examines the algebraic generalisation techniques used by 147 aspiring basic math teachers. Five open-ended linear and non-linear (quadratic) pattern problems requiring the general term of number patterns were presented to pre-service instructors. The generalisation techniques and application of mathematical models by pre-service teachers were examined. Our study showed that pre-service instructors employed visual models carelessly and explained number pattern principles in terms of disparities between words.

Keywords: Number patterns; mathematics teacher education, generalisation strategies.

1. Introduction

Research on generalization of patterns drew interest over the past decade. This interest emerges from the idea that the structure of mathematics can be observed by searching for patterns and relationships (Hargreaves, Threlfall, Frobisher & Shorrocks-Taylor, 1999). Learning about patterns is crucial for the transition from arithmetic to algebra since it requires making verbal and symbolic generalizations (English & Warren, 1998). The algebraic generalization of a pattern is also important because, according to Radford (2006), "it serves as a warrant to build expressions of elements of the sequence that remains beyond the perceptual field (p. 5)." Numerous studies have been conducted which examined students' strategies of finding rules of number patterns (e.g. Hargreaves et. al; Stacey, 1989). Pre-service teachers' understanding of number patterns has received less attention from the research community. In an attempt to contribute to this growing literature, this study investigates algebraic generalisation strategies of pre-service elementary mathematics teachers.

Lannin, Barker & Townsend's (2006) generalization strategy framework was used in our investigation. Lannin, Barker & Townsend (2006) assembled previous research on generalization strategies and developed 'generalization strategies framework'. Four strategies are defined in this framework, namely; explicit, whole-object, chunking and recursive which were explained below:

- Explicit: A rule is constructed that allows for immediate calculation of any output value given a particular input value
- Whole-Object: Portion is used as a unit to construct a larger unit using multiples of the unit
- Chunking: Recursive pattern is built on by building a unit onto known values of the desired attribute
- Recursive: Relationship is described that occurs in the situation between consecutive values .

An fMRI study comparing mathematicians and non-mathematicians found that naive and scientific theories in mathematics and science can interfere with one another

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ABSTRACT

Background: Conceptual interference is one of the most common learning challenges in mathematics. The majority of conceptual interference research has, however, been on science. In this functional magnetic resonance imaging (fMRI) study, we investigated the moderating effects of mathematical expertise as well as the conceptual interference effects in both mathematics and science.

Methods: A speeded reasoning assignment using assertions from mathematics and science was performed by thirty adult mathematicians and 31 non-mathematicians who were matched for gender, age, and intelligence. Statements could be truthful or incorrect in accordance with both naive and scientific conceptions, or they could be incongruent (differed in their truth value).

Findings: In the science and math challenge, both groups made more mistakes and took longer to respond when evaluating incongruent versus congruent statements, but mathematicians were less impacted by naive beliefs. Inhibiting naive hypotheses in mathematics activated the left dorsolateral prefrontal cortex, whereas in science it activated both the dorsolateral and ventrolateral prefrontal cortex bilaterally. The brain level conceptual interference effect was unaffected by mathematical proficiency.

Keywords:
Conceptual knowledge Conceptual interference Mathematical expertise Inhibition

Attitudes About Mathematics, Success, And Plans To Drop Out Among Norwegian STEM And Non-STEM Students

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ABSTRACT

In many fields, having strong mathematical skills is essential. In the current study, we looked into the relationships between students' high school math preparation, their current study regimen, and various outcomes linked to mathematics. We anticipated that students who had taken advanced mathematics courses in high school would have more favourable views towards the subject and perform better in math-related topics in college than those who had taken basic mathematics courses. We anticipated that there would be a similar distinction between STEM and non-STEM students. Additionally, we anticipated that students' grades in courses linked to mathematics would be predicted by their mathematical self-efficacy but not by their overall study efficacy. Finally, we looked at whether students' intentions to drop out of school varied across STEM and non-STEM students and whether general study efficacy and mathematics self-efficacy had any bearing on these intentions. After adjusting for GPA and general study efficacy, data from a cross-sectional online survey of 264 Norwegian university students revealed that high-school mathematics background is related to all aspects of students' attitudes towards mathematics, whereas their current field of study is only related to the subjective value of mathematics. As anticipated, grades in courses relating to mathematics were predicted by mathematical self-efficacy but not by general study efficacy. Finally, drop-out intentions were correlated with overall study efficacy and did not significantly differ across STEM and non-STEM students.

Keywords:

Higher education Mathematics Attitudes, Self-efficacy ,Drop-out intentions.

Solving Linear Programming Problems with the Simplex Method

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Abstract: The simplex method is a powerful algorithm used to solve linear programming problems. In this paper, we provide an overview of the simplex method and its application to solving linear programming problems. We present the basic steps of the simplex method, including how to convert a linear programming problem into standard form and how to apply the simplex method to find an optimal solution. We also discuss the different types of linear programming problems that can be solved using the simplex method, including problems with multiple constraints and non-negative variables. Finally, we provide an example to illustrate the application of the simplex method to solve a linear programming problem.

Introduction: Linear programming is a mathematical technique used to optimize a linear objective function subject to linear constraints. The simplex method is one of the most widely used algorithms for solving linear programming problems. The simplex method was developed by George Dantzig in the 1940s and has since become a cornerstone of Operations Research and other fields.

Overview of the Simplex Method: The simplex method works by moving from one feasible solution to another until an optimal solution is found. The simplex method operates on linear programming problems that are in standard form, meaning that the objective function is to be minimized and all constraints are expressed as linear equations with non-negative variables. The basic steps of the simplex method include:

- Convert the linear programming problem into standard form.
- Identify the initial basic feasible solution.
- Find an adjacent basic feasible solution with a better objective function value.
- Repeat until an optimal solution is found.

Applications of the Simplex Method: The simplex method can be used to solve a wide variety of linear programming problems, including problems with multiple constraints and non-negative variables. Some of the most common applications of the simplex method include:

- Resource allocation problems, such as determining the optimal mix of products to manufacture.
- Transportation and distribution problems, such as finding the optimal way to transport goods from one location to another.
- Financial planning problems, such as portfolio optimization.

Example: To illustrate the application of the simplex method, consider the following linear programming problem:

Maximize Z = 3x1 + 2x2 Subject to: x1 + x2 ≤ 4 2x1 + x2 ≤ 5 x1, x2 ≥ 0

First, we convert the problem into standard form by introducing slack variables:

Atomic structure of silicene nanoribbons on Ag(110)

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Abstract. Silicon nanoribbon (NR) growth on Ag(110) substrate is reinvestigated using scanning tunneling microscopy (STM) and low energy electron diffraction (LEED). Deposition of a single silicon monolayer at 230 ◦ C results in the formation of one-dimensional 1.6 nm wide silicon nanoribbons into a well-ordered compact array with a nanometer scale of only 2 nm. Based on STM analysis, we obtained an atomic model of silicon nanoribbons (NRs) in which they are essentially twisted, and the quantum confinement of electrons in NRs contributes to the electron density of states.

1. Introduction

Substantial efforts have been focused recently on the electronic properties of two-dimensional (2D) materials in the perspective of their integration new devices [1]. Given the impact of graphene over the last few years [2], the isomorphic silicene [3] and germanene [4] are now considered to be promising novel materials with the advantage of being compatible with existing semiconductor technology [5]. Theoretical investigations of free-standing silicene show that these two novel materials have electronic structures with band structures presenting a linear crossing at the K and K' points of the surface Brillouin zone indicative of semi-metallic character, and massless Dirac fermion character. These result in similar properties such as a large charge carrier mobility and Hall effect [4,6-8]. For the moment, the primary method for growing silicene and germanene is on solid substrates, in particular silver: Ge/Ag [9-12] and Si/Ag [3, 13-15] and recently on gold [16] and iridium [17]. On Ag(111), silicene forms a continuous sheet [15], with at least three distinct ordered phases [18-21], depending on the deposition conditions. Free-standing silicon sheets only exist as silicon nanotubes [22] or multilayer silicene from chemical methods [23]. Now, nanoribbons are very interesting because of their potential for 1D dispersion effects with directional conductivity. A perfectly well defined edge structure is required and the coherent electron confinement will lead to observable effects such as quantum interference channeling at their edges [24]. To achieve this, graphene nanoribbons have to be synthesized chemically [25, 26], and Bi nanolines on Si(001) require a high formation temperature (600◦) [27], while Si nanowires on SiC did not show any 1D conductivity [28]. On the Ag(110) surface, one-dimensional silicene nanoribbons (NRs) [13] can be grown. The isolated NRs show a low

Static topology recombination and alignment

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Abstract
In this work, we examine a novel method for multiple sequence alignment called xed topology alignment with recombination. We show that it cannot be approximated within any fixed ratio unless P = NP. We show that for a limited version, the problem is MAX-SNP-hard. This implies that there is no PTAS for this variation unless P = NP. We also provide approximation methods in a special case where any two merge paths for different recombination nodes do not share a common node and each internal node has a maximum of one recombination child.

Keywords: Recombination; evolutionary tree; multiple sequence alignment; approximation approach; computational biology

1. Introduction

Multiple sequence alignment is the most critical cutting-edge tool for extracting and representing biologically important commonalities from a set of sequences. It plays an essential role in the solution of many problems such as searching for highly conserved subregions among a set of biological sequences and inferring the evolutionary history of a family of sequences [4,20]. Many versions have been proposed [1,4,20]. *Tree alignment* is one of the most famous versions. It was first proposed by Sankoff [11].

For tree alignment, we are given k sequences and a tree *Tree* of k leaves, each of which is labeled with a unique given sequences. The goal is to construct a sequence for each internal node in *Tree* such that the cost of the tree is minimized. The cost of an edge in a tree is defined as the edit distance between the two sequences assigned to the two ends of the edge. The cost of a tree is the total cost of edges in the tree. Once each internal node is assigned a sequence, one can produce a multiple sequence

The relevance of mathematical modelling and cost-effectiveness analysis in the research agenda for HIV cure

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Abstract
The research agenda to find a treatment for HIV is expanding quickly. In this post, we go over the rationale for and methodology of employing cost-effectiveness analysis and mathematical modelling in this agenda. We give a quick overview of the cure proof of concept as well as the current research directions. The sorts of clinical economic evaluations, such as cost analysis, cost-benefit analysis, and cost-effectiveness analysis, are then discussed. We discuss the use of cost-effectiveness analysis and mathematical modelling both in the early stages of the HIV epidemic and at the time of combination antiretroviral therapy. The innovative Value of Information (VOI) analysis methodology is then highlighted, along with its potential application to the design of clinical trials. We conclude with suggestions for cost-effectiveness analysis and modelling.

Key words: mathematical modelling, cost-effectiveness, and HIV/AIDS cure

Introduction

Since the description of the original cases in 1981, AIDS has become the most important global pandemic in recent history, with an estimated 35 million people currently infected with HIV [1]. The advent of effective combination antiretroviral therapy (ART) in 1996 had a dramatic impact on improving survival with HIV, initially in well-resourced and then in resource-limited settings [2,3]. In the past several years, studies demonstrating the efficacy of prevention have added to the armamentarium of strategies for care [4–6]. Recent trials have proven that early ART improves both individual clinical outcomes, and decreases HIV transmission [7–9]. Until recently scientists, policy-makers and civil society organisations have generally not considered the possibility of curing HIV infection. Scientific developments over the past few years, however, suggest that an effective cure might be on the horizon. Research protocols are under way on a broad range of biological approaches, as well as therapeutic strategies, that may lead to either a functional cure (i.e. control of HIV without full elimination, but with no requirement for further ART), or a sterilising cure (i.e. complete elimination of the virus) [10–12]. On World AIDS Day 2014, President Obama committed to providing $100 million for the investigation of HIV cure [13].

In light of this promising research and increasing commitment, issues are already emerging related to the potential cost and cost-effectiveness of plausible HIV cure strategies [14]. Cost-effectiveness, that is, the 'value for money' of any healthcare intervention, is generally compared to a current standard of care. Assessing the potential cost-effectiveness of HIV cure strategies, as well as the value of the information to be derived from future clinical trials of cure strategies, can help guide priority-setting and decisions by governments and other funders towards research into HIV cure.

In anticipation of and alongside clinical trials, mathematical models provide a framework by which the cost-effectiveness of new interventions can be defined. This is because such models can be used to anticipate the future impact of emerging innovations as well as integrate data from a variety of sources once studies are completed. This integration can be used to project outcomes beyond the timeline of the completed studies and assess uncertainty using formal methods [15]. By providing insight into the potential cost-effectiveness of HIV cure strategies, simulation models can be instrumental in highlighting the value of pursuing specific research strategies and informing the design of clinical trials [15].

Challenges for and directions of HIV cure research

The mechanisms by which HIV persists in spite of potent ART are the focus of intense research. Among the multiple mechanisms involved, the most important one appears to be the establishment of HIV latency, when integrated viral DNA is silenced by host mechanisms and the virus cannot be accessed by current ART or by host clearance mechanisms [16]. The primary cellular target for HIV infection is the CD4+ T cell. Most infected cells die rapidly,

A Multisemiotic Study of Mathematical Classroom Discussion

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ABSTRACT:

An examination of the effects of mathematics' multisemiotic character on classroom discourse is made from the standpoint of systemic functional linguistics. Because it makes use of the semiotic resources of mathematical symbolism, visual display, and language, mathematical discourse is multisemiotic. In classes, verbal and written modes alternate constantly while the three resources serve as the primary code. Each of the three semiotic resources has its own distinct lexicogrammatical systems for encoding meaning, and these interact to shape the types of constructions present in the classroom. This leads to the complexity of instructional discourse. This is particularly important in the context of mathematical symbols, where precise grammatical techniques are used to express information unambiguously and efficiently..

INTRODUCTION:

Interest in mathematical language and its implications for the teaching and learn- ing of mathematics has steadily grown over the last decade (Cocking & Mestre, 1988; Elliot, 1996; Mousley & Marks, 1991; Pimm, 1987 for example). As Morgan (1996) claims, however, the focus of those investigations has largely centered around vocabulary, symbolism and isolated examples of specialist grammatical forms. This suggests that what has been lacking to date within the community of mathematicians and mathematics educators is a coherent linguistic theory. Given the traditional compartmentalization of academic disciplinary fields, this is not so surprising. M.A.K. Halliday's systemic functional model of language, however,provides a comprehensive linguistic theory from which to proceed.

The problem of investigating ‘‘mathematical language," however, extends be- yond the examination of particular linguistic selections that occur in ma- thematical texts and classroom discourse. Rather, a critical reading of any formof mathematical discourse must necessarily take into account the multisemiotic nature of its makeup. Mathematics is not construed solely through linguistic means. Rather, mathematics is construed through the use of the semiotic re- sources of mathematical symbolism, visual display in the form of graphs and dia- grams, and language. In both written mathematical texts and classroom discourse, these codes alternate as the primary resource for meaning, and also interact with each other to construct meaning. Thus, the analysis of ‘‘ma- thematical language" must undertaken within the context of which it occurs; that is, in relation to its codeployment with mathematical symbolism and visual display. The analysis of the language of mathematics classrooms must necessarilybe incomplete unless the contributions and interaction of the symbolism and vi- sual display are taken into account.

Significantly, the Hallidayan model provides a theoretical framework for theanalysis of semiotic systems other than language as demonstrated by, for exam- ple, O'Toole's (1994; 1995) systemic model for the visual arts. Thus systemic functional theory can be extended to investigate the lexicogrammar of ma- thematical symbolism and visual display. Although not presented here, preli- minary frameworks which outline the major systems for these resources have been constructed and used for the analysis of the oral discourse and board texts in mathematics classrooms (O'Halloran, 1996). Each of the cited examples in this paper is from this larger research project.

As comprehensive descriptions of systemic functional grammar of the English language (Halliday, 1994; Martin, 1992; Matthiessen, 1995) are available, to- gether with introductory texts (Butt, Fahey, Spinks, & Yallop, 1996; Eggins, 1994; Martin, Matthiessen, & Painter, 1997; Thompson, 1996) I limit my discus- sion to the extensions of the model, which involve mathematical symbolism and visual display.

THE MULTISEMIOTIC NATURE OF MATHEMATICAL DISCOURSE

Mathematics is multisemiotic because the linguistic, visual and symbolic semioticsystems differentially contribute to the meaning of the text. Following Lemke (1998), each semiotic system is basically uniquely functional in its contribution in the construction of mathematical meaning. I briefly consider the functions of

Implicational paradoxes in Classical Mathematical Logic: A Quantitative Analysis

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Abstract

Since its logic theorems, classical mathematical logic contains numerous "implicational paradoxes." This article lists all of the logical theorem schemata of classical mathematical logic that do not satisfy the strong relevance condition and utilises it as a criterion to discover implicational paradoxes in those theorems. This quantitative research demonstrates that the traditional logic of mathematics is by far not an appropriate logical foundation for automated forward deduction.

Knowledge representation and reasoning are some keywords. forward deduction automatically pertinent logics, High importance

1 Introduction

A forward deduction engine is an indispensable component for any knowledge-based system to discover new knowledge or predict future incidents. Since any automated forward deduction for discovery or prediction has no explicitly specified proposition or theorem given previously as goal, intrinsically, to apply all inference rules to all given premises and previously deduced conclusions is the only way to deduce new knowledge or predictions. This naturally requires that a forward deduction engine deduces only conclusions that are certainly relevant to given premises.

The Islamic Republic of Iran's Guidance-School Mathematics Books' Content Was Analyzed Using the Concepts and Elements of Constructive Realism

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Abstract

This study examined the mathematical content of guidance-school textbooks in Iran using the ideas and elements of constructive realism. This study use the content analysis method as its methodology. 22 components were broken down into 5 principles when doing content analysis. Results: According to the findings, two principles—creating conceptual connections between the book's materials and encouraging creativity in order to inspire students to come up with new constructs—are 30% confirmed. At the levels of 50% and 70%, just one principle (the conceptual link) was validated. We conclude by recommending that constructive realism-based elements of the philosophy of mathematics be used to the creation of better math textbooks.

Key words: Guidance-school, content analysis, math textbooks, Iran, and constructive realism.

1. The Constructive Realism Approach in Mathematics Instruction

The constructive realism approach has been developed since decades ago (Rescher, 1987; Wallner, 1994; Bagheri, 1995). This approach was posed to adjust the relativism inherent in constructivism and has tried to oppose the relativism that had emerged in science. In mathematics, constructive realism is comprised of Plato's realism in mathematics and the Piaget-oriented constructivism, in an attempt to adopt the advantages of both approaches and to avoid their disadvantages. One advantage in Plato's external realism is its emphasis on the description nature of the mathematics knowledge; for it is only through exploration one can say that he/she has "knowledge" of something. (Bagheri, 2011)

In defining the constructive realism approach in mathematics can be said: constructive realism in mathematics includes a philosophical perspective that emphasizes on representation of mathematics knowledge to the external reality. Additionally, this perspective adopts existence, independence and description of mathematics. Due to the complexity of reality, this perspective seeks to produce the more sophisticated constructs through dealing with the mental, dynamic, innovative and fallible constructs concerned with social-cultural interactions to trap the reality and access knowledge about math things. (Bagheri, 2011)

2. Method

In this research, content analysis is used as a method (Borg, Gall & Gall, 2003; Connlly & Clandinin, 1991; Burgess & Rosen, 1997) for analyzing mathematical books in guidance schools in Iran (Farzan, et al. 2009a; Farzan, et al. 2009b; Farzan, et al. 2009c). It is necessary to determine unit analysis and visible indicator in that unit for doing (practicing) content analysis. From one prospective, since the content of mathematics books have a special characteristic, one specific unit cannot be considered to analyze it; thus, for the content of mathematics books have been shaped a complicated and cohesive system with the consistence of Persian texts, table, figure, and mathematic symbols, they must be searched (investigated) in the bigger and multiple unit analysis. The following categories are used for content analysis of mathematics books: Creating an insight as to the real existence of the mathematical

Carbon nanotubes formation in the decomposition of heavy hydrocarbons creeping along the surface of the glow discharge

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Abstract. The possibility of the decomposition of heavy hydrocarbons in the plasma of a creeping glow discharge in a magnetic field is investigated. Electron microscopic analysis of carbon accumulation on the electrodes and walls of the discharge chamber is performed, as well as gas chromatographic analysis of the gas produced during the experiment. The length of the grown carbon nanotubes is approximately 6.17 μm and the diameter is approximately 18 nm.

1. Introduction

A high degree of disequilibrium is established in the glow discharge caused by a large detachment of the electron temperature from the gas one. Despite the fact that the temperature of the electrons in the glow discharge reaches many hundred thousands of degrees, the discharge itself is cold, and the gas temperature is only slightly different from ambient. In other words, in the glow discharge the electric field energy is transferred mainly to the electrons, which in elastic collisions with neutral particles do not practically lose their energy. Inelastic collisions, depending on the situation, can lead to the excitation of atoms or either ionization or to bonds rupture in the molecules. For the conversion of new hydrocarbon the bonds break between atoms is of particular attraction. The attractiveness of gas discharges for new compounds was confirmed in [1-4]. Modern hydrodynamic theory of such discharges is described in [5-6]. It is easy to provide selectivity of the reaction in the glow discharge by changing the reduced electric field. In this case there is no heating of the hydrocarbon mixture unlike thermal cracking. However, the organization of heavy hydrocarbons interaction with a glow discharge is not an easy task, as the glow discharge burns in a rarefied gas, but heavy hydrocarbons are in a liquid phase. The glow discharge arranged near the liquid surface practically does not interact with this fluid. In order to ensure the best possible interaction of the glow discharge with liquid hydrocarbons we decided to use a magnetic field.

2. A theoretical basis

The behavior of charged particles in the electric and magnetic fields is studied in details. As is known, an electric current in the gas is caused by the electrons and ions drift. Since opposite charged particles move in opposite directions in the electric field then the Lorentz force is routed in the same direction for all of them. By selecting the appropriate direction of the electric and magnetic fields, the discharge side of the deflection surface of the liquid hydrocarbons can be achieved.

Let us analyze the physical processes occurring in the glow discharge in a magnetic field near the surface of the liquid hydrocarbons. First, we estimate the mean free path of electrons by the formula $\lambda = 1/\sigma n$, where σ - the cross section area, $n = p/kT$ - the concentration of particles in the gas, p - pressure, T - the temperature of the gas, k - Boltzmann constant. For estimations let us assume that the pressure is 10 Torr, the temperature is 500 K, $\sigma = 7 \cdot 10^{-20}$ m^2. Then the mean free path of electrons would be 0.074 mm and the potential drop in the positive column at this pressure corresponds to 10 V/mm. Thus, the mean free path of electron energy will be 0.74 eV, and the average velocity of the electron on the mean free path (i.e. the speed of the drift in the direction of the electric

Two-Phase Rule Induction from Incomplete Data

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Abstract. A framework for learning new rules from incomplete data is introduced so that the user can easily identify attributes with or without rule values. The rule defines two measurement levels. A two-step rule induction algorithm is presented. Instead of filling in missing attribute values before or during a rule call, we split rule induction into two steps. In the first step, rules and subrules are induced based on non-missing values. In the second step, partial rules are modified and refined by filling in some missing values. Such rules faithfully reflect knowledge embedded in incomplete data. The study not only provides new insights into rule inference from incomplete data, but also offers a practical solution.
Keywords: Missing attribute values, Filled-in values, Two-phase rule induction.

1 Introduction

A major focus of machine learning and data mining research is to extract useful knowledge from a large amount of data. For such a purpose, the integrality of data is very important. However, real-world data sets frequently contain missing values, i.e., attribute values of objects may be unknown or missing [14]. To deal with missing values, many methods have been proposed [2,3,4,5,6,8,1,10]. They may be broadly classified into three categories. The first category mainly focuses on transforming incomplete data into complete data by filling in the missing values. Rules are induced from the completed data. The second category fills in the missing values during the process of rule induction. The third category considers tolerance relations or similarity relations defined based on missing values [5,6,10].

The third category may be considered as a special case of the first category.In fact, one may first fill in the missing values and then derive a similarity rela- tion. One disadvantage of filling in attribute values before the learning process is that the learning goals and algorithms are not directly considered. Anotherdisadvantage is that all missing values are filled in although some of them arenot necessary. Since rules normally contain only a subset of all (*attribute, value*) pairs, we do not need to fill in all missing values. To avoid those problems, one can combine the processes of filling in the missing values and learning together. Algorithms like C4.5 [1] fill in missing attribute values according to some special learning goals. In addition, missing values are filled in only when the demand arises in the learning process.

Two fundamental important problems still remain in the existing algorithms for inducing rules from incomplete data. One is the use of the filled-in values. Any method of filling in missing values is based on certain assumption about the data, which may not be valid. However, rule learning algorithms treat filled-in values as if they are the original values. This may result in rules having more number of filled-in values and less number of the original values. That is, we mayobtain rules that more fit the filled-in values. Although these rules may have goodstatistical characteristics, they are in fact not reliable. The other issue is the useof induced rules by users. Without a clear distinction between the filled-in values and the original values, a user may find it difficult to interpret and apply rules. In fact, a user may misuse a rule by putting more weights on filled-in values. Solutions for those two problems require new ideas and methodologies.

The objective of this paper is to propose a new framework of rule induction by separating filled-in and the original values in both the learning process and the induced rules. A two-phase model is suggested. The first phase induces partial rules based only on the original values. Rules induced in the first phase will be associated with a quantitative measures such as confidence, coverage and generality [11,13]. In the second phase of rule induction, filled-in values are takeninto account so that the performance of the rules may improve. A new form of rules is introduced, in which known attribute values and filled-in attribute values are used. A user can easily identify attributes with or without missing values in rules.

2 A Framework of Two-Phase Rule Induction

The two-phase framework of rule induction from incomplete data uses a new form of rule involving both the known attribute values and filled-in values. Inthe first phase of rule induction, rules is induced only based on known attribute values. Many approaches of machine learning and data mining methods, suchas concept learning, decision tree and rough set-based learning, can be used. One may associate certain quantitative measures to express the strength of a rule. In the second phase of rule induction, missing attribute values are filled in according to a certain method, and rules are induced based on the repaired data. The performance of the new rule induced in the second phase should be superior (higher) than that of rule induced in the first phase.

The main ideas of two-phase rule induction can be illustrated by a simple example. Suppose *r* is a rule induced in the

Beyond Cartesian limits: Leibniz's passage from algebraic to "transcendental" mathematics

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Abstract

The topic of this article is Leibniz's reaction to Descartes' "geometry." Five key ideas served as the foundation for Leibnizian mathematics: calculus, characteristic, the art of invention, method, and freedom. Descartes' limitation of geometry to things that could be expressed in terms of algebraic (i.e., finite) equations was attacked by Leibniz on the basis of methodological issues, saying that "Descartes' mind was the limit of science." The inability of algebra to handle transcendental issues prompted Leibniz to develop linear algebra, and the inability of algebra to solve higher degree equations prompted him to establish a science of the infinite. In order to establish "a veritable complement of algebra for the transcendentals," Leibniz recreated the mathematical corpus, developed brand-new (transcendental) conceptions, and redefined old notions (equality, exactness, and construction) endless equations,.

Introduction:

1. From the theory of equations to linear algebra

In 1924, the French poet Paul Valéry praised the algebraic use of unknowns in the following way:

> Quelle idée plus digne de l'homme que d'avoir nommé ce qu'il ne sait point ? Je pus engager ce que j'ignore dans les constructions de mon esprit, et faire d'une chose inconnue une pièce de la machine de ma pensée. [Valéry, 1999]

Yet, in Leibniz's eyes algebra suffered from two imperfections:

(1) The algorithmic solution of the general algebraic equation of *n*th degree was still unavailable;
(2) Algebraic equations did not suffice to comprehend transcendental problems in geometry.

Like all of his contemporaries, Leibniz was convinced of the solvability of the first problem. His own attempts in this direction resulted in the emergence of determinant theory. His studies of transcendental problems, such as the quadrature of conic sections, resulted in the invention of his differential and integral calculus.

In order to solve the quintic equation Leibniz generalized Cardano's approach by using a substitution of the form

Using 3-D mathematical modelling, a targeted tumour puncture algorithm for cognitive fusion

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A R T I C L E I N F O

Keywords:
Precise percutaneous tumor puncture
Radiological data
Space analytic geometry
Mathematical modelling
Algorithm

A B S T R A C T

Background: The procedure of percutaneous puncture is crucial for the detection and management of tumours. Currently, the majority of puncture procedures still rely on clinical judgement and imaging location, making it unable to perform a targeted puncture that is quantitatively correct. More research is needed to address scientific issues such as how to increase the percutaneous tumour puncture's accuracy, minimise errors, prevent complications, and generally improve the quality of clinical diagnosis, therapy, and curative outcomes.
Method: In the current study, the tumour puncture path was initially created, the needle entrance angle was determined, the important restricted parameters were defined, and the substitution formula was developed. Second, the deviation angle and puncture path were identified, the customised tumour puncture scheme was carried out, and pertinent parameters were retrieved from CT and other ageing data and substituted into formulas. Finally, B-ultrasound was used to precisely apply targeted puncture. Our approach outperformed the conventional empirical puncture in terms of accuracy, puncture time, and pain reduction for patients during diagnosis and therapy.

Results: Based on mathematical theory and imaging data, a tumor-targeted puncture model was developed. The ideal puncture deviation angle was modelled and estimated using clinical data extraction, including tumour radius, projection distance of tumour centre, and projection distance from puncture point to body surface, and a customised puncture scheme was constructed. When compared to the traditional approach, our algorithm significantly improved puncture accuracy rate by 30%. Our methodology resulted in a 50% reduction in punctures. Also, our model reduced the duration of the procedure by 20% to reduce patient discomfort and provide improved safety. Scores for patient discomfort and doctor satisfaction were looked at. Our methodology decreased patients' subjective discomfort by 25% while increasing doctor satisfaction by 20%. These results showed that the model could significantly increase puncture accuracy and efficiency, clinical efficacy, and tumour diagnosis accuracy. Also, patient suffering was significantly decreased, and doctors' confidence in the procedure was dramatically increased.

Conclusion: The ideal puncture path utilising a mathematical model was carefully examined in the current study. Accurate puncture was successfully achieved using the mathematical model for cognitive fusion puncture, along with clinically customised data and mathematical calculation analysis. It may be worthy of clinical application because it not only significantly increased the effectiveness of puncture but also ensured the safety of clinical patients and decreased harm.

An empirical study of luxury brand marketing effectiveness and its impact on consumer engagement on Facebook

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Abstract: Luxury brands have embraced the social media era through marketing communication pointing out the particular attributes of luxury such as high quality, rich pedigree, rarity, personality, placement, public relations and figures as well as a typically high pricing, to drive consumer engagement. This paper provides empirical findings about the effectiveness of luxury brand marketing to drive consumer engagement on social media platforms. An empirical study on 52 luxury brand's Facebook pages has been conducted. The findings of this study provide valuable guidance for luxury brand managers and marketing researchers on how to formulate and implement effective social media marketing strategies to leverage their luxury brand potential.

Keywords: Consumer Engagement; Social Media Marketing; Online Marketing; Luxury Brand Management; Facebook

1 Introduction

Over the last decade, social media has changed the way brands interact with their customers leading to new online marketing practices. Facebook, among other social networking website, became a major marketing communication channel that allows marketers to promote their brand and engage their customers and audiences. Social media has also been considered as particularly suitable for developing customer relationships (Kane et al., 2009) creating the need for a dedicated research effort around the concept of online consumer engagement.

The social media era has brought new challenges to the luxury market which has been historically reluctant to any mass availability medium like the Internet (Okonkwo, 2009; Geerts & Veg-Sala, 2011). Luxury brands started to increasingly adopt social media (Phan, 2011) in a move to target "emergent afflulents" who are under 35 years old (Ortved, 2011).

This paper provides insights into how luxury brand marketers can formulate and implement effective social media marketing strategies and how much (and what type of) engagement they could expect. In this paper, the main attributes of luxury brand marketing are discussed and their effectiveness at engaging with consumers on social media platforms is investigated. This paper focuses on Facebook as the chosen social network to support the empirical study, driven by its popularity and its wide adoption by the business community. This paper makes several contributions to the research effort around online consumer engagement. Firstly, a multi-dimensional conceptualisation of consumer engagement is proposed to allow a more precise measurement of its individual constructs. Secondly, several attributes specific to luxury brand marketing have been evaluated empirically as to how much engagement they would create on Facebook. A statistical analysis of full online conversations has been conducted to gain insights on how to formulate and implement effective social media strategies.

2 Luxury brand marketing on social networking websites

Luxury brands are described as goods which bring prestige apart from any functional utility (Grossman & Shapiro, 1988). Many luxury brands have embraced social media to build up relationships with their customers through online conversations. In particular, luxury brands actively make use of social media for advertising and marketing (Kim & Ko, 2012). Social media can be defined as the “online applications, platforms and media which aim to facilitate interactions, collaborations and the sharing of content” (Palmer & Koenig-Lewis, 2009). Both marketing practitioners and researchers have attempted to understand the scope of consumer engagement in the context of online social networks as well as its determinants (Brodie et al., 2013; Cvijikj & Michahelles, 2013; Mollen & Wilson, 2010). However, there appear to be limited academic research about the effectiveness of social media marketing in the context of luxury brands (Kim & Ko, 2010; Jahn et al., 2012; Juric et al., 2012; Chu et al., 2013; Phan et al., 2011).

The literature review shows a lack of consensus of what constitutes a luxury brand (Vigneron and Johnson, 2004; Vickers and Ronand, 2003; Dubois and Duquesne, 1993). The luxury brand potential relies on a set of characteristics including exclusive, glamorous, extremely expensive, high quality, rare, precious, crafted, etc. (Vigneron and Johnson, 2004). Dubois, Laurent and Czellar (2001) tackled the characteristics of luxury brands using cross-cultural luxury consumer studies and proposed six main facets of luxury including "excellent quality", "very high price", "scarcity and uniqueness", "aesthetics and polysensuality", "ancestral heritage and personal history" and "superfluousness". While these luxury brand attributes are of particular relevance in the evaluation of luxury brand marketing, very few studies focused on the characteristics of luxury brand marketing strategies. Rohit Arora (2012) summarized luxury brand marketing strategies into 8 Pillars, also called the 8 P's. The 8 P's have also been proposed as a framework for luxury marketers to audit their marketing

content and leverage their luxury brand potential. The 8 P's include the "Performance", "Pedigree", "Paucity", "Persona", "Public Figures", "Placement", "Public Relations" and "Pricing" of luxury brands as described in details in Table 1. In this paper, we adopt the 8 pillars of Rohit Arora (2012) as the attributes of luxury brand marketing. The 8 P's model has been reviewed against the main other models of luxury brand attributes (Vigneron and Johnson, 2004; Dubois, Laurent and Czellar, 2001) and has been found to be the most relevant to this study because it specifically focuses on the attributes of luxury brand marketing strategies rather than more generic marketing attributes.

Table 1. The 8 P's of luxury brand marketing (Rohit Arora, 2012).

1st P: Performance. The performance of a luxury brand is defined at a product level and at an experiential level. The quality of luxury products is usually reinforced by generous warranties (Keller, 2009) as well as investments in innovation and creativity by appointing talented designers and professionals (Fionda & Moore, 2009). Brands not only create functional but also emotional value for consumers (de Chernatony et al., 2011). A luxury brand must particularly perform well at an experiential level, i.e. the emotional value of the brand the consumers buy into. The performance of luxury brands, at both product and experiential levels, is important in the luxury segment as it is instrumental in communicating symbolic meaning (Fionda & Moore, 2009).
2nd P: Pedigree. The pedigree of luxury brands has its roots in the culture and history of the brand. These are considered as the most important attributes with firms deliberately drawing on their histories in their marketing (Beverland, 2004). Traditional and fundamentally authentic values of a luxury brand are important in their brand positioning () both at the brand level and the product level. Authenticity involves elements both intrinsic and extrinsic to a product (Beverland, 2006). Example of pedigree attributes include the appellation as an origin of place, the people behind the product, the quest for a unique style, the quality, consistency, honesty and transparency of the brand and its products.
3rd P: Paucity. The challenge for luxury brands is to increase their success and still preserve the impression of exclusivity (Dubois, 1992). To achieve that, they strictly control the accessibility of their brand and practice highly selective distribution (Fionda & Moore, 2009; Keller, 2009). Rohit Arora (2012) identified three types

of paucity: natural, technology-led and tactical. Natural paucity is due to the scarce ingredients such as diamonds or to the exceptional human expertise required to create the luxury products.
4th P: Persona. The persona of a luxury brand refers to its symbolic meaning, including the human values and lifestyles (Vigneron & Johnson, 2004). The persona of luxury products and brands is covered to a large extent by the concept of brand personality. Heine (2009) considers the five major dimensions of the luxury brand personality as its modernity, prestige, sensuality, understatement and eccentricity.
5th P: Public Figures. Luxury products are often linked to popular celebrities (Keller, 2009). More generally, public figures have traditionally been employed as one of the marketing mix in luxury brand advertising Rohit Arora (2012) including film stars, music personalities, sports personalities or even the designers themselves.
6th P: Placement. The placement of luxury brands "is not limited to the physical environment where the brand retails, but it extends to all of the environments or consumer touch points that the brand associates itself with" (Rohit Arora, 2012). This includes placement in selective niche media, festivals (e.g. Cannes), prestigious events or "an attractive country-of-origin" (Keller, 2009).
7th P: Public Relations. Typical communication tools of luxury brands also include Public Relations (PR) (Fionda & Moore, 2009) and play an enormous role in image proliferation of the brand, thereby subtly influencing public opinion (Rohit Arora, 2012). Luxury brands utilise PR to generate buzz and communicate brand news, point of views of inspirers and influencers, a crucial support for brand activation (like the fashion weeks, sport-events, themed previews and so on) (Rohit Arora, 2012).
8th P: Pricing. Price is a major indicator of quality and prestige (Keller, 2009). Therefore, luxury brands have to resist price reductions, which would in fact increase the demand in the short-run, but decrease sales in the long-run (Dubois, 1992). Sales promotions tend to be handled differently by luxury marketers (Rohit Arora, 2012) such as adding more value to the purchase like gift with purchase, online or email exclusives, etc.

3 Consumer engagement: a multidimensional concept

Brand engagement, customer engagement, consumer engagement, or simply engagement are among the various names given to the same concept. Since the early stages of social

networking sites, a significant attention has been devoted to foster the concept of consumer engagement in online communities (Algesheimer et al., 2005). Both practitioners and researchers from social science, management and marketing disciplines have attempted to understand the scope of consumer engagement in the context of online social networks as well as the broader context of business relationships and branding (Appelbaum, 2001).

A review of the related literature reveals a multidimensional conceptualisation of consumer engagement. The multidimensional nature of consumer engagement is developed by Hollebeek (2011) who considers "customer brand engagement" as "the level of a customer's motivational, brand related and context-dependent state of mind characterized by specific levels of cognitive, emotional and behavioural activity in brand interactions."

Consumer Engagement has also been studied within online contexts. Mollen & Wilson (2010) define engagement in online consumer experience as "the cognitive and affective commitment to an active relationship with the brand as personified by the website or other computer-mediated entities designed to communicate brand value". More recently, Brodie et al. (2013) proposed a definition of consumer engagement specifically fitting the context of virtual brand communities as "specific interactive experiences between consumers and the brand, and/or other members of the community". More precisely, the authors consider consumer engagement as "a context-dependent, psychological state characterized by fluctuating intensity levels that occur within dynamic, iterative engagement processes". Similarly to previously cited research, Brodie et al. (2013) consider consumer engagement as a multidimensional concept comprising cognitive, emotional, and behavioural dimensions. In this paper, the definition of Brodie et al. (2013) is adopted, including its experiential and behavioural dual-approach to engagement. However, the focus in this work is on the measurement of behavioural engagement due to the limited capacity of capturing experiential engagement on Facebook.

4 Consumer engagement measurement framework

The content shared on Facebook brand pages can take various forms including text, photos, videos or links. These forms of content are the "stimuli" that appear on the Facebook brand page's timeline to create engagement among the brand community. From a community perspective, various forms of interactions occur on Facebook brand pages, among which the following are considered in this paper: (1) indicating interest in a content by pressing the "like" button, (2) sharing a content with friends, and (3) commenting on a content. These interactions play a crucial role in word of mouth communications by propagating stimuli across the social network of friends leading towards the goal of viral marketing (Kirby & Marsden, 2005).

The measurement approach proposed in this paper has been inspired by the levels of consumer engagement described by Roberts & Alpert (2010) ranging from the purchase of products/services to their advocacy. However, purchasing products is generally not the first level of consumer engagement on Facebook, nor is it a condition to engage in the first place. In this paper, a set of consumer engagement constructs is defined and ranges from the endorsement of a brand to its advocacy as follows.

The first construct is the "endorsement" of marketing content by Facebook users when they "like" the content published on the brand's page. By "liking", they demonstrate their endorsement of the brand and/or the values expressed in the content.

The second construct is the "feedback" from Facebook users. Social media can provide a novel community-oriented and social way of sharing feedback about new products and concepts (Barker, 2008). When Facebook users comment on a content published on a Facebook brand page, they provide feedback to the brand and share it with the other community members. Feedback from the brand's community is an indicator of how well the

brand is doing to serve the needs and wants of its consumers, and where there is an opportunity to improve.

The third construct is the "conversation" with/among Facebook users. When Facebook users reply to a comment, they create engaging conversations and the original comment becomes source of engagement.

The fourth construct is the "recommendation" of marketing content by Facebook users. Recommending online content is one of the main drivers of word of mouth in online social networks and has an important impact on both consumers and brands. This behaviour is widely adopted as 59% of people report that they frequently share online content with others (Allsop et al., 2007). As the word implies, the "Share" button on Facebook allows the users to share a content with their friends. There are various reasons a user may share a content (post) that they read on Facebook. In this paper, the main intention of "sharing" a content on Facebook is considered to be recommending friends to read it. Thus, the amount of "share" generated by a content is associated with the measure of its recommendation.

5 Research methodology

A content analysis of a sample of Facebook brand pages of luxury brands has been performed to measure the characteristics of the social media marketing messages (posts) as well as its generated consumer engagement. Kassarjian (1977) defines content analysis as a scientific, objective, quantitative and generalizable description of communications content. In marketing research, various studies have been conducted using content analysis for advertisement content (Grove & Kangun, 1993; Laforet & Saunders, 2005). In this paper, the analysis concerns content collected from Facebook's social networking platform.

5.1 Sample selection

The Digital Luxury Group (2013) has published the 2nd edition of World Luxury Index©

China. It is the result of an analysis of Chinese consumer interest for luxury brands and has been released in partnership with Luxury Society, the world's largest community of luxury executives. The report comprises over 400 luxury brands across 6 key segments including cars, fashion, beauty, hotels, watches, jewellery. For the present study, the top 10 luxury brands of each of the above segments have been included in the sample resulting in 52 brands (some brands were in the top 10 of several segments such as fashion, jewellery and watches). The official ("verified") Facebook brand page of every selected luxury brand has been identified. The list of luxury brands considered in this study is provided in the Appendix.

5.2 Measures

Consumer engagement on Facebook corresponds to the various interactive experiences around the concept of "brand page" and its published content which can be of various types (status update, link, photo or video). The following notations are used in this paper:

- F_b is the set of Facebook users who "like" the brand page b (corresponding to the fans of the brand), and P_b is the set of posts published on the Facebook page of brand b.

- Likes of post. This can be measured as the number of Facebook users who "like" a content published on the Facebook brand page, equals p_{likes} for a post p.

- Shares of post. This can be measured as the number of Facebook users who "share" a content published on the Facebook brand page, equals p_{shares} for a post p.
- Comments on post. This can be measured as the number of comments created for the post p and equals $|CP_p|$, CP_p being the set of comments created for the post p. This measure excludes comments on comments, also called replies.
- Community replies to comment on post. This can be measured as the number of comments made by the community members on a comment c, equals $|RC_c|$, RC_c

being the set of replies made by the community (excluding those made by the brand itself) to a comment c.

- Brand replies to comment on post. This can be measured as the number of comments made by the brand itself on a comment c, equals $|BRC_c|$, BRC_c being the set of replies made by the brand to a comment c.
- Likes of comment. This can be measured as the number of Facebook users who "like" a comment on a post published on the Facebook brand page, and equals c_{likes} for a comment c.
- Likes of replies to comment. This can be measured as the number of Facebook users who "like" a reply to a comment on a post published on the Facebook brand page, and equals r_{likes} for a reply r.

5.3 Dependent variables

The above basic measures are representative of the rich data that can be collected from a Facebook brand page. These metrics are used to calculate the five constructs of consumer engagement (Endorsement, Feedback, Conversation and Recommendation) described in the consumer engagement measurement framework. Consumer engagement rates (dividing each of the engagement construct measures by the number of fans of a brand) are used to allow the comparison of brands having Facebook brand communities of different sizes. The following consumer engagement rates are calculated and form the dependent variables:

- The consumer endorsement rate is the total number of likes for a post p on a brand page b divided by the size of its community:

$$CER(p) = \frac{p_{likes}}{|F_b|}$$

- The consumer feedback rate is the total number of comments and replies to comments for a post p on a brand page b divided by the size of its community:

$$CFR(p) = \frac{\left|CP_p\right| + \sum_{c \in CP_p} |RC_c|}{|F_b|}$$

- The consumer conversation rate is the total number of replies to comments for a post p on a brand page b divided by the size of its community:

$$CCR(p) = \frac{\sum_{c \in CP_p} |RC_c| + |BRC_c|}{|F_b|}$$

- The consumer recommendation rate is the total number of shares for a post p on a brand page b divided by the size of its community:

$$CRR(p) = \frac{p_{shares}}{|F_b|}$$

5.4 Independent variables

The independent variables investigated as explanatory of the consumer engagement rates (CER, CFR, CCR and CRR) are the 8 pillars of luxury brand marketing as described in Rohit Arora (2012). Such 8 P's being Performance, Pedigree, Paucity, Persona, Public figures, placement, public relations and pricing are identified for every collected post including text, photos, videos or related links.

5.5 Data collection

The data collection phase has been conducted using Facebook's social graph (Graph API) which allows to access all public conversations on any Facebook brand page as well as their related comments, likes and shares. The Graph API has been used to collect all data fields

related to the entire public interactions within each of the 52 Facebook brand pages in the sample. Two months' worth of interactions have been collected covering the period ranging from 15st July 2013 to 15th September 2013.

The data collection included posts (status updates, links, photos and videos) as well as their corresponding number of likes and shares, all comments and replies to comments, likes on comments and likes on replies to comments.

5.6 Data coding

Every post on each of the selected brand's Facebook pages is a marketing message that enacts one or more of the 8 P's of luxury brand marketing strategies. In order to identify which P's are enacted in a post, a qualitative data coding process has been conducted using the coding scheme of the 8 P's. The coded data has then been further analysed as described below.

6 Data analysis and Findings

The R statistical package (R Core Team, 2013) has been used to conduct the statistical analysis of the data set. The findings are presented in two parts. The first part reports some descriptive statistics. The second part presents the results of statistical hypothesis testing using a multiple regression model.

6.1 Descriptive statistics

Fifty two (52) brands published content in English on their Facebook pages while 1 brand published non-English content. Due to the qualitative coding process, which is a human intensive process, brands that published content in English have been maintained in the sample. Furthermore, one brand page was inactive on its Facebook page and has been

excluded. This resulted in a final sample size of 51 luxury brands and have been selected for the rest of the analysis.

The median number of posts published on brand pages was 39 over a 2 months period with the largest by a brand of luxury cars (135). The distribution of median frequencies of posts per segment is shown in figure 1.

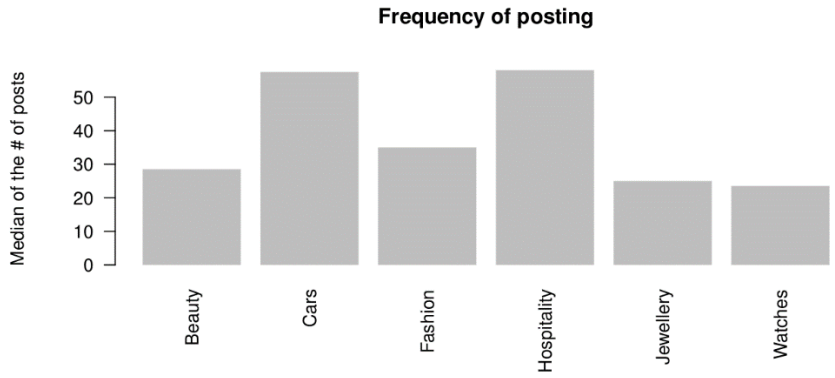

Figure 1. Frequency of posts per industry.

In regard to the content collected, the dataset comprised 2,372 posts (2092 photo posts (88.19%), 149 video posts (6.28%), 82 link posts (3.45%), 49 status update posts (2.06%). All comments on posts have also been collected totalling 10,780 comments. In addition, information about posts and comments have been collected including the number of likes and shares for posts and comments totalling 321,858 likes and 1,569,452 shares.

While 59.61% of posts received no comments at all, the average number of comments received by a post is 4.54 and only 23.6% of all posts received a brand reply to comments. Furthermore, 13.65% of posts received no likes at all, while the average number of likes of a post is 135.75. Finally, 8.73% of posts do not get shared at all, while the average number of shares of a post is 661.66.

In order to get a sense of the relationship between the 8 P's and the consumer engagement rates, figure 2 illustrates the mean values of consumer engagement rates

depending on which P's are enacted in the post's message. It shows that there are noticeable differences in the consumer engagement rates of depending on which of the 8 P's are enacted. In particular, it shows that a performance, public figures, placement, public relations and pricing generate more consumer feedback. It also shows that pedigree, paucity and persona generate more consumer recommendation.

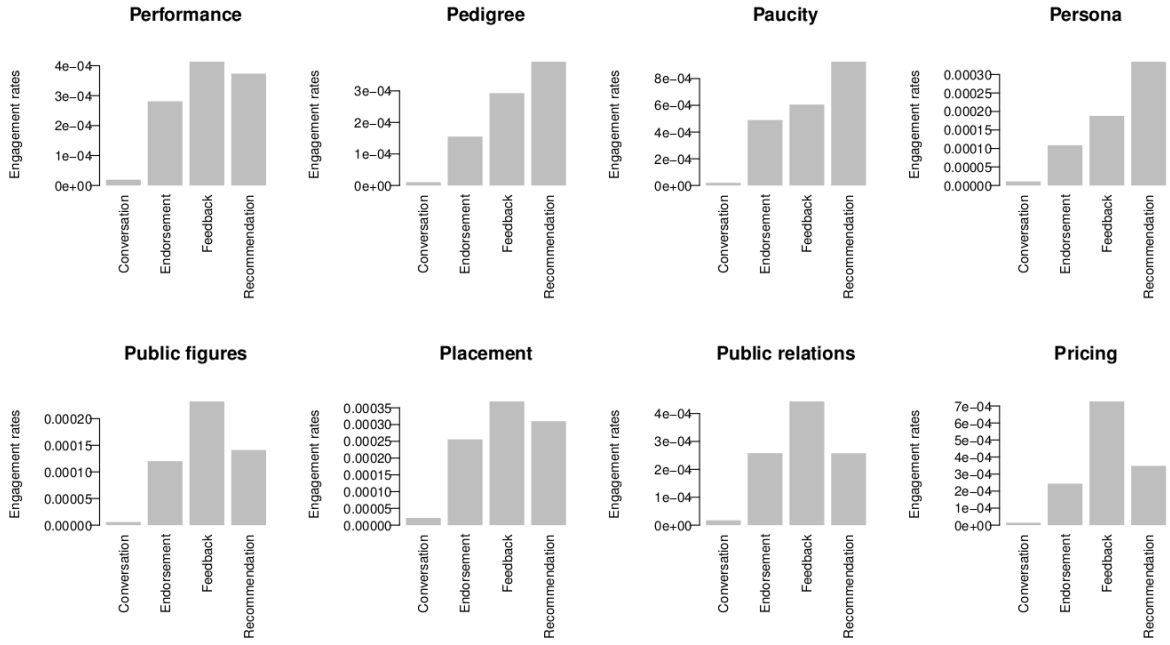

Figure 2. Effect of the 8 P's on consumer engagement.

Figure 3 illustrates the distribution of P's among the 6 segments considered in this study. It mainly shows that the luxury car segment significantly emphasizes on its pedigree while jewellery and watches use more paucity than other segments. It also shows that placement as well as pricing are mainly used by the hospitality segment. Another noticeable finding is that the fashion segment uses public figures more than other segments.

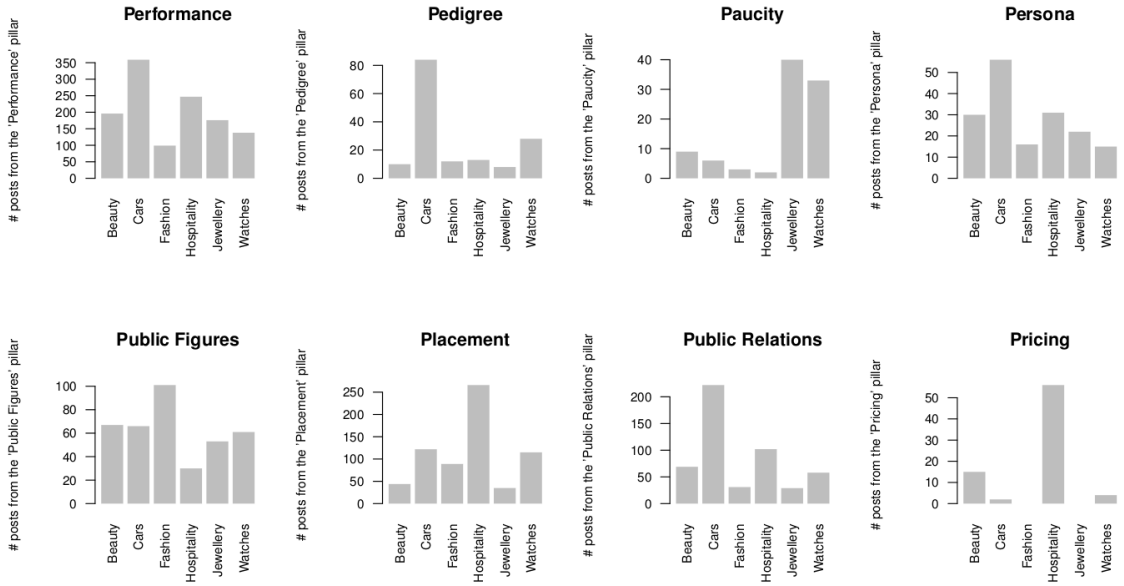

Figure 3. Distribution of P's among the 6 industries.

6.2 Multiple regression analysis

In order to verify whether the relationship between the use of the 8 P's in social media marketing communication and the various consumer engagement rates is statistically significant and to better estimate the relative level of impact of each of the 8 P's on consumer engagement measures, a multiple regression analysis has been conducted. Outliers have first been removed to avoid the bias of extreme values of either endorsement rate, feedback rate, conversation rate or recommendation rate. The remaining dataset of 2355 posts (N=2355) has been used for a multiple regression analysis where the dependent variables are the endorsement, feedback, conversation and recommendation rates, while the independent variables are the 8 P's. The findings of such analysis are described as summarized in table 2.

Table 2. Multiple regression analysis of the effect of the 8 P's on consumer engagement rates.

	Endorsement Rate		**Feedback Rate**		**Conversation Rate**		**Recomm. Rate**	
	B	S.E.	B	S.E.	B	S.E.	B	S.E.
Intercept	3.784e-05***	3.599e-06	6.624e-05***	6.345e-06	3.188e-06***	5.179e-07	2.413e-04***	2.390e-05
Performance	1.988e-06	3.690e-06	7.522e-06	6.505e-06	1.055e-07	5.310e-07	8.972e-05***	2.450e-05
Pedigree	1.623e-05*	6.892e-06	-3.528e-06	1.215e-05	-5.247e-08	9.919e-07	6.809e-05	4.577e-05
Paucity	1.322e-05	8.748e-06	7.807e-05***	1.542e-05	1.339e-06	1.259e-06	6.114e-04***	5.809e-05
Persona	2.907e-06	6.935e-06	5.301e-06	1.223e-05	-6.725e-07	9.980e-07	3.866e-05	4.605e-05
Public figures	-1.747e-05***	4.852e-06	-3.972e-05***	8.555e-06	-2.106e-06**	6.983e-07	-1.543e-04***	3.222e-05
Placement	-5.318e-06	3.863e-06	-2.842e-06	6.812e-06	7.241e-07	5.560e-07	4.690e-05.	2.566e-05
Public relations	3.472e-06	4.291e-06	-8.527e-06	7.566e-06	-7.118e-07	6.176e-07	-5.330e-05.	2.850e-05
Pricing	-1.126e-05	9.418e-06	-4.066e-07	1.661e-05	2.016e-07	1.355e-06	3.554e-05	6.254e-05
Likelihood ratio χ^2 (8,N=1228)	31.247***		60.654***		13.827.		178.93***	

Table 2 shows that the multiple regression model comprising all of the 8 P's is significant as a whole for all the endorsement rate, feedback rate and recommendation rate with a likelihood ratio $\chi^2(8, N=2355) = 31.247$ (endorsement), 60.654 (feedback) and 178.93 (recommendation) with $p<0.01$. The model comprising all of the 8 P's is not strongly significant for conversation rate although $p<0.1$ (likelihood ratio $\chi^2(8, N=2355) = 13.827$). It can however be considered as acceptable for conversation rate as $p<0.1$.

Regarding the effect of the 8 P's of luxury brand marketing on the endorsement rate, the results reveal that the Pedigree has a statistically significant relationship with an increase in the endorsement rate (B=1.623e-05, $p<0.05$). It has also been found that the use of Public Figures has a statistically significant relationship with a decrease in the endorsement rate (B=-1.747e-05, $p< 0.001$).

The results reveal that Paucity has a statistically significant relationship with an increase in the feedack rate (B=7.807e-05, $p<0.001$). It has also been found that the use of Public Figures has a statistically significant relationship with a decrease in the feedback rate (B=-3.972e-05, $p< 0.001$), a decrease in the conversation rate (B=-2.106e-06, $p< 0.01$), and a decrease in the recommendation rate (B=-1.543e-04, $p< 0.001$).

Furthermore, the results reveal that two P's have a statistically significant relationship with an increase in the recommendation rate. These P's include Performance (B=8.972e-05, $p<0.001$) and Paucity (B=6.114e-04, $p<0.001$).

7 Discussion and managerial implications

The empirical findings discussed in the previous section provide luxury brand managers with valuable guidance on how effective are each of the 8 P's of luxury brand marketing on social media. They also allow luxury brand managers to gain insights on how to formulate and implement effective social media marketing strategies to leverage their luxury brand

potential. Some of the 8 P's are more fundamental than others to create consumer engagement. The main marketing implication to be drawn from this study is that the individual constructs of consumer engagement could ultimately be controlled by emphasizing certain attributes of luxury brand marketing rather than others.

More specifically, factors contributing to higher endorsement rates are found to be primarily articulated around the Pedigree of luxury brands. Factors contributing to higher feedback rates are found to be articulated around the Paucity of luxury brands. This study is however not conclusive about whether any of 8 P's significantly contributes to the higher conversation rates. Finally, Performance and Paucity of luxury brands seem to be the main drivers of recommendations on Facebook brand pages for luxury brands. Therefore, it would seem advisable to make an effort to focus more on the above mentioned attributes of luxury brands to increase consumer engagement. It is also important to note that the use of Public Figures has been found to be related to a decrease in all of the engagement constructs.

Interestingly, the results differ from one luxury brand segment to another. Therefore, findings depend on the segment and specific characteristics of the segment can also play an important role in consumer engagement. The experimental settings created for this study can also serve as a "benchmark" for a particular segment of luxury brands so that brands can be compared and their engagement rates can be evaluated comparatively.

8 Conclusion and future research perspectives

This research has attempted to provide insights into the effectiveness of key attributes of luxury brand marketing at engaging consumers on social media platforms. These insights would allow managers to better design and implement social media marketing strategies generating higher consumer engagement in online social networking websites.

Despite these contributions, a number of limitations of this work provide a platform for the undertaking of further research in this emerging area. First of all, this empirical study was limited to Facebook brand pages. Other social networking websites could widen the scope of this research as it would be interesting to investigate additional constructs of consumer engagement on different platforms.

Moreover, this empirical research has covered a large number of luxury brands spanning across 6 segments. However, as a consequence of the large number of industries, this research did not get into the specificities of each industry domain that may display different engagement behaviour. For example, the hospitality segment has clearly a tendency to focus on the placement and pricing attributes, while the fashion segment does not use the pricing attribute at all. Thus, it is perhaps of a greater importance to take a deeper look at attributes of social media marketing strategies that are specific to a particular industry segment. Finally, future research is also needed to investigate additional attributes of luxury brand as noted by Rohit Arora (2012).

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Appendix. The sample of luxury brands considered in this study:

- **Cosmetics:** Biotherm, Givenchy, Guerlain, La Prairie, Lancome, Sisley.
- **Fashion and cosmetics:** Chanel, Christian Dior.
- **Fashion:** Ermenegildo Zegna, Fendi, Ferragamo, Giorgio Armani, Hermes, Louis Vuitton, Prada, Versace.
- **Jewellery:** Boucheron, Bvlgari, Cartier, Chaumet, Harry Winston, Mikimoto, Montblanc, Van Cleef & Arpels.
- **Liquor:** Dom Perignon, L'or De Jean Martell, Louis XIII, Macallan, Perrier Jouet, Ron Zacapa.
- **Resorts:** Amanruya, Armani Hotel Dubai, Fregate Island Private, Hotel Le Toiny, Hotel Turtle Island, Le Sirenuse, W-Hotel-Puerto Rico.
- **Watches:** Audemars Piguet, Blancpain, Breguet, Franck Muller, IWC, Jaeger-Le Coultre, Piaget, Rolex, Vacheron Constantin.
- **Yachts:** Azimut, Beneteau, Ferretti, Itama, Lurssen, Pershing, Princess, Riva, Sunseeker, Wally.
- **Cars:** Aston Martin, Bentley, Bugatti, Ferrari, Koenigsegg, Lamborghini, Maserati, Pagani, Rolls-Royce, Spyker.
- **Aircrafts:** Bellhelicopter, Bombardier, Cessna, Cirrus, Eurocopter, Gulfstream, Hawker Beech, Sikorsky.
- **Innovative brands:** Bose, Harley Davidson, Lotos, Segway PT, Steinway.

Fabrication And Scintillation Properties Of A Flexible Optical-Guiding Crystal Scintillator

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ABSTRACT

We describe the scintillation characteristics of a flexible optical-guiding crystal scintillator with a borosilicate glass cladding and a thallium-doped CsI (Tl:CsI) crystal as the core, respectively. During 662 keV -ray irradiation, the optical-guiding crystal scintillator as-fabricated displays a light production of 31,000 photons MeV1. The recrystallized sample is equivalent to single-crystal Tl:CsI in terms of transparency and light production, with a greater 54,000 photons MeV-1. 400 ns (or 28%) and 1,350 ns (or 72%) are the decay times. With excellent light yield, energy discrimination, and sensitivity to X- and -rays, this substance can function as a scintillator fiber.

INTRODUCTION

Plastic scintillation fibers (PSFs) are used in various detectors because of their softness, flexibility, and optical-guiding performance based on the refractive index difference between the core and cladding materials.[1–4)] PSFs with a diameter of several hundred micrometers and a length of more than 1 km are used in various detectors. A typical example is the use of a PSF in the identification of the incident position of a charged particle using the time of flight method.[5)] However, plastic scintillators have a low sensitivity for γ- and X-rays owing to their low effective atomic number and density.[6)] Inorganic oxide and fluoride scintillator fibers with a diameter of ~j 1 mm (single crystal fiber shape: SCFS) have been reported.[7–14)] Such inorganic scin- tillator crystals have higher effective atomic numbers and densities, resulting in higher sensitivity for γ- and X-rays. However, they are not flexible, and it is difficult to obtain continuous, long-distance fibers measuring greater than 1 m. In addition, it is also challenging to decrease the fiber diameter.

Certain halide-based scintillator materials such as chloride-, bromide-, and iodide-based scintillators have a smaller energy gap and higher light yield than oxide- and fluoride- based scintillators, and have therefore been the focus of attention in recent years.[15–23)] However, scintillation fibers based on chlorides, bromides, and iodides have not been reported because most of them are hygroscopic in nature. In this study, we developed an Optical-guiding Crystal Scintillator (OCS) based on a halide-based material. Similar to PSF, it has a double-layer structure consisting of a core and a cladding. When heavy inorganic scintillator crystals are used in the core with glass as the cladding, the sensitivity of the fiber for γ- and X-rays is high. As the refractive index of chloride-, bromide-, and iodide-based scintillator crystals are generally larger than that of glass, the scintillator exhibits optical-guiding performance based on total reflection. Furthermore, as the scintillator crystals are surrounded by

High-Energy Electron Beam From Laser Wakefield Acceleration Under Precise Aperture Aiming Control

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ABSTRACT

the installation of a circular aperture smaller than the laser diameter before the OAP and its movement perpendicularly to the laser axis enables the precise steering of high-energy electron bunches of several-hundred MeV. The steering of the electron beam is caused by the laser propagation axis tilting at the focal position without changing the focal position of the laser pulse. The parameters of the electron beam, generation point, divergence, and energy distribution, did not change much by shifting the aperture.

The installation of the aperture is quite easy, and the method is simple and effective because the high-energy electron beam can be controlled without any manipulation of the optics in the laser system. This technique is necessary for the future development towards practical uses and applications of laser−plasma accelerators such as a free electron laser. In particular, in staging LWFA for higher electron energy, μrad accuracy of the beam control is required for the injection of the electrons into the next laser wakefield. Further stabilization and precise control of the NFP of the laser pulse will be required for improvement of the pointing control of the electron beams.

INTRODUCTION

Laser wakefield acceleration (LWFA), which has an acceleration gradient three orders of magnitude higher than conventional RF accelerators, is expected to be a next-generation compact accelerator and has been studied and developed around the world. Since the proposal of the LWFA concept in 1979,[1)] its R&D has progressed with the development of ultrashort pulse laser systems. In the 2000s, quasi-monoenergetic electron beams[2–5)] and high-energy electron beams exceeding 1 GeV[6)] were observed. The maximum energy and minimum energy spread of the LWFA electron beam have already been achieved to be 8 GeV[7)] and less than 1%,[8)] respectively, but not at the same time. The stability of the beams has been improved by the stabilization of the laser system and the establishment of injection methods. Most recently, a group in Germany has achieved the continuous operation of a laser wakefield accelerator at 5 Hz exceeding 24 h with active stabilization.[9)] As one of the recent milestones in this research area, free electron lasing at 27 nm wavelength has been demonstrated by a group in China.[10)]

The beam-pointing control of the electron beams from LWFA is one of the most important issues for its practical use. In particular, for the staging acceleration of LWFA,[11,12)] the precise control of the electron beam pointing is necessary for injection into the next wakefield acceleration phase space of which the vertical size is small.

An Integrated Energy System Operational Cost Estimation Technique Considering Component Failures

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Abstract.
The integrated energy system (IES) is a popular area of research in the energy profession as the energy crisis gets worse and worse. The effect of component failures on the operational expenses of IES has not been taken into account in previous research. As a result, individuals frequently underestimate running expenses, and an overly optimistic operational strategy may result in mishaps like disruptions in the energy supply. In order to assess the normal and failure states of IES, this study suggests a technique of operational cost computation. Moreover, the failure rate and additional running cost are used to calculate the effect of component failures on the IES. The findings show that, in comparison to the conventional calculation technique, the operational cost when component failure is taken into account increases dramatically.

Introduction

Traditional forms of energy generation have a large adverse impact on the environment. It is a hot research direction in energy research to maintain the energy supply level and meet the energy demand while minimizing pollution to the environment. Integrated Energy Systems (IES)[1] adjust the operation of each part of the systems so that various forms of energy complement each other. IES helps improve energy efficiency. It can also help promote renewable energy usage, thereby reducing the use of traditional fossil energy sources. As an important indicator for evaluating IES, the economic index requires IES to meet energy supply needs and environmental protection standards while minimizing operating costs and maximizing economic benefits. Therefore, a cost analysis can inform the planning and operation of IES.
A large number of scholars have already studied the operating costs of IES. The reference[2] introduces demand response and cost of carbon into the scheduling strategy to optimize CO_2 emissionsand system costs. An IES model including PV, cogeneration, and battery storage was developed to maximize the utilization of PV. Optimization reduces battery life loss and lowers operating costs[3]. In order to reduce system costs and improve energy efficiency, an optimal operating model that considersthe energy price response is proposed[4]. A day-ahead dispatching strategy that includes electricity-to- gas components considering demand response is proposed[5]. It is experimentally confirmed that the dispatching strategy can shift load, increase income, promote renewable energy consumption, and improve energy utilization.
However, when a component fails, the energy dispatching scheme will change to meet the energy demand, and it will cause an increase in operating costs and harm economic interests. Along with the prolonged operation of IES, each component's loss and failure rate rise. The stability of the IES

Enhancement of CO_2RR product formation on Cu-ZnO-based electrodes by varying ink formulation and post-treatment methods

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Abstract

For the electrochemical CO2 reduction process, many catalysts have been described with better performance, such as extended lifespan and increased selectivity (CO2RR). Yet, very little is known about how the structure and pre-treatment of the electrodes affect this catalytic layer response. As a result, we describe in this article how changing the ink composition and applying an electrode treatment thereafter to the catalytic environment of a Cu-ZnO-carbon black catalyst before performing CO2RR. We also discuss the effects on the performance of the CO2RR of various solvents, ionomers, and additives used to prepare the ink as well as post-treatment activities like as pressing and sintering the produced electrodes. Although all electrodes having the same catalyst, there are notable variances in hydrophobicity, surface morphology.

1.Introduction

Tackling the negative effects of climate change requires new disruptive technologies. Along this line, the conversion of the greenhouse gas CO_2 into valuable chemicals is suggested to be key to achieve this goal [1]. A potential method to convert this molecule to e.g. multicarbon products is the use of surplus electricity from renewable energy sources to electrochemically drive this reduction. While the catalyst is key to facilitate the catalytic conversion of CO_2, the electrode assembly and reactor setup play an equally important role to achieve efficient CO_2 reduction reaction (CO_2RR) processes of industrial relevance. Along this line, a minimum current density of 200 mA cm^{-2} with Faraday efficiencies (FEs) of at least 60% for multicarbon products are required [2–5]. Herein, utilization of gas diffusion electrodes (GDEs) in continuously driven flow cells showed promising results toward this aim. High achievable current densities and cell voltages below 3 V further support the promising role of GDEs for industrial CO_2RR toward multicarbon products—e.g. Li *et al* reached a FE for ethanol of 41% at a partial current density of 250 mA cm^{-2} using an $Ag_{0.14}/Cu_{0.86}$ catalyst [6–10].
Among the large variety of reported catalysts, especially combinations of copper and zinc were shown to support the formation of C–C coupling products such as ethylene, ethanol, acetic acid, or propanol [11–13].

Platform for AI-Assisted Failure Location in an Optical Network

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Abstract

For the high-density interconnection scenario of data centres, we implemented the AI-assisted optical network fault location technique in the study by applying the customised AI module to the OTDR device and combining it with the optical power monitoring module. The data from optical links can be fully utilised by the process. The AI module can identify potential weak links using link data, and the optical power module will then keep an eye on the target links. The system has a quick way to identify broken links and react to them. According to the test, using an AI model can increase the link's average fault detection performance by 98.41%.

1. Introduction

As the data center gets bigger and bigger and the topological structure becomes more and more complex, a data center failure is a disaster that can cause the loss of huge amounts of data and the interruption of large calculations. At the same time, as the number of devices and links increases rapidly, the frequency of failure in optical networks of data centers increases and the number of alarms increases, which makes it difficult to locate faults and takes more time to rectify faults. How to locate the fault quickly and accurately from a large number of alarm devices has proven to be a thorny problem [1].

As reported by the Federal Communications Commission (FCC), more than one-third of service disruptions are caused by fiber-cable problems [2]. Therefore, automatic monitoring and diagnosis of optical fiber links are very beneficial. By introducing machine learning (ML) in data centers, it will not only revolutionize the (mainly manual and human) approach to the traditional management of fiber-optic network fault management [3]. It also helps optical network operators plan and schedule their maintenance activities more efficiently [4] and thereby save CAPEX/OPEX and reduce the time to repair (MTTR) by quickly discovering and pinpointing the link faults. This enables operators to more easily meet service level agreements (SLAs) and improve customer satisfaction by reducing downtime and improving network quality. In 2018, Rafique et al. [5, 6] proposed an optical layer fault detection architecture based on machine learning and defined four types of optical layer fault types. It was suggested to acquire and collect optical power monitoring data through the southbound interface of SDON, conduct data analysis through the ANN algorithm, and upload data analysis results through the northbound interface. In the same year, Huawei put forward the optical service fault prediction scheme combining artificial intelligence and big data technology, mainly taking the bit error rate (BER) and optical power as input to predict the optical service fault, and cooperated with operators to carry out the initial verification of the OTN live network. The prediction accuracy is 85%, which not only improves the robustness of their network but also reduces the network cost of inspection. Chen et al. [7] proposed a DNN-based optical transmission link fault detection scheme in which the clustering module of unsupervised learning and the DNN module of supervised learning were integrated to analyze the internal relationship between optical power and the alarm log to detect link faults. However, the above work only realizes the fault prediction and does not consider the problem of fault location.

Mathematical analysis and numerical methods of a stock loan pricing problem

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Introduction:

Stock loans are financial transactions where a borrower receives cash from a lender in exchange for securities that are used as collateral. The interest rate on the loan depends on various factors such as the type of security, its liquidity, and the borrower's creditworthiness. The pricing of stock loans is therefore an important issue for both lenders and borrowers. In this paper, we present a mathematical model for the pricing of stock loans and investigate its properties using mathematical analysis and numerical methods.

Model:

We consider a simple model where a lender offers a loan to a borrower using a single security as collateral. We assume that the price of the security follows a stochastic process described by a partial differential equation (PDE) of the form:

$$\partial u/\partial t + 1/2\ \sigma^2 S^2 \partial^2 u/\partial S^2 + rS\partial u/\partial S - ru = 0$$

Here, u(t,S) represents the value of the loan at time t and security price S, σ is the volatility of the security price, and r is the risk-free interest rate. The PDE is subject to boundary conditions representing the value of the loan at the maximum and minimum values of S.

We assume that the borrower defaults on the loan if the value of the collateral falls below a certain threshold. This threshold is represented by a barrier function B(S), which satisfies the condition B(S) > S. If the value of the security falls below the barrier function, the borrower defaults and the lender takes possession of the security.

To price the loan, we assume that the lender charges a constant interest rate, which we denote by α. The price of the loan at time t and security price S is given by the expected present value of the loan payments discounted at the risk-free rate r. Using the pricing formula for European call options, we can express the loan price as:

$$u(t,S) = e^{-r(T-t)}(\alpha B(S)N(d_1) - \alpha SN(d_2))$$

where T is the maturity of the loan, N is the standard normal cumulative distribution function, and d_1 and d_2 are the standard Black-Scholes option pricing model parameters.

Analysis:

A Student-to-Project Supervisor Assignment Problem Optimization Model: The Example of an Engineering Department

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ABSTRACT:

Empirical studies on the topic of assigning university project students to supervisors are currently underexplored. Such studies are critical to success of both the students and the university. Whilst extant research on this topic has contributed to an understanding of student assignments, what appears to be missing is application of a comprehensive framework to inform formulation and validation of a robust solution approach that takes account of both student and supervisor preferences, to optimize a real-life student-to-project supervisor assignment problem. *Methodology*. Questionnaire and interview surveys with project coordinators, project supervisors, head of department and students were conducted to identify factors surrounding the student-to-project supervisor assignment, through a case study approach in a university department ofering engineering degree programs. This study not only develops a framework to understand an efective student-to-project supervisor assignment decision but also applies it in practice, through a case study in a University department ofering engineering degree programs. An integer linear programming model was developed and implemented in an optimization software to optimize the student-to-project supervisor assignment, using data from the case study. *Findings*. Using OpenSolver, validated model results show improvements in matching both students and project supervisors' preferences, whilst complying with supervisors' workloads. These results also reveal an improvement in minimizing the project coordinator's time in doing the assignment by introducing a standardized approach that concurrently considers all variables in a consistent manner. *Originality*. The contribution lies in: (1) development of a robust framework for student-to-supervisor assignments, (2) explicit consideration of contextual factors that recognize diferent assignment scenarios, (3) identification of feedback loops to recognize not only the need for continuous improvement in student-to-supervisor assignments but also links to performance in final year projects, (4) unique insights to guide project coordinators in relation to an efficient, efective, comprehensive, and standardized approach to the student-to-project supervisor assignment, and
(5) a deeper understanding of a comprehensive range of factors that play a role in student-to-project supervisor assignments in higher education institutions.

1. Introduction

The assignment of students to project supervisors represents a category of assignment problems. This assignment prob- lem ought to be conducted in a transparent, standardized, comprehensive, and balanced manner free from decision makers' personal biases. Examples of applications of as- signment problems include assignment of students to courses ([1]) and assignment to students to supervisors and projects [2–9].

Existing empirical studies from operations research lit- erature have contributed to an understanding of the assign- ment of final year project students to supervisors, referred to in this study as the student-to-project supervisor assignment problem. This assignment problem, viewed as a process, has become an important area of interest for most universities, given the evolving nature of academic activities in relation to the need for efectiveness in processes. The literature reveals that this assignment process is treated informally in practice [10], in the context of reliance on intuitive approaches by project coordinators. These intuitive approaches fall into two categories namely: (1) random assignment and (2) permitting students to choose supervisors (and hence projects) by themselves. Whilst these two approaches may be necessary for both creativity and accommodating students' preferences for certain supervisors, there is a need to complement these approaches with a standardized and balanced approach that accommodates a number of important decision criteria. This need is crucial, given the complexity of the assignment process. This formalized approach adds to our understanding of what constitutes an efective student-to-project supervisor assign- ment process. Although existing studies have contributed to an understanding of assignment problems in general, the gap lies in using a comprehensive framework to inform mathe- matical model formulation and practical validation of the resulting model, taking into account both students and su- pervisor preferences concurrently.

Study Motivations and Research Gaps. Existing studies have contributed significantly by formulating mathematical models to aid student-to-supervisor assignments. However, these models do not accommodate opportunities to develop

Immersion in Plasma Radio frequency implantation of ions Plasma

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Abstract

Since plasma immersion ion implantation (PIII) mimics traditional ion-beam ion implantation (IBII) in specialised applications, it has garnered considerable interest. For instance, the technology allows for very high throughput, the implantation time is unaffected by the size of the sample, and irregularly shaped samples can still be implanted without the need for intricate beam scanning or sample manipulation. A capacitive coupled Radio frequency (RF) plasma operating at 13.6 MHz is utilised for uniform ion implantation and deposition on a variety of substrates, including silicon, stainless steel, etc. Physical factors that are anticipated to be important in the deposition process, such as RF power, Negative pulse voltage and pulse duration, gas type and gas mixture, gas flow rates, and the implantation dose, are researched throughout the PIII phase. The homogeneous model of rf plasma discharge takes into account Ohmic as well as stochastic heating to determine the plasma parameters from the V-I characteristic and power balance equation and the dynamic sheath model to calculate the ion dose. Discussion is had regarding the relationships between the physical and plasma parameters and the implantation process' yield.

1. Introduction

An efficient method for fabricating new materials and modifying surfaces is plasma immersion ion implantation (PIII) [1]. The primary driving force for the creation of this method was to enhance the surface qualities of materials [2]. PIII is currently used widely in fields such material surface modification, microelectronics, and the production of new materials [2-4]. A target object is submerged in a plasma during the PIII process, after which a series of high negative voltage pulses (HNVPs) are applied to the target to remove ions from the plasma and implant them into the target [6,7]. The electrons are evacuated from the target region on a time scale equal to the electron oscillation period when a short HNVP is applied [8]. In contrast, the ions that are unable to react to the pulse as quickly as the electrons do make very little movements away from their starting points. A zone of almost pure ion space charge, or an ion sheath, emerges next to the target surface as a result of the significant disparity in mobility between ions and electrons [9–11]. As a result, between the sheath border and the target surface, a potent electric field develops [4]. Theions are accelerated and implanted into the target on a much longer time scale [3]. In order to maintain a continuous flow of ions, the ion sheath continues to expand while the externally applied pulse is present. The evolution of the sheath is important for surface modifications, and is directly related to the optimization of discharge parameters, such as the plasma density and the duration and waveform of the externally applied pulse [4]. The plasma characteristics in the sheath have an influential role on the current density and the energy distribution of implanted ions, which determine the implantation efficiency. The homogeneity of the implantation process is directly related to the plasma properties. To achieve a homogeneous implantation process, it is necessary to use homogeneous plasma. Capacitivly couple radio frequency (CCRF) discharge is one of the suitable medium for producing homogeneous plasma and implementation of PIII process [12]. As a result of energetic ions, chemically active species, radicals and also energetic neutral species, rf

Globus-M2 Experiments in the Development of Fusion-Fission Reactors

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Abstract. In 2018, the Globus-M2 spherical tokamak, a new generation, was introduced. It retains the Globus-dimensions, M's but a new electromagnetic system makes it possible to produce a higher toroidal magnetic field and plasma current. In 2019, the first experimental campaign using a toroidal magnetic field of 0.7 T and a plasma current of up to 300 kA was completed. The plasma current and toroidal magnetic field were increased, which improved the discharge properties all around. Both the plasma temperature and the neutron rate significantly increased. A record stored energy level was attained, which is roughly 1.5 times higher than in the Globus-M trials. Current drive was clearly present at the launch of the toroidal lower hybrid wave. The next experimental campaigns with the stronger toroidal magnetic field and plasma current are now being prepared for.

INTRODUCTION

In 2018, the Globus-M2 [1, 2] (Fig. 1), a next generation spherical tokamak, was launched. It maintains the same dimensions as the previous Globus-M [3,4] (plasma major radius R 36 cm, minor radius a 24 cm, and elongation 2), but a new electromagnetic system enables it to achieve toroidal magnetic field BT and plasma current Ip that are up to two times higher: up to 1 T and 500 kA, respectively. First plasma was produced in 2018; discharges with BT = 0.5 T, Ip = 0.2 MA, which match the characteristics of the most recent Globus-M experimental campaign [5], were shown [6].

Diagnostics and heating and current-drive complexes were also upgraded along with the tokamak electromagnetic system. A second 50 keV 1 MW neutral beam injector was docked to the tokamak (see right third of Fig. 1). Power of the ion cyclotron resonance heating and lower hybrid current drive systems were increased. Neutral particle analyzer was equipped with a scanning platform, allowing change of the line of sight between tokamak shots. This system provides quasi-active measurements of the core ion temperature and anisotropic fast ion distribution. Five spatial points were added to the Thomson scattering diagnostics allowing electron temperature and density measurements at the plasma boundary. A single-channel dispersion interferometer was installed at the mid-plane of the tokamak. The plasma is probed along the line, symmetrical to the Thomson scattering diagnostics line of sight, providing the possibility of direct comparison of these diagnostics data. A system of two neutron spectrometers based on the BC501A liquid scintillator was added to the tokamak diagnostic complex allowing comparison of the calculated and measured neutron spectra.

Terahertz Emission from InGaN Quantum Wells Under Ultrafast Excitation: Influencing Variables

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Abstract

Strain is experienced in InGaN quantum wells (QWs) formed on c-plane sapphire substrate as a result of the mismatched lattice. Under ultrafast stimulation, the strain creates a potent piezoelectric field in QWs that aids in THz emission. Physical factors that affect the piezoelectric field's strength and cause THz emission include QW width, period number, and indium concentration. To further enhance the THz emission, experimental variables like pump fluence, laser energy, excitation power, pump polarisation angle, and incidence angle can be adjusted. The effects of physical and experimental THz emission parameters on InGaN QWs are summarised in this paper. THz emission in InGaN QWs is further explained by a comparison and relationship between photoluminescence characteristics and THz emission in QWs.

1. Introduction

With the advent of THz radiation-based spectroscopic techniques, efficient THz generation has become an urgent need [1–4]. The THz spectroscopy has applications in environmental monitoring [5], imaging [6], biomedical diagnosis [7], material characterization [8], food inspection [9], medicine inspection [10], communication technologies [11], detection of explosives [12, 13], etc. The THz generation has been observed upon ultrafast excitation of semiconductors, alloys, gas plasmas, and some material combinations including $LiNbO_3$ [14], ZnTe [15–17], GaAs [18], InAs [2, 19], $W/Co_{40}Fe_{40}B_{20}/Pt$ [20–23], InGaN [24], and quantum wells (QWs) [25–33], to name a few. The THz pulse generation is accomplished using various methods including photocurrent transients in gas plasmas, photocurrent surge from electro-optic materials [34–38], Cerenkov radiation in ferroelectric materials, diference frequency generation in nonlinear materials, spintronic emission from magnetic metal multilayers [23], and dynamic screening of electrostatic field in QWs [25, 27, 29, 30, 32, 33, 39–41]. Due to the extensive research on QWs for their importance in lighting applications, the growth technologies of QWs are mature and the rich underlying physics of QWs have been widely explored over the last few decades. One of the unique characteristics of InGaN/GaN QWs is the built-in electric field (of the order of MV/cm) originating from spontaneous and piezoelectric polarization in QWs grown along the [0001] crystal orientation of (c-plane) sapphire [42, 43]. The lattice mismatch between the QW and barrier materials results in a strain that causes piezoelectric polarization in QWs [44, 45]. The strong built-

Experimental Investigation of the Impacts of Several Water Flow Rates on the Evaporator's Heat Transfer Properties

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Abstract. Studies on the heat transfer properties of evaporators have been a popular topic in the refrigeration and heating industries ever since China announced the objective of "dual carbon." The water flow of the evaporator and condenser is changed in this work to conduct an experimental investigation on how well evaporators transmit heat at various flow rates. The findings demonstrate that, under the assumption of constant condenser water flow, the cooling coefficient of performance (COP) and heat transfer coefficient (HTC) increase when evaporator flow rates and water temperatures rise. However, the changes in HTC are rather smooth; the compressor's inhalation and expulsion temperatures rise as the evaporator's water flow rates rise, and the changes are reasonably gradual.

1. Introduction

The efficient use of energy has become increasingly important in science and technology as technologies advance continuously [1]. Evaporators are required for the manufacturing of goods in industries including metallurgy, petroleum, electricity, and chemical products. Evaporators are being used more frequently now than in previous years. An evaporator serves as a heat exchange element in a complete refrigeration and heating device when it is operating at a low temperature. The performance of the overall refrigerating and heating control system is significantly affected by the evaporator's properties [2–4]. Many experimental studies on the heat transfer properties of evaporators have been carried out by researchers both domestically and internationally. Jingyu Liu and Xinyue Yang researched ideas and experiments based on binary mixes of high-temperature electric heat pump cycle performance and quantifying irreversible loss in heat pump cycle expansion, respectively. The evaporator is another crucial and challenging area of study in the IEA and IIR heat pump in the American development plan [8], big heat pumps in the European research programme, and the super heat pump programme [7]. Because of this, experimental investigations on how to create new energy-saving evaporators and raise their operational efficiency are very important for research.

Doppler Backscattering from Filaments: Whole Wave Modeling

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Abstract. Using slab geometry and the finite-difference time-domain code IPF-FD3D, Doppler backscattering from filaments was modeled. Artificial filament-like disturbances with a wide range of parameter variations were employed in the simulation. The identification of the effect of the filament's amplitude and size on the DBS was the main goal of DBS signal modeling.

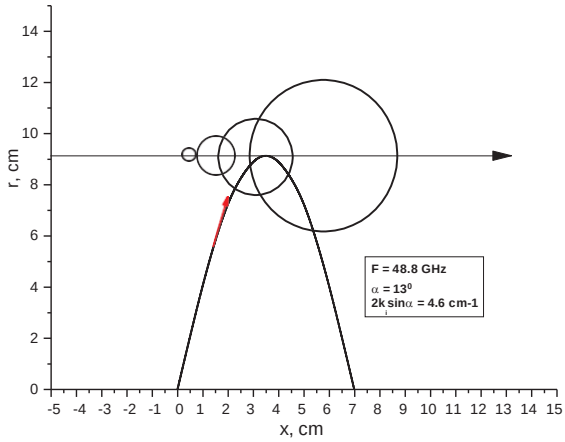

Figure 1 Ray-tracing for 48GHz and filament cross-section.

Our simulation was carried out using finite-difference time-domain 2D code IPF-FD3D in slab geometry [7]. We did not resort to using well-known non-linear MHD codes to determine filament parameters. In the simulation artificially created filament-like perturbations were used, the parameters of which varied over a wide range. Modeling DBS signal was focused on the identification of the influence of the amplitude of the filament and its size on the shape and size of the DBS output signal. The filament amplitudes with a Gaussian cross-section were varied from 0.1% upto 150% of density at cut off of the probing wave. The parameters of the computations are as following: antenna tilt angle α = 13°, antenna horn mouth 5,5 cm, Computations have been carried out for the frequencies 16GHz, 24 GHz, 32GHz, 40GHz, 48GHz, 56GHz, 64GHz of O-mode propagation. Gaussian beam with flat wave front in the antenna mouth. This dependency of the IQ (in-phase (I) and

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Overview of Recent Developments and Novel Concepts for Open Magnetic Traps

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Abstract. The fundamental issues with earlier generations of mirror traps, including as MHD, kinetic stability, and longitudinal thermal conductivity, were successfully resolved, allowing temperatures to be reached that were significantly greater than those predicted by sceptics in the early 2000s. The studies on magnetic mirrors in the Budker INP are summarised in this work along with their contribution to efforts on the subsequent linear machines. The current linear machine fusion programme makes use of both freshly developed and experimentally validated longitudinal particle and energy loss suppression techniques. Fusion with advanced fuels can be accomplished with a linear machine that has sufficiently improved longitudinal confinement. At GDT (gas-dynamic), GOL-NB (multiple mirror), SMOLA (helical), and CAT (diamagnetic) devices, methods of the suppression are validated. All of the discussed are included in the next-generation GDMT project.

INTRODUCTION

Advanced plasma confinement in magnetic mirrors features high relative pressure (local $\beta \approx 60\%$), mean energy of hot ions of 12 keV and electron temperature of up to 0.9 keV in stable regime today [1–3]. These parameters in gas-dynamically confined plasma exceed both the design parameters of the GDT (gas-dynamic trap) device and the parameters, which can be obtained in linear plasma with classical longitudinal thermal conductivity [4]. The main drawbacks, which led to the decrease of the research activity on the linear machines, were MHD stability of the plasma column, kinetic instabilities driven by the anisotropic ion distribution function and high longitudinal particle and energy losses [5]. The progress in confinement became possible due to the implementation of new techniques. The problem of the MHD stability was solved by the vortex confinement, which limits the most dangerous modes (except m = 1 flute mode) by the strongly sheared azimuthal rotation of the plasma periphery [6, 7]. Drift Cyclotron Loss Cone (DCLC) instability, which led to the scattering and loss of the fast ions in previous experiments [8], has no significant effect with skew neutral beam injection and gas-dynamically confined warm ions, which populate loss cone. An appropriate conditioning of the end expander zone leads to the suppression of the electron channel of the heat losses [9], therefore the moderate power of the local ECR heating makes it possible to exceed the temperature limits of the classical mirrors.

Numerical simulations of the simple gas-dynamic trap with these three problems solved shows the possibility to achieve fusion gain Q ~ 0.1–0.5 appropriate for fusion neutron sources in a relatively small mirror machine (plasma radius r ~ 20 cm, length of the active zone L ~ 14 m) [10]. At the same time, technically achievable magnetic fields limit the mirror ratio, and the simple gas-dynamic trap with Q >> 1 should be inadequately long (about 3–5 km) [10].

Mirror machine for fusion requires improved longitudinal confinement [11]. Suppression of the particle losses was already shown in multiple-mirror scheme [12]. Due to the diffusive outflow in the case of the ion mean free path comparable to the length of the individual mirror cell particle losses are suppressed by the factor of the number of the cells N. In technically achievable case, simple mirror ratios of ~10–20 can be backed by 10–20 multiple-mirror cells, providing an effective mirror ratio above 100 [13]. The compatibility of the gas-dynamic and multiple-mirror confinement is being experimentally verified now on GOL-NB (from Russian Corrugated Open Trap with

Neutral Beams) device [14]. Such combination gives fusion gain $Q_{DT} > 1$ in a ~300-meter-long linear machine [13]

Globus-M2 Experiments in the Development of Fusion-Fission Reactors

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Abstract. In 2018, the Globus-M2 spherical tokamak, a new generation, was introduced. It retains the Globus-dimensions, M's but a new electromagnetic system makes it possible to produce a higher toroidal magnetic field and plasma current. In 2019, the first experimental campaign using a toroidal magnetic field of 0.7 T and a plasma current of up to 300 kA was completed. The plasma current and toroidal magnetic field were increased, which improved the discharge properties all around. Both the plasma temperature and the neutron rate significantly increased. A record stored energy level was attained, which is roughly 1.5 times higher than in the Globus-M trials. Current drive was clearly present at the launch of the toroidal lower hybrid wave. The next experimental campaigns with the stronger toroidal magnetic field and plasma current are now being prepared for.

INTRODUCTION

In 2018, the Globus-M2 [1, 2] (Fig. 1), a next generation spherical tokamak, was launched. It maintains the same dimensions as the previous Globus-M [3,4] (plasma major radius R 36 cm, minor radius a 24 cm, and elongation 2), but a new electromagnetic system enables it to achieve toroidal magnetic field BT and plasma current Ip that are up to two times higher: up to 1 T and 500 kA, respectively. First plasma was produced in 2018; discharges with BT = 0.5 T, Ip = 0.2 MA, which match the characteristics of the most recent Globus-M experimental campaign [5], were shown [6].

Diagnostics and heating and current-drive complexes were also upgraded along with the tokamak electromagnetic system. A second 50 keV 1 MW neutral beam injector was docked to the tokamak (see right third of Fig. 1). Power of the ion cyclotron resonance heating and lower hybrid current drive systems were increased. Neutral particle analyzer was equipped with a scanning platform, allowing change of the line of sight between tokamak shots. This system provides quasi-active measurements of the core ion temperature and anisotropic fast ion distribution. Five spatial points were added to the Thomson scattering diagnostics allowing electron temperature and density measurements at the plasma boundary. A single-channel dispersion interferometer was installed at the mid-plane of the tokamak. The plasma is probed along the line, symmetrical to the Thomson scattering diagnostics line of sight, providing the possibility of direct comparison of these diagnostics data. A system of two neutron spectrometers based on the BC501A liquid scintillator was added to the tokamak diagnostic complex allowing comparison of the calculated and measured neutron spectra.

Soft Skills Development in Personnel Training

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Abstract.

The importance and demand of graduates on the labor market, the ability to quickly adapt to the demands of the employer or to change majors in a short time is one of the key aspects that is increasingly important and necessary. This is related to the increasing amount of information and the increasing level of uncertainty. The development of students' soft skills (along with professional skills) helps to improve flexibility, quick reaction and decision-making speed, as well as sensitivity, systematic solving ability. The result is a stable personality and a professional employee. The article presents a study on the development of soft skills of undergraduate students of the Samara State Agricultural University. The obtained results showed important ways, approaches and methods to develop soft skills. Recommendations for the development of students' soft skills were also analyzed. It is proven that further training, especially related to foreign languages, contributes to the development of the following soft skills: multilingualism and multiculturalism, the ability to work with people, the ability to work in unstable conditions, creative thinking and behavioral flexibility.

1 Introduction

During the course of professional education, hard skills are built. They serve as the foundation for the necessary professional abilities and are easily measured and trained. In the contemporary world, soft skills are becoming more and more important. These are the lifelong abilities that are developed first in the family and subsequently in society. They aid in the graduates' swift social and professional integration into a new workplace or rapid career transition. All of these contribute to the graduate's increased competitiveness on the job market. Soft skills are referred to by a variety of names, including life skills, flexible skills, and overly professional skills.

The skills of the twenty-first century are soft skills. The relevance of soft skills is increasing today, despite the fact that the first studies on the topic were presented at the CONARC Soft Skills Conference in the West in the 1970s. Novel techniques and strategies have been created. The impact of soft skills on one's career path and future is defined by numerous researchers in this field. Further soft talents can be mastered and developed to create new professional prospects. Approaches to assessment methodology of soft skills have not been well developed in contrast with the professional skills evaluation [1]. Nevertheless the level of development of employee`s one type of soft skills or the other influences the employer`s final decision. Itproves the relevance of systematic soft skills development in the personnel training for the increase of employee`s competitiveness at the labor market. There is a number of fundamental scientific papers dedicated to the soft skills and the professions of the future: “Atlas of the professions of the future” developed by the Agency of strategic innovations
[2] and reports of company group (including Sberbank and WorldSkills Russia) “Russia 2025: from human resources to talents” [3].

The soft skills are divided according to “the Atlas” into the following: System thinking,
Intersectoral communication,

Multilingualism and multiculturalism (fluent English language and the second language competence, the understanding and awareness of national and cultural context of partner countries, the awareness of professional sphere in other countries)

Improving classification algorithm on education dataset using hyperparameter tuning

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Abstract

In this study, researchers use the Placement Data Complete Class for campus recruiting dataset to provide a classification approach for every institution's potential for campus placement. The supervised learning classification methods, such as Logistic Regression, Support Vector Classifier (SVC), K-Nearest Neighbors (KNN), Gaussian Naive Bayes, Decision Tree, Random Forest, Gradient Boosting, and Linear Discriminant Analysis, are being studied by researchers (LDA). The supervised methods are additionally improved through the use of hyperparameter tuning. According to experimental findings, Linear Discriminant Analysis (LDA) can perform more accurately and produce better results than other algorithms by applying hyperparameter adjustment

Keywords: Supervised classification; logistic regression; support vector classifier (SVC); K Nearest Neighbors (KNN); Gaussian Naive Bayes; decision tree; random forest; gradient boosting; Linear Discriminant Analysis (LDA); hyperparameter optimization; campus recruitment.

1. Introduction

As universities look to the future, numerous challenges are emerging. Increasing competition and public demand on education urge university to develop a better curriculum system for students. Moreover, higher education recognizes that it is a service industry and has great impacts on meeting the expectations and needs of students [1].

One of the most important business-process in university is recruitment of the new students, whether bachelor or master's degree. It means, if there are no new recruitments, there will be no business processes on teaching and learning for universities. Recruiting students is one important task to do in a university as it makes sure that core business, teaching and doing research can keep going. As a result, universities should recruit students to keep exist and work as an established institution [2]. Worldwide universities are effectively looking for new methods for enrolling and holding students from across nations, as it is widely assumed that universities recruiting international students because they need to represent plurality in a university: equal education for everyone. According to a research, student enrollment and retention can be utilized to increase accountability arguments [3].

Numerous research have been conducted, utilizing various procedures, to use environmental data to predict recruitment [4]. Probabilistic classification models allow to determine the degree of uncertainty related to a prediction [5]. The known classification methods are K-Nearest Neighborhood (K-NN) [6], Logistic Regression [7], Support Vector Classifier (SVC) [8], Gaussian Naive Bayes [9], Decision Tree [10], Random Forest [11], Gradient Boosting [12], and Linear Discriminant Analysis (LDA) [13]. Previous studies about campus placement for students also conducted by using Ensemble Voting Classifier [14]. The researchers of this paper try to develop a better classification method to generate the best result for campus placement problem.

In this paper, researchers attempt to address issue about university recruitments for new master students. More specifically, researchers try to compare several classification methods to solve student recruitment problem.

Complexity analysis and representation in relation to the mathematical theory of living systems

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Keyword: living systems complexity, functional sunsystems, active particle, statistical presentation

a b s t r a c t

1. The difficult task of creating a mathematical theory for living systems is the focus of this paper, the first of a series. We take into consideration systems made up of several living things—so-called "active particles"—that may communicate and interact with one another. The author offers a personal approach, focusing primarily on the depiction of systems based also on a strategy to reduce their complexity, beginning with the identification of a number of common traits of living systems that can be seen as sources of complexity. The overall system is divided into functional subsystems, each of which is represented by a probability distribution over the microscopic state of its associated active particles.

2. Introduction

The study of complex systems, namely systems of many individuals interacting in a nonlinear manner, has received in recent years a remarkable increase of interest from applied mathematicians [1]. Their interest follows that, already well settled, of physicists and researchers in various other fields as engineering, economy or social sciences.

Focusing on large systems constituted by several living entities, it is very difficult to understand and model them based on the sole description of the dynamics and interactions of a few individual entities localized in space and time. In other words, the modeling of individual dynamics does not lead in a straightforward way to a mathematical description of collective emerging behaviors. Understanding the rôle of nonlinear interactions is indeed one of the greatest challenges in the studyof complex systems, considering that they are at the core of the emergence of qualitatively different states, namely, new collective states that are not mere combinations of the states of the individual units belonging to the system. In other words, the dynamics of each entity is not determined by the dynamics of all other entities, but by their action as a whole.

A remarkable conceptual difficulty arising from dealing with living system is the lack of fundamental paradigms (first principles) about equilibrium and conservation rules. Some reasonings on this matter are offered in various papers [2–8], and books [9–11]. This lack of paradigms has prevented that various existing models of biological phenomena, even successful under many respects, could generate a biological–mathematical theory analogous to historical theories born fromthe encounter between mathematical and physical sciences.

Moreover, causality principles are almost always lost due to the heterogeneously distributed ability of living systems to express a strategy often related to their will to survive. More precisely, it is a complex output related to the afore-mentioned ability to express specific strategies that may change not only due to the presence of other entities, but also as a consequenceof environmental conditions.

A Study of Neutrosophic Functions' Derivative and Integration

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Abstract

This paper's goal is to analyse and define the AH-Isometry, a class of neutrosophic real functions with one neutrosophic variable dependent on geometric isometry, using a variety of real analysis concepts, such as continuity, differentiability, derivativility, and integrability. Several common functions in the neutrosophic environment, such as the logarithmic function, exponential function, and trigonometric functions, have formal formulations that we have described. Rising to neutrosophic functions are included in the well-defined rising neutrosophic derivative, indefinite integral, and definite integral.

Keywords: Integration, Derivative Neutrosophic Function, Indefinite Integral Neutrosophic Function, and Definable Integral Neutrosophic Function are all terms used in Neutrosophic Real Analysis**.**

Introduction

Neutrosophy is a new branch of philosophy concerns with the indeterminacy in all areas of life and science. It has become a useful tool in generalizing many classical systems such as equations [1,9], number theory [2,3], topology [4,5], linear spaces [6,10], modules [4,5], and ring of matrices [7,8].

In the literature, we find many studies about neutrosophic calculus, where some definitions and properties were presented about neutrosophic real functions and numbers [10].

The neutrosophic real functions with one variable were defined only in a special case [11], as follows:

$(\boldsymbol{x}) = (\boldsymbol{x}) + (\boldsymbol{x})$ where $\boldsymbol{I}$ takes an interval value defining what is called by neutrosophic thick functions . For example$(\boldsymbol{x}) = \boldsymbol{2x} + \boldsymbol{5xI}, \boldsymbol{I} \in [\boldsymbol{0}, \boldsymbol{0.01}]$ is a neutrosophic real thick function.

The problem with this definition, that it does not consider the general case $\boldsymbol{f}: (\boldsymbol{I}) \rightarrow (\boldsymbol{I})$; $\boldsymbol{f} = (\boldsymbol{X})$

And $\boldsymbol{X} = \boldsymbol{x} + \boldsymbol{yI} \in (\boldsymbol{I})$.

Recently, Abobala et.al, have presented the concept of two-dimensional AH-isometry to study the correspondence between neutrosophic plane $(\boldsymbol{I}) \times (\boldsymbol{I})$ and the classical module $\boldsymbol{R^2} \times \boldsymbol{R^2}$. Also, the one-dimensional AH- isometry between R(I) and $\boldsymbol{R} \times \boldsymbol{R}$. This isometry was useful in defining inner products and norms [10], ordering [9], and neutrosophic geometrical shapes [10].

A Novel Approximate Approach to the Solution of Systems of Linear and Nonlinear Differential Equations

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ABSTRACT. In order to improve the precision and convergence of solutions for differential equations, a new approximation method is put forth in this study. This approach derives from the Taylors' series. Several kinds of linear and nonlinear differential equation systems have been solved using the given method with the initial conditions. To evaluate the method's efficacy, accuracy, and convergence, four examples have been provided. The suggested approach's solutions were also contrasted with those found using the Homotopy analysis method and the Adomian decomposition method (ADM) (HAM). In terms of accuracy and convergence, the results of the suggested method fared better than those of the alternatives.

Keywords: Non-Linear Operator, Approximate Solution, Accuracy, Taylors' Series, Differential Equations System.

INTRODUCTION

It is very rare that a real-life phenomenon can be modeled by a single partial differential equation. Different systems of ODEs and PDEs have applied to describe these phenomena. There are a lot of numerical and approximation methods that use to solve these systems.

Recently, several numerical methods have been developed to solve ODEs and PDEs systems, which can be found in [1], [2], [3], [4], [5], [6], [7], [8]. These techniques consider a necessitate as computational resources to solve some problems that appear in other sciences such as in image processing [9]. Still, these techniques perhaps complicated and require a high computational cost for solving different linear and nonlinear systems of ODEs and PDEs. To avoid these defects, analytic approximate methods have used to solve the linear and nonlinear systems of differential equations.

There are many used approximate methods to find the exact solution, such as nonlinear self-adjointness and conservation method [10], multiplication generating method [11], a generalization of the overdetermined method [12], etc. Also, there are other types of approximate techniques that combine the exact and approximate methods, which can be found in [13], [14], [15], [16], [17], [18], [19], [20].

One of these methods which has received much concern is the Adomian decomposition method (ADM) [13]. The ADM has been employed to solve various linear and nonlinear models. The ADM yields a rapidly convergent series solution with much less computational work [21]. The ADM is unlike the traditional numerical methods, where ADM is used extensively to solve nonlinear differential equations because it works based on calculation Adomian polynomials for non-linear terms [22] and [23].

While, the approximate solutions of differential transform method (DTM) [15], are as a polynomial form which is different from the traditional higher-order Taylor series method because the Taylor series method needs huge computational for large orders. So, the DTM uses a different procedure to obtain an analytic Taylor series solution of the PDE [24].

A useful introduction to probability distributions

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Abstract: This essay's goal is to provide a general description of probability, along with an analysis of its key mathematical properties and the characteristics it exhibits in many situations. The characteristics of the phenomena we would anticipate are connected to the behaviour of probability. Probability distributions can be used to define this relationship. There is a definite probability distribution given the properties of phenomena (which we can also characterise as variables). A binomial or Poisson distribution may often be used to represent the probability for categorical (or discrete) variables. The probability may be expressed for continuous variables using the normal distribution, which is the most significant statistical distribution. A basic description of probability distributions is provided, along with a few examples of potential applications.

Keywords: Probability distributions; discrete variables; continuous variables

A short definition of probability

We can define the probability of a given event by evaluating, in previous observations, the incidence of the same event under circumstances that are as similar as possible to the circumstances we are observing [this is the frequentistic definition of probability, and is based on the relative frequency of an observed event, observed in previous circumstances (1)]. In other words, probability describes the possibility of an event to occur given a series of circumstances (or under a series of pre-event factors). It is a form of inference, a way to predict what may happen, based on what happened before under the same (never exactly the same) circumstances. Probability can vary from 0 (our expected event was never observed, and should never happen) to 1 (or 100%, the event is almost sure). It is described by the following formula: if X = probability of a given x event (Eq. [1]):

$$\sum P(X = x) = 1 \quad [1]$$

This is one of the three axioms of probability, as described by Kolmogorov (2):

(I) If under some circumstances, a given number of events (E) could verify (E_1, E_2, E_3, …, E_n), the probability (P) of any E is always more than zero;

(II) The sum of the probabilities of E = $P(E_1)$ + (E_2) + … + P (E_n) is 100%;

(III) If E_1 and E_3 are two possible events, the probability that one or the other could happen P (E_1 or E_3) is equal to the sum of the probability of E_1 and the probability of E_3 (Eq. [2]):

$$P(E_1 \text{ or } E_2) = P(E_1) + P(E_3) \quad [2]$$

Probability could be described by a formula, a graph, in which each event is linked to its probability. This kind of description of probability is called probability distribution.

Binomial distribution

A classic example of probability distribution is the binomial distribution. It is the representation of the probability when only two events may happen, that are mutually exclusive. The typical example is when you toss a coin. You can only have two results. In this case, the probability is 50% for both events. However, binomial distribution may describe also two events that are mutually exclusive but are not equally possible (for instance that a newborn baby will be left-handed or right-handed). The probability that x individuals present a given characteristic, p, that is mutually exclusive of another one, called q, depends on the possible number

The Application of Probability Statistics to Solve the Practical Problems

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ABSTRACT:The mathematical approach of probability statistics is used to discover the statistical rules governing the occurrence of random events in the natural world. Probability statistical knowledge has gained popularity as science and technology have advanced, and it is now widely used in industrial and agricultural production, the national economy, as well as day-to-day living. This article examines the use of probability statistics to resolve real-world issues, focusing primarily on the relevant understanding of the Bernoulli scheme, common school, and mathematical expectation.

Keywords: Bernoulli scheme, normal school; mathematical expectation

INTRODUCTION

As one mathematical branch, the probability statistics has innumerous links with our life[1-6]. People master the nature of things by observing the random phenomena and researching its statistical law, and therefore applying the probability statistics thinking to the practice to guide our behaviors [6]. The following is the practical application of the probability statistics knowledge.

The application of Bernoulli scheme to the insurance industry

We often contact the social insurance in real life. With people paying more and more attention to the properties, safety, retirement and others of themselves and their family members, the social insurance has received more and more attention.

Take an example: assuming that 2500 people at the same age and social class join the life insurance of some insurance company. On January 1, each of them pays 120 insurance expenses to the company, and the family members can receive 20 thousand insurance benefits from the company when the insured dies. Assuming that the death probability within one year is 0.002, the question is: the probability that "the insurance company losses money" is?

The analysis is: assuming that "whether the people will die or not within one year" is as one test, thus 2500 people take part in this test, then the question turns to be the 2500 Bernoulli scheme, assuming that the death probability of each person within one year is P=0.002, and that the death record each year of the insured is X, thus

$$P(X = k) = C_{2500}^{k} 0.002^{k} (1 - 0.002)^{2500-k}$$
$$(0 \le k \le 2500)$$

And assuming that "the insurance company losses money" is the incident A, X is the number of the death toll, then the company shall pay 20000 by X (Yuan), the total income of the company shall be 2500 by 120 (Yuan). If the company pays more than its income, that is 20000 by X is greater than 2500 by 120, thus the company will lose money.

Solve the inequation 20000 by X is greater than 2500 by 120, to obtain X is greater than 15. And then $P(A) = P(X > 15) = C_{2500}^{k} 0.002^{k} (1 - 0.002)^{2500-k} \approx 0.000069$,

Therefore the insurance company "benefits a lot" and basically will not lose money.

The application of normal school to selecting the travel routes

The normal school has its extremely broad practical background, which prevails in mathematics, physics, medical science, engineering and other fields, therefore the probability distribution of so many random variables in the practical problems is subject to normal school. For example measuring the random error of the same object in physics; the red blood cell count and the mean corpuscular and others in the medical science; the students' intelligence level in educational statistics; under the certain production

Using mathematics communication as a substitute to get around undergraduate students' barriers to mathematical proof

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ABSTRACT

Students frequently struggled to prove ideas, according to observations at the educational staff education institution Department of Mathematics Education Institute of Teacher Training and Education Pontianak (IKIP) (theorems in mathe-matics). This study's alternative was to help students improve their proof skills through mathematical communication. Qualitative research with a case study was the research methodology employed in this study. Two undergraduate students who had been given real analysis introductions and were the study's subjects. Tests and interviews were utilised as the data collection methods. Data reduction, data display, and conclusion were the data analysis strategies used. based on research, theoretical study, and discussion findings.

Keywords: Mathematics Communication; Mathematical Proof; Square and Triangle; Learning Media

1. INTRODUCTION

Experts at the National Council of Teacher of Mathematics (NCTM) include mathematical evidence as one of the components of a standard mathematical process in schools (NCTM, 2000). The inclusion of mathematical evidence into the components of the mathematical process of the standard implies that the topic must be mastered by students. This obligation also has implications for teachers and prospective mathematics teachers to master it in its entirety. The topic of mathematical proof is often a subject of con-versation among experts, because this topic tends to be difficult to learn by students whose mathematical achievements are on average down. Some foreign studies have found that there are still many students who experience difficulties in proving (Ozdemir & Ovez, 2012; Guler, 2016; and Selden & Selden, 2003). This difficulty is also often found by researchers when teaching undergraduate students in real analysis introduction.

Experiences at the Educational Personnel Education In-stitution, Mathematics Education Program Study Program Institute of Teacher Training and Education Pontianak shows that students often have difficulty in proving propositions (theorems in mathematics) (Hodiyanto, 2017). This experience also happened in other regions, this was revealed from the study of Maya and Sumarmo (2014) and Andri (2013). Students generally experience difficulties when planning, implementing plans, and checking the validity of proof of a mathematical proposition. The reason, among others, is hampered from recognizing important information in a mathematical proposition. As a result they: (1) fail to identify what is known and what will be proven; (2) exchanging what will be proven by what is evidence (Weber, 2003; Recio and Godino, 2001). These obstacles occur repeatedly in every mathematics course.

Other things that are predicted to be the main cause of the recurrence of obstacles, namely the instructor uses a formal approach as adopted by structuralist ideas. Mathematics is delivered in the order of lecture methods that have been used so far in the following order: (1) theory / definition / theorem; (2) examples are given; (3) given problem training (Soejadi, 2000). The use of structuralist understanding is not without reason, established students in deductive thinking because they are considered to have existed in the stage of formal thinking so that the order of mathematical presentation as such is justified theoretically. However, such theoretical justi-fication seems to be weakened by the recurring barriers of students who are capable of a downward average in learning proof of mathematics when taught with structuralist ideas. Therefore, it is necessary to find an alternative. The alternative offered through this research is to develop students' abilities in proof through mathematical communication. Some considerations for choosing mathematical commu-nication as an alternative to develop students' abilities in proof. First, mathematical communication is a way of sharing ideas and clarifying

Statistics and probability: A tale of two worlds?

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Important terms and phrases: refereed journals, productivity rankings, research in probability and statistics, and bibliometrics.

ABSTRACT

The paper that was originally published in this Journal at the end of 1997 is now complete with this comparative analysis of research output and publication practises in probability and statistics. It is based on an analysis of 18 international publications published internationally over a ten-year period, half of which have a focus on probability theory and the other half on statistics. For nations and institutions that contributed to fundamental research in these two connected domains during the years 1986-1995, paper, author, and adjusted page counts provide quick metrics of productivity. The volume of research, length of articles, coauthorship practises, and other factors show that probabilists and statisticians have quite different cultural backgrounds. One of the countries with the greatest contributions to the growth of these two fields is Canada.

1. INTRODUCTION

Since the middle of the 1980s, increased financial pressure on governments has gradually led a number of national granting agencies to use objective and subjective performance indicators in their allocation of public funds to institutions, individuals and teams of individuals active in research in different fields of science. Johnes *et al.* (1993) report how a British advisory group assessed research quality and productivity in a national selectivity exercise conducted in 1989.

In preparation for a similar review undertaken by the Natural Sciences and Engineering Research Council of Canada, the author (Genest 1997) surveyed sixteen international statistics journals over the period 1985–1995. He produced worldwide rankings of countries and institutions based on paper, author and adjusted page counts, in an attempt to gauge the research productivity of the Canadian statistical community.

The present paper complements this study by comparing the research output and publication habits of probabilists and statisticians of the world over approximately the same period. National and institutional rankings are derived from a 1986–1995 survey of eighteen international journals, half of which are specialized in probability theory and the other half in statistics. The database is described in Section 2, and some of the differences between publication practices of probabilists and statisticians are highlighted in Section 3, with regard to the length of papers, the frequency of coauthorships and international collaboration. National and institutional rankings are then presented and discussed briefly in Sections 4 and 5, and Section 6 provides some general information based on individual performance. The relative positions of probability and statistics in Canada are further examined in Section 7, and a brief discussion concludes the paper.

Beyond budgetary allocation concerns, the productivity rankings provided here suggest benchmarks that may assist national and institutional policy makers who wish to set priorities for science, elaborate development strategies for their constituency, or attract clientele or personnel. Comparisons with similar findings reported ten years ago by Phillips *et*

An Integrated Framework for Functional and Non-functional Study of Software Architectures

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Abstract
Software systems' functional and non-functional analysis are frequently done separately, which frequently makes it impossible to think about design solutions that would be obvious if an integrated study were feasible. Software developers are really losing valuable input due to a lack of analytical integration, which might have improved the quality of the programme or, even better, prevented late software discrepancies with regard to functional or non-functional needs. In this research, we present a framework for integrating software analysis. Software models and formal relationships between models make up the XML-based framework's core. The relationships aid in the automated spread of analytical feedback amongst software models. We outline the integration of several analytical approaches within our system.
Keywords: XML Schema, non-functional analysis, and functional analysis.

1 Introduction

Software analysis has always been a non-trivial activity along the software development process, due both to special skills required to developers and to short time-to-market. On the other end, as the software systems progress and find new application environments (e.g. heterogeneous platforms, mobile devices, etc.) the analysis of functional and non-functional properties is becoming a primary concern to meet customer requirements.

Major efforts have been spent in the past for the functional analysis of software systems, that brought nowadays to offer quite sophisticated (formal and semiformal) methodologies and tools to verify and validate the functional behaviour of a software system since the early phases of its lifecycle [1]. On the contrary, non-functional attributes (such as performance, security, etc.) have not received the same consideration. Only in the last few years the idea of integrating such type of analysis along the whole software lifecycle has been supported from new methodologies aimed at filling the gap between the software development process and its non-functional validation [2].

The rationale behind this paper is that the software evolution seems to ask

Combined effect of natural dispersant and a stabilizer in formulation ofhigh concentration coal water slurry: Experimental and rheological modeling

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Keywords:
Acacia auriculiformis (surfactant)
Critical micellar concentration
Carboxymethyl cellulose (stabilizer)
Coal-water slurry
Rheological modeling

A B S T R A C T

The present study deals with the formulation and stabilization of a high concentration coal-water slurry using a sub-bituminous bimodal coal sample and a dispersant derived from the plant Acacia auriculiformis in the presence of the stabilizer carboxymethylcellulose. For the first time, we investigated the surface activity of A. auriculiformis natural surfactants isolated by chemical and aqueous extraction methods by calculating their critical micelle concentration (CMC) from surface tension measurements. The CMC of the isolated dispersant was found to be 0.021 g/cm3 and 0.010 g/cm3 by chemical extraction method . Four coarse particles of different sizes, such as 217-295 μm, 97-295 μm, 155-217 μm, and 80 -1 5 μm, were mixed with fine particles below 37 μm to form the bimodal coal samples Sa-1, Sa-2, respectively Sa-3 and Sa- . Apparent viscosity of coal slurry was studied as a function of coal particle size variation, different coarse to fine coal ratio, coal concentration (60-67.2%), A. auriculiformis concentration in the area. (0.01-0.021 g/cm3) and stabilizer content (0.001-0.01 g/cm3). The addition of carboxymethyl cellulose as a stabilizer increased the carbon content and durability of the sludge. The effect of the functional group of the surfactant was discussed in explaining the stabilization mechanism of coal-water sediments. A theoretical simulation is given to prove the experimental observation.

1. Introduction

One of the major factors that decide the socioeconomic growth of a country is the extent of industrialization which in turn solemnly depends on the accessibility to power generating sources. Due to the depletion of the natural energy sources as a result of climatic change and exhaustive uses by modern society, significant awareness has been perceived for the production of alternative energy sources [1,2]. Coal in particular, has been receiving worldwide attention as alternative fuel similar to hydrogen fuel, biodiesel, bioethanol etc. due to its ability to replace fuel oil in several industrial applications. At this cross road, it is inevitable to have a controlled utilization through up gradation of quality of coal and minimal expenses with restricting wastage of during transportation. Coal is usually, delivered as energy source to many industries in liquid form popularly known as coal water slurry (CWS) due to its low cost, ease in handling and ability to produce large amount of heat energy on combustion [3]. CWS is the concentrated solution of coal in water, the effectiveness of which depends on its coal content and free-flowing characteristics. But due to the association of nonpolar coal as result of Vander Waal interactions, CWS splits into two phases obstructing its pouring characteristics. Thus, attempts are being made from time to time to formulate stable CWS with increased coal concentration and durability. In order to maintain the smooth flow of concentrated CWS, several physical and chemical methods have been developed which inhibit the interactions among coal particles. The physical methods like microwave irradiation [4], exposure to ultrasonic radiation [5,6], changing the pH [7,8] and temperature of the medium [9].

Surfactant molecules are amphiphilic in nature and consist of a long chain hydrophobic, tail and hydrophilic head. Surfactant has the unique property to reduce the surface tension of water on mixing with it. Above a particular surfactant concentration when air-water interface is saturated or complete formation of a monolayer, residual surfactant molecules go in to bulk and forms a cluster like structure called micelle. Thus above CMC there is no further reduction in liquid-air surface tension [10]. To obtain a suitable CWS, use of an appropriate type and

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An Analysis of Student's Verbal Communication Skills by Gender in the Schools in Odisha

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Abstract. Since it is one of the 21st-century abilities that must be enabled in learning, communication skills are extremely important in the workplace. The purpose of this study was to identify the gender-specific profiles of learners' verbal communication skills, including both vocal and non-vocal communication. 186 students made up the study's 186 subjects, 88 of whom were male and 98 of whom were female. This study employed a descriptive-quantitative research methodology. An observation sheet served as the research tool. In order to accurately determine the worth of the students' communication skills, the data collected were next subjected to quantitative analysis. The study's findings revealed that the mean communication skill scores for men and women were different.
Key words: communication skills, verbal communication, gender, quantitative analysis

INTRODUCTION

The Success not only related to technical knowledge and abilities (hard skills) but also is related to soft skills namely the ability to manage one self and others. This is reinforced based on the results of a 2002 survey conducted by NACE USA which stated that the most important thing compared to the cumulative grade index (GPA) is soft skills. Soft skills consist of communication skills, honesty, motivation, adaptation, cooperation, and good interpersonal skills [1]. These things must be enhanced by preparing competent students.

One of the soft skills that are really needed at this time is communication skills. This is supported by the results of the Indonesian Skill Report in 2010. The report shows that communication skills are the most needed skills by workers and employees in Indonesia [2]. Other reports from the McKinsey Global Institute also showed that poor communication skills are the reason why someone fails in fulfilling the qualifications needed in a job [3]. In other words, communication skills are also very important skills in the world of work.

Communication skills also influence the direction and purpose of education. Education today prepares students to have good hard skills and soft skills. The Indonesian government has responded to this fact by developing the 2013 curriculum in which three things were demanded namely knowledge, skills and attitudes. Communication skills, in this case, fall into the realm of skills that are the demands of the 2013 curriculum. This is supported by Triling & Fadel which state that communication skills are one of the important skills in thinking and learning process to deal with the development of the 21st century [4].

Dynamics of the Holstein polaron in non-equilibrium

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Abstract. We calculate the Holstein polaron's one-dimensional relaxation time after it was driven far from equilibrium by a powerful oscillatory pulse while maintaining the problem's full quantum nature. It is compared to linear response theory. The inverse relaxation time deviates downward from the linear regime at $\lambda > 0.1/\omega_0$, but is linear with for small values of electron-phonon coupling.

Keywords: Electron-phonon interactions, Nonequilibrium processes

INTRODUCTION

The self-trapping of excitions that emerged following the pump pulse was seen in several pump-probe experiments [1, 2, 3]. Theoretical analyses of various polaron generation scenarios were then sparked by these findings, revealing a complicated interplay between a single electron and quantum phonons in nonequilibrium situations [4, 5].

The basic line-ear response hypothesis has been extensively used to study charge transport in inorganic crystals [6, 7]. Only recently[8] were the traditional band theory and the polaron hopping picture united, extending their applicability to all temperatures. The Boltzmann equation for band transport describes transport at low temperatures, while Marcus' electron transfer theory is obtained at high temperatures. The foundational work by Thornber and Feynman [9] marked the beginning of theoretical studies of the polaron motion in a strong but constant electric field. In later investigations, where quantum coherence effects are not present, the rate or Boltzmann equations were mostly used [10, 11, 12].

MODEL

We present results of a fully quantum mechanical time evolution of the Holstein model in one dimension driven far from the equilibrium by a laser pulse. The investigated Holstein polaron is subjected to a spatially homogeneous and time-dependent scalar potential that mimics a short laser pulse:

$$\varphi(t) = Ae^{-((t-t_c)/t_d)^2} \sin(\omega_p(t-t_c)), \quad (1)$$

An Integrated Energy System Operational Cost Estimation Technique Considering Component Failures

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Abstract. The integrated energy system (IES) is a popular area of research in the energy profession as the energy crisis gets worse and worse. The effect of component failures on the operating costs of IES has not been taken into account in previous studies. As a result, individuals frequently underestimate running expenses, and an overly optimistic operational strategy may result in mishaps like disruptions in the energy supply. In order to assess the normal and failure states of IES, this study suggests a technique of operational cost computation. Moreover, the failure rate and additional running cost are used to calculate the effect of component failures on the IES. The findings show that, in comparison to the conventional calculation technique, the operational cost when component failure is taken into account increases dramatically.

1. Introduction

The environment is greatly harmed by conventional energy producing methods. Maintaining the energy s upply level and meeting the energy demand while reducing environmental pollution is a popular study are a in the field of energy. Integrated Energy Systems (IES)[1] modify the operation of each component of t he system to allow different types of energy to work in harmony. IES aids in enhancing energy effectiven ess. Also, by promoting the use of renewable energy, it can lessen the need for conventional fossil fuels. The economic index, which is a significant factor in IES evaluation, calls for IES to fulfill environmental protection regulations and requirements for energy supply while reducing operating costs and maximizin g economic advantages.
As a result, a cost analysis can help with IES planning and management.

A large number of scholars have already studied the operating costs of IES. The reference[2] introduces demand response and cost of carbon into the scheduling strategy to optimize CO_2 emissions and system costs. An IES model including PV, cogeneration, and battery storage was developed to maximize the utilization of PV. Optimization reduces battery life loss and lowers operating costs[3]. In order to reduce system costs and improve energy efficiency, an optimal operating model that considers the energy price response is proposed[4]. A day-ahead dispatching strategy that includes electricity-to-gas components considering demand response is proposed[5]. It is experimentally confirmed that the dispatching strategy can shift load, increase income, promote renewable energy consumption, and improve energy utilization.

However, when a component fails, the energy dispatching scheme will change to meet the energy demand, and it will cause an increase in operating costs and harm economic interests. Along with the prolonged operation of IES, each component's loss and failure rate rise. The stability of the IES

Detachment and effects of field penetration in ASDEX Upgrade due to magnetic disturbances for ELM control

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Abstract
At ASDEX Upgrading and many other tokamaks, magnetic perturbation (MP) fields are now being studied in terms of edge localised mode control, the implications for steady state divertor power demand, and access to detachment. High density L- and H-mode investigations are coupled with previous ASDEX Upgrade research in low density, attached L-mode (Faitsch et al. 2017 Plasma Phys. Control. Fusion 59 095006). (Brida et al 2017 Nucl. Fusion 57 116006). The variation in steady state power load caused by the 3D MP is explained consistently. When density rises, there is a decreasing departure from an axisymmetric power load, which is a result of the divertor region's growing broadening. There is no negative impact on the ability to access a detached divertor regime. Similar power load profiles for plasmas without and a toroidal averaged profile in the presence of an external MP are revealed by experimental results from ASDEX Upgrade. A fundamentally different power demand pattern is seen in plasma settings with field penetration and locking of internal modes. Edge ergodization fits the pattern, and the extent can be used to estimate the amount of current required to fully express the internal mode.

Keywords: magnetic perturbation, infrared thermography, scrape-off layer, power exhaust

Introduction

For ITER and other upcoming tokamaks to operate successfully, transient power demands caused by edge-localized modes (ELMs) in H-mode must be controlled. the use of a non-

1 Refer to "A Kallenbach 2017 Nucl. Fusion 57 102015"'s appendix.

2 See the "H Meyer et al 2017 Nucl. Fusion 57 102014" author list.

In order to reduce or suppress massive ELMs in next-generation fusion devices like ITER, axisymmetric external magnetic perturbation (MP) is one method that is being researched [1, 2].

Many of today's tokamak experiments are equipped with magnetic coils to study the physics and feasibility of ELM mitigation/
suppression with an external MP field, e.g. ASDEX Upgrade
[3], DIII-D [4], EAST [5], JET [6], KSTAR [7], MAST [8], NSTX [9]. Such 3D MP fields lead to toroidal asymmetries in the power load pattern in the divertor [9–13] that cause further challenges for future devices. It is discussed that for ITER it might be necessary to rotate the external MP field in order to prevent local over-heating due to the toroidally asymmetric power load [2].

Use of Technology in English Language Teaching and Learning

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ABSTRACT.
We have a wide range of technological options for language instruction and learning, including radio, television, CD-ROM, computers, C.A.L.L., the Internet, electronic dictionaries, email, blogs, audio cassettes, Power Point, videos, DVDs, and VCDs. Due to the advent of technology, the last two decades have seen a revolution that has altered many industries' dynamics as well as how people interact and go about their daily lives in society. This information technology's rapid growth and development has made it easier to investigate a new teaching strategy. As a result, technology is crucial to the teaching of English. There are special benefits to using multimedia to construct a setting for teaching English. This essay examines the need for multimedia technology in language instruction while also highlighting the difficulties associated with its application. Additionally, it attempts to inform English teachers on the best practices for using it.

KeyWords: English Language teaching, Multimedia Technology, Advantages, Disadvantages, Optimization, Strategies.

1. Introduction:

A nation like India uses English as a second language, and for some individuals it serves as their first language, thanks to the growth and diffusion of the language throughout the world. It is well regarded throughout the nation. The importance and standing of English in India today are greater than ever, as shown by its prominence in the curriculum and as a primary medium of teaching. Several teaching approaches have been used to measure the effectiveness of the teaching process as the number of English learners grows. Usage of authentic materials in movies, radio, and television has been around for a while. It is true that these technological advancements have succeeded in displacing conventional education.

The modern teacher faces new challenges and responsibilities in the new period. With the astounding advent of technology, the tradition of teaching English has undergone significant transformation. Technology offers a wide range of alternatives for both making lessons engaging and improving their effectiveness. One of the main forces behind both social and linguistic development is technology. Technology is at the core of the globalisation process, affecting culture, labour, and education, according to Graddol (1997:16). From 1960, the English language's usage grew quickly. English currently plays the role of being the language of social context, politics, socioculture, commerce, education, industries, media, libraries, cross-border communication, and a key subject in curricula as well as the language of imparting education. It also plays a significant role in selecting students for university admission and hiring them for lucrative positions in the private sector. Since there are more and more English learners in India, several teaching strategies have been used to gauge how well they work. One technique for creating English settings in ELT uses multimedia. It has been proven useful and is widely approved for use in teaching English in the

EFFECTIVE COMMUNICATION AND SUCCESS

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ABSRTACT

The ability to communicate effectively has evolved into a qualitative trait. It wouldn't be incorrect to refer to it as today's standard for success. The process of interaction is made more orderly by the use of both verbal and nonverbal cues in communication. The appropriate communicative environment is a must for all communication. The communication process cannot function without a communicative setting, or, to put it another way, without the sender and receiver. It requires logical and semantically accurate deciphering because it is an emotionally and intellectually developed process. Based on the conditioned influence of a communicative context, symbols and cues employed in communication are adaptable, reinterpretable and infinitely extensible

KEYWORDS: Qualitative trait, Benchmark, Verbal, Nonverbal, Communicative Environment, adaptable, reinterpretable, infinitely extensible, and customizable

INTRODUCTION

The word communication has been derived from or Greek word communiqués', which means to share. On this note it can notably be said that the first and the foremost aspect of communication is "to share" or as a matter of fact "sharing of Ideas". These ideas could be an outcome of our interactions, aspirations, expectations and our perceptions collectively enforced as our experience in one or another way. In India we have people hailing from many socio-cultural religious backgrounds but still they conjoin at one front with a "Common level of understanding." This "Common level of understanding" is a consensus, which is labeled as national language, national identity and national integration. So, this way it can easily be said that communication has two important parameter of support which are : (i) sharing of ideas (ii) common level of understanding.

Communication is all about emphasizing and a point of view. This emphasis is based on the intonation, stress and selectively delivering language corresponding to the references while empathizing refers to a level headed emotional state, where the sole aim is make the message comprehensively reachable.

Process of Communication

The process of communication gets registered, by way of encoding; process which refers to the incorporation of message codes, which can be verbal or non-verbal, in nature. The encoded message is produced by the speaker, writer, actor in the form of utterances, written syntax and body actions or paralanguage respectively. This encoded message is produced by the speaker viz. producer for a receiver viz. listener, spectator or a reader. The encoded message quite expectedly should reach the receiver, but in practical terms it never happens like this. The encoded message has to cross certain hurdles before it is finally decided by the receiver or interpreted by the receiver.

Doppler Backscattering from Filaments: Whole Wave Modeling

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Abstract. Using slab geometry and the finite-difference time-domain code IPF-FD3D, Doppler backscattering from filaments was modeled. Artificial filament-like disturbances with a wide range of parameter variations were employed in the simulation. The identification of the effect of the filament's amplitude and size on the DBS was the main goal of DBS signal modeling.

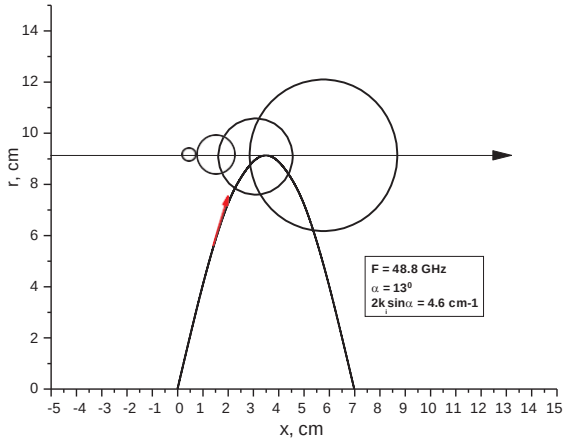

Figure 1 Ray-tracing for 48GHz and filament cross-section.

Our simulation was carried out using finite-difference time-domain 2D code IPF-FD3D in slab geometry [7]. We did not resort to using well-known non-linear MHD codes to determine filament parameters. In the simulation artificially created filament-like perturbations were used, the parameters of which varied over a wide range. Modeling DBS signal was focused on the identification of the influence of the amplitude of the filament and its size on the shape and size of the DBS output signal. The filament amplitudes with a Gaussian cross-section were varied from 0.1% upto 150% of density at cut off of the probing wave. The parameters of the computations are as following: antenna tilt angle α = 13°, antenna horn mouth 5,5 cm, Computations have been carried out for the frequencies 16GHz, 24 GHz, 32GHz, 40GHz, 48GHz, 56GHz, 64GHz of O-mode propagation. Gaussian beam with flat wave front in the antenna mouth. This dependency of the IQ (in-phase (I) and

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Based on the fuzzy set-valued statistics and fuzzy mathematics theory in the evaluation of the safety of the air traffic control system

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Abstract

The key meaning of elaborate carries on the safety evaluation to the air traffic control system. The first step is to construct the air traffic management system safety evaluation indication system using the guidance from the person-equipment-environment-management system management model. The weight of various targets is then calculated based on the fuzzy set value statistical theory, and its weight has undergone a fail-safe analysis. Finally, based on the fuzzy mathematics theory, the use of fuzzy comprehensive judgement is used to carry out the safety evaluation of the air traffic management system. Eventually, the method's validity and viability have been confirmed through the example analysis calculation.

Keywords:safety assessment; fuzzy set-valued statistics; fuzzy synthetic evaluation; air traffic control system

1. Introduction

With the rapid development of air transport, the world's ATC (air traffic control) system is facing more severe challenges. Airline congestion, flight delays and flight safety is receiving increasing attention and importance. To improve accident prediction and controllability, prevention strategies must be taken; therefore, effective and scientific methods of safety assessment for ATC system t is very important.

Safety assessment methods, according with the theoretical system, can be divided into four categories[1]: safety check list, indicator method, probability evaluating method and so on. Different methods of evaluation have different emphases; therefore, each method has its scope and limitations. Currently in the actual work of China's civil aviation ATC system security management[2], the study are mainly based on experience and intuitive ability to qualitative analyze the situation of the ATC system which include person, equipment, environment and management. As a result, we were unable to describe the quantized or dynamic system security status. ATC system with many influence factors which affect safety is very complex, and it is difficult to accurate analyze or evaluate quantitatively for the ambiguity concept of indicator. On account of fuzzy mathematics solving the unity of qualitative and quantitative efficiently, so the fuzzy comprehensive evaluation method would be adopted[3].We use the theory of fuzzy sets value statistics[4] to determine the value of indicator weight. The indicator with uncertain, random, fuzzy, subjective and other non-linear behavior was analyzed in the safety evaluation of ATC system. The method is more reasonable and more objective; also it is suitable for realistic situation. Obviously, the calculation is practical and scientific for the safety assessment of ATC system.

This paper intends to combine these two methods for the ATC system safety analysis. In the first place, we determine the weight of each indicator by using fuzzy set-valued method. Then we use fuzzy comprehensive evaluation method for ATC system security assessment. Finally the security situation would be obtained in the ATC system.

Acceptance SamplingPlans and Quality Control Charts through Probability Distributions

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Abstract: The objective of the current work recognises the probability distributions used in controlling the quality of products of industrial companies via the effectiveness of probability distributions in strengthening the control process, which would lead businesses to adapt to new technologies to get around challenges and issues they have in regulating the quality of their output. By looking at the inputs, outputs, and the production process itself, this study used discrete and continuous probability distributions to show how they might be used in acceptance inspection plans and quality control charts. The findings of this study showed that the usage of probability distributions promotes ongoing quality improvement and verifies input and output convergence. Probability distributions are also used to improve quality control's efficacy and efficiency. The findings of this study are significant for management in manufacturing firms because they highlight the value of employing probability distributions to monitor product quality throughout the whole production process. Furthermore, the creation of recurring training courses with an emphasis on probability distributions and quality control.

Keywords: Probability distributions, acceptance-sampling plans, quality control charts

Introduction

The demonstration of the benefit of probability distributions to monitor product quality throughout the whole production process, the study's findings are significant for management in manufacturing organisations. Also, the development of ongoing training programmes with a focus on quality assurance and probability distributions. Or to inspect the production process for the purpose of conforming to the specifications; In order to continue production, modifying and reviewing process. Due to the importance of these distributions in controlling the quality of industrial products, the probabilities are used to determine the percentage of defective units produced under a stable production process. Each of the units that we select is considered an experiment, and the result of each experiment is determined by registering whether the unit is defective or not. That is, we use the defective ratio (non-matching) in the sample as an approximation of the probability of the appearance of a defective unit in the production process or the submitted sample for inspection. In this context, we are very interested in the random variable and the probability distribution, because they form the backbone of the Statistical inference. The probability distribution expresses the probabilities of all values that the random variable can be represented by X. It is expressed by mathematical formulas or probability functions that are used to determine the probabilities for each of the random variable values. regarding the difference in the sizes of populations (production batch - production line - continuous production ...) The probabilities calculated from these samples (the probability of acceptance) will change from one population to another. This leads to a difference in the samples selected from these populations. Therefore, each size of these populations has its own distribution for calculating these possibilities. (Dradkeh 2001: 95). That is, the probability distributions play a role in quality control, and that's when we want to estimate the percentage of the samples which has a particular characteristic such as the defectiveness percentage of the submitted sample or the production process. By determining the appropriate sample size, the type of sampling that it is supposed to be, the form of selecting the sample. As they are essential conditions for the use of probability distributions in quality control. Probability theory categorizes distributions into discrete distribution and continuous distribution. Discrete distributions are used to calculate the probabilities of a number of units that do not conform to specifications (defective) in a

Using Random Forest Machine Learning, predict the price of a house

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Abstract

In many real-world applications, predicting a price variance rather than a fixed figure is more plausible and appealing. In this context, price prediction can be seen as a classification problem. The House Price Index (HPI), however, is a popular method for determining the irregularities of housing prices. Predicting individual house prices requires information other than HPI because housing prices are tightly connected with other characteristics including location, city, and population. A repeat-sale index called the HPI monitors average price changes in subsequent sales or refinancings of the same assets. Because HPI is a rough predictor based on all transactions, it is unsuccessful at forecasting the price of a particular house. This investigation into the application of Random Forest machine learning

Keywords : Sales forecasting; House Price Prediction; Machine Learning; Random Forest Algorithm

1. Introduction

Housing is one of the integral components that can be used to measure how successful the economy of a nation is. As the economy increases, people tend to migrate from the urban to rural areas which results to an increase in the population of urban dwellers. As the population of urban dwellers increases, the demand for accommodation increases. As the demand increases, the price of house also increases. In addition to these, the infrastructural developments in an area can result in a sudden rise in the price of houses in a particular area. For instance, once the challenges of unmotorable road and unstable electricity a residential area become resolved, house owners tend to increase the prices of house in that particular area. In several nations, such as the United States Federal Housing Finance Agency HPI, the United Kingdom National Statistics HPI, the United Kingdom Land Registry's HPI, the United Kingdom Halifax HPI, the United Kingdom Rightmove HPI, and Singapore's URA HPI, the House Price Index (HPI) is often used to calculate price increases in residential housing [1,2,3,4]. However, research has shown that the use of HPI is not enough in this 21st century [3,4,5]. Generally, house prices are influenced by a number of variables. Authors in [6] identified these factors to be physical condition, concept and location. Physical conditions that can be observed by physical perception include the size of the property, the number of rooms, the size of the kitchen and garage, the availability of the yard, the area of land and structures, and the age of the property. Physical characteristics of a house, such as the size of the structure, the year it was built, the number of bedrooms and bathrooms, and other facts that may define the house's interior features, may affect the price of a house [7]. Although concepts refer to various marketing tactics employed by developers to attract potential investors. This includes how close the property is to hospitals, markets, educational institutions, airports, major roads etc. The location of a property has a significant impact on its price. This is because the current land price is determined by the area.

Therefore, understanding house price patterns and determining factors is not only a thing of interest to tenants alone; it is also an issue of interest to home owners, analysts and policy makers in the real estate industry as well as urban and regional planning authorities [8]. A computer-based prediction system can help them to make informed decision about if a property should be acquired and the best time to acquire the property [9,10,11,12] Residential real estate is the primary store of equity for the middle class that serves as leverage for new businesses. However, rising house prices can boost demand by increasing homeowners' income, but they can also promote debt-financed consumption and weaken financial resilience. Price forecast strategies can be divided into two categories. The first category of strategies was intended to forecast market trends in a time-series format, such as

Information on math lessons that children took during the COVID-19 school closure

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abstract

Similar to other educational systems throughout the world, remote learning became necessary as a result of the closing of the COVID-19 schools in Zambia. It was unclear, though, if every student remained interested in the mathematics they were learning at the time. The information presented in this study was gathered to support the findings of a descriptive survey that sought to learn about Zambian students' experiences with distance learning in mathematics. In order to gather information from 367 secondary school students in the Kitwe district, a semi-structured questionnaire was used. It was hoped that the data will provide some insightful information about how secondary school students engage in remote learning during emergencies like the COVID-19 epidemic and beyond..

Gallium nitride crystal photoluminescence polaron-related states

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Abstract. It has been suggested and developed to use the polaronic model of luminescence processes in nominally pure gallium nitride. The model is based on two coexisting mechanisms that have a common ancestor. One of these is the visible-range recombination luminescence of charge transfer vibronic excitons (bi-polaronic excitons) trapped by charged defects with varying effective charges, such as Ga- or N-related vacancies with varying numbers of trapped electrons or holes, or interstitial O2- and O- ions (yellow-green luminescence). The other is the non-correlated self-localized electronic and hole polaron recombination luminescence (blue band) in the violet range. We may use the model to explain experimental findings, such as the intricate structure of yellow-green fluorescence.

Introduction

Its use in optoelectronic devices that operate in the green to ultraviolet spectral range is coupled with interest in gallium nitride and similar nitride wide-band-gap semiconductors. Thus, it is crucial to have a good grasp of the electrical and radiation properties of such materials. Even though the technology for light-emitting devices based on III-nitrides has had great success, the mechanism of effective radiation in both the green-yellow and blue luminescence bands is still not completely understood. Various theories have been put out to explain that luminescence, such as transitions from a shallow donor or the conduction band to a deep acceptor, from a shallow donor to a deep donor, but it is still unclear (see [1] and references therein).

Green or Yellow-Green Luminescence (GL) in undoped ionic-covalent crystals with strong enough electron-lattice interaction is a very well known phenomenon especially for ferroelectric oxide crystals[2-10]. This phenomenon was explained during the last years as a result of recombination of self- localized Charge Transfer Vibronic Exciton CTVE (see [10] and references therein). CTVE state (bi- polaronic charge transfer exciton) was verified on the basis of both GL investigations and comparison of these experimental results with quantum-chemical computations for extended system of ionic- covalent crystals [4, 6-8].

In the present work a new GaN matrix from the same extended group with respect to ionic-covalent behaviour has been investigated. In order to elucidate the origin of luminescence-active states we could consider the essential electron-lattice interaction in GaN. Namely, such an approach is key-like and makes it possible to ground bi-polaronic excitons effect. The approach leads to experimental data explanation in the framework of phenomenological treatment based on the Landau type “charge