

Optimal angle of polycrystalline silicon solar panels placed in a building using the ant colony optimization algorithm

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Abstract.

This paper describes the mathematical model used to determine the amount of solar radiation received on an inclined solar photovoltaic panel. The optimum slope angles for each month, season, and year have also been calculated for a solar photovoltaic panel. The optimization of the procedure to maximize the solar energy collected by the solar panel by varying the tilt angle is also presented. As a first step, the global solar radiation on the horizontal surface of a thermal photovoltaic panel during clear sky is estimated.

Thereafter, the Muneer model, which provides the most accurate estimation of the total solar radiation at a given geographical point has been used to determine the optimum collector slope. Also, the Ant Colony Optimization (ACO) algorithm was applied to obtain the optimum tilt angle settings for PV collector to improve the PV collector efficiency. The results show good agreement between calculated and predicted results. Additionally, this paper presents studies carried out on the polycrystalline silicon solar panels for electrical energy generation in the city of Ghardaia. The electrical energy generation has been studied as a function of amount of irradiation received and the angle of optimum orientation of the solar panels.

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Investigation of phase and dielectric properties of lead nickel tantalate ceramics

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ABSTRACT

Lead nickel tantalate (PNT) ceramic was prepared by solid-state reaction method using 2-step columbite precursor route. Phase analysis of samples sintered at 1473 K shows PNT pyrochlore phase with minute peaks of NiO rich phase. 2-phase Rietveld refinement of x-ray diffraction patterns reveal ~92.4 (0.33) % pyrochlore phase (cubic structure; space group: Fd-3m; $a = 10.5867(4)$ Å). From temperature dependent dielectric constant and dissipation factor study, strong frequency dependent dielectric anomaly within 140–240 K, related to relaxation rather than structural changes in PNT ceramic is obtained. Observed Arrhenius behavior of dielectric relaxation is believed to be associated with single-ionized oxygen defect hopping.

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KEYWORDS

Lead nickel tantalite; pyrochlore; Rietveld refinement; dielectric relaxation; single-ionized oxygen defects

Introduction

Lead based perovskite systems represented by $\text{Pb}(\text{B}_I\text{B}_{II})\text{O}_3$, where B_I is lower valent cations e.g., Mg, Ni, Fe, Sc etc., and B_{II} is occupied by Nb-ion, are well known and thoroughly studied ferroelectrics for their broad frequency dependent dielectric maxima. However, least attention has been given in investigating lead based perovskite systems where B_{II} is occupied by Ta-ion. Lead nickel tantalate [$\text{Pb}(\text{Ni}_{1/3}\text{Ta}_{2/3})\text{O}_3$: PNT]. Single crystal is reported to show diffuse dielectric maximum at temperature (T_m) ~ 113 K with maximum dielectric constant (ϵ'_m) ~ 2400 at 450 kHz [1, 2]. Low phase transition temperature makes this material attractive for devices, operating at cryogenic conditions, such as low temperature capacitors and actuators for space applications. At the same time, Ni^{2+} ($3d^8$) will introduce magnetic properties in this compound as it is a magnetic ion carrying electron in partial filled d-orbital. Recently magnetic ion (Fe, Co, Ni, Mn) carrying Pb-based mixed perovskites are receiving special attention due to advancement of multiferroic materials showing magnetoelectric coupling.

Depending upon the origin of ferroic orders and magnetoelectric coupling, multiferroic materials are divided into two types, i) type I multiferroics contain those materials in which

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IN SILICO DRUG DESIGN AND MOLECULAR DOCKING STUDIES OF NOVEL COUMARIN DERIVATIVES AS ANTICANCER AGENTS

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ABSTRACT

Objective: Cancer is the major worldwide problem. It arises due to uncontrolled growth of cells. In the present study, a series of novel coumarin derivatives were designed and computationally optimized to investigate the interaction between designed ligands and 10 protein data bank (pdb) files of five selected proteins. The objective here was to analyze *in silico* anticancerous activity of designed ligands to reduce cost and time for getting the novel anticancerous drug with minimum side effects.

Methods: Docking studies were performed to find out the maximum interaction between designed ligands and selected five proteins using Schrodinger software Maestro. Capcitabine has been used as reference compound. Structures of selected proteins were downloaded from protein data bank.

Results: All the designed ligands showed mild to excellent binding with proteins. Most of the ligands exhibited better interaction compared to reference compound capcitabine with all pdb files. Some of the designed ligands among (1-7) showed excellent docking score with all pdb files (2v5z, 2v60, 2v61) of amine oxidase.

Conclusion: All the designed ligands were docked with 10 pdb files of five different proteins, and it was found that out of seven designed ligand, ligand 4 showed the best binding (docking score -10.139) with pdb 2v5z of protein amine oxidase. Docked ligand cavity of ligand 4 showed important hydrophobic/non-polar residues such as Ile199, Ile416, Trp119, Phe168, Ile198, Cys172, Tyr188, Tyr298, Tyr435, Phe543, Tyr60, Leu328, Leu171, and showed pi-pi interaction with Tyr326. Further wet laboratory studies are continued in our laboratory to confirm and find out efficiency and activity of target compounds.

Keywords: Docking, Monoamine oxidase, Coumarin derivatives, Anticancerous activity, Binding energy, Ramachandran plot, Hydrophobic residue

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INTRODUCTION

In spite of the development of many cancer drugs in recent years [1], cancer is considered the major threat for human health [2]. Coumarin is one of the most widespread scaffolds in medicinal chemistry, and its derivatives are reported to possess anticancerous property [3] along with other biological activities [4,5].

Monoamine oxidases (MAOs) are flavin adenine dinucleotides containing an enzyme which are tightly bound to the outer membranes of mitochondria through a cysteine residue that catalyzes the degradation of monoamine neurotransmitters and dietary amines by oxidative deamination, which produces a by-product, hydrogen peroxide, a major source of reactive oxygen species [6]. There was significant correlation found between increased levels of MAOA expression and high Gleason grade or poorly differentiated human prostate tumors [7]. Coumarin derivatives have been recognized as potential MAO inhibitors [8]. It is a cytosolic reductase and is up-regulated in many human cancers compared to adjacent normal tissues [9]. Dicoumarol and series of 4-hydroxycoumarin derivatives have been reported to inhibit overexpressed NAD(P)H dehydrogenase (quinone) 1 (NQO1) in many cancer cells [10]. Epidermal growth factor receptor (EGFR), a member of ERBB family of tyrosine kinase of Rtk and, is associated with pathogenesis and development of different types of cancers [11,12].

Coumarin derivatives like Daphnetin have been identified as EGFR-PTK inhibitors [13]. The enzyme cytochrome P450 2A6 (CYP2A6) is a key factor in genesis and treatment of breast cancer cells [14] and lung cancer [15]. P450 2A6 activate procarcinogens and also play a

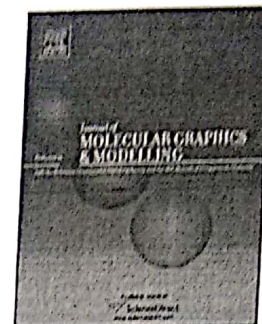
major role in the inactivation and activation of anticancer drugs [16]. Binding of P450 2A6 with coumarin and methoxsalen are also reported in literature [17]. Protein kinase C (PKC) has proved an interactable target in cancer therapeutics [18]. PKC, a prototypical class of enzyme which gives signals the molecules that are linked with multiple cellular processes of cancer. Furo coumarinoulconamides acts as PKC inhibitors particularly for cancer tumors [19]. Anticancerous drugs in the market are reported to have cytotoxic properties, coumarin compounds having antioxidant and cytostatic properties so it can minimize side effects caused due to existing drugs, radiotherapy and surgery [20]. Neo-tanshinlactone a coumarin containing compound is reported to have better selectivity and potency than tamoxifen [21]. These valid information from literature showing the involvement of selected proteins in genesis of cancer and their binding affinity with coumarin derivatives prompted authors to design novel coumarin derivatives.

Molecular docking study is a well-established technique to determine the interaction of two molecules. This technique evolves the best orientation of ligand and protein forming a complex with minimum energy [22,23]. Typically, it is used in the process of developing new drugs and identifies proteins responsible for the appearance or progression of disease in the body. The designed novel coumarin-based ligands, 1-7 have been subjected for studying binding interactions with five receptors. In the present study, novel coumarin derivatives were analyzed for their *in silico* anticancer activity against 10 protein data bank (pdb) files of five proteins, namely, amine oxidase, NQO1, EGFR, CYP2A6, and protein kinase and their docking scores were compared with the reference compound capcitabine by computational docking protocol.

Accepted Manuscript

Title: Understanding the Molecular basis of Stability in Kunitz (STI) family of Inhibitors in terms of a Conserved Core Tryptophan Residue: A Theoretical Investigation

Authors: Ravi Datta Sharma, Nabajyoti Goswami, Debasree Ghosh, Sudip Majumder



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Effect of solvent on crystallographic, morphological and optical properties of SnO₂ nanoparticles

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Highlights

- Single phase SnO₂ nanoparticles are synthesized by co-precipitation method.
- Characterized by XRD, FE-SEM, EDX, HR-TEM, FTIR, Raman and UV spectroscopy.
- Solvent can be used to control the size and shape of the nanoparticles.
- Optical band gap increases with increase in volume ratios of methanol to water.

Total span of farm work flow using Petri net with resource sharing

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Abstract: The aim of this work is to present the graphical model of farm work flow (FWF) problem with multi resources sharing, in which each operation may need more than one kind of resources. Using the Petri net concept with resource shared places we describe the farming process mathematically and graphically, and simulate the farming activation and resources assignment. The marking that is one of the properties of Petri nets facilitates mastering the farming progress and the status of the farmland and resources. Here, we apply a new concept deadlock-free Petri net model with resource sharing for minimising the total span of FWF, which is essential in agricultural production systems.

Keywords: Petri net; resource sharing place; transition; marking; composite Petri net.

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Biographical notes: Sunita Kumawat obtained her PhD in Mathematics from the Banasthali University Rajasthan, India, as a Research Fellow under the Centre for Mathematical Sciences, governed by Department of Science and Technology (DST), New Delhi. Her work is in the field of discrete mathematics as graphs and Petri net theory specialism. She has published over many research publications in various refereed journals. Currently, she is working on graph theory and Petri net theory, optimisation technique, wireless networking and antenna designing.

G.N. Purohit is the Dean from the Apaji Institute of Mathematics and Applied Computer Technology, Banasthali University, Rajasthan. He has published over many research publications in various refereed journals. Currently, he is working on fluid mechanics, cryptography, graph theory and Petri net theory, optimisation technique, and wireless networking.

1 Introduction and related work

Since the farming processes can be characterised as a working-flow program in computer science (Daikoku, 2005), a new mathematical and graphical tool, Petri net, for modelling and simulating the farming processes can be applied (Guan et al., 2006a, 2006b). Petri nets are widely used to model discrete event systems such as computer systems, manufacturing systems, and communication systems and so on (Murata, 1989). In comparison with program evaluation and review technique (PERT) model (Cottrel, 1999), which is another working-flow model widely used in the flow and scheduling of large and complex projects, Petri net has its superiorities in presence of dynamic changes in uncertain environments. However,

few researches apply Petri net into agriculture (Daikoku, 2005; Guan et al., 2006a, 2006b, 2008; Nanseki, 1998; Pham and Karaboga, 1998), and until there are no more researches on the farm work flow (FWF) on Petri net up to the present. In the FWF system, Petri net is a model that describes the farming process, and simulates the farming activation on the allocation of the resources such as the machines, labour force and so on. Different allocation of the resources produces a large number of possible farming assignments. Therefore, the problem of solving an optimum FWF from all possible farming assignments is an optimisation problem. Because the resources are limited in the agricultural production corporations, the farming assignment problem is usually

Vibrational Frequency of Circular Tapered Square Plate

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Abstract: - In this paper, we analyse the natural (free) vibration of tapered non homogeneous square plate on clamped (C-C-C-C) boundary condition. For non homogeneity of the plate's material, we considered circular variation in Poisson's ratio (as a new interesting aspect). It is also considered that plate thickness also varies circular (another new aspect) in one direction. To make study realistic, linear temperature variation along both the axes i.e., linear in x direction and linear in y direction is being viewed. Rayleigh Ritz technique has been applied to obtain the vibrational frequency.

Keywords: - Circular variation, Vibrational frequency, Tapered square plate, Thermal gradient.

SYMBOLS USED

a Length of the plate
 x, y Coordinates in the plane of plate
 M_x, M_y Bending moment intensities in x and y direction
 M_{xy} Twisting moment intensity
 γ Young's modulus
 ν Poisson's ratio
 \hat{D} Visco elastic operator
 D_1 Flexural rigidity

ρ Mass density per unit volume of the plate material
 t Time
 $\phi(x, y, t)$ Deflection of plate
 $\Phi(x, y)$ Deflection function
 $T(t)$ Time function
 g Thickness of plate at x, y
 β Tapering parameter
 m Non homogeneity of the material
 α Temperature gradient

1. INTRODUCTION

Non homogeneous tapered plates are very much used in making of engineering structures because of high tensile strength and durability. It is the requirement to study these plates under vibrational phenomena because vibration (wanted or unwanted) is common in engineering and science applications. The main aim of the researcher and scientist is to optimize the vibration for the better performance of the mechanical structures. All most all engineering structures such as power plant, aerospace industry and machines are working under high temperature. Videlicet the effect of temperature cannot be disdain. A significant work has been reported in these directions

Leissa [1] provided vibration of different structure (plates of different shape) on different boundary (clamped, simply supported and free) conditions in his excellent monograph. Chakarvarty et. al [2] discussed free vibration of annular elliptical plates using boundary characteristic orthogonal polynomial as shape function in Rayleigh-Ritz method. A new exact solution for free vibrations of thin orthotropic rectangular plate has been studied by Xing et. al. [3]. Zhou et. al. [4] used Hamiltonian approach to find natural vibration of circular and annular thin plates. Vibration of visco-elastic rectangular plate with linearly thickness variations in both directions has been studied by Gupta and Khanna [5]. Khanna et. al. [6] provided effect of thermal gradient on vibration of non-homogeneous square plate with exponentially varying thickness. Wang et. al [7] discussed thermal

Vibration of Square Plate with Parabolic Temperature Variation

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Abstract: - Here the effect of parabolic temperature variation (along both the axes) on the natural frequency of non-uniform and non-homogeneous square plate is presented. For non uniformity and non homogeneity, circular variation in thickness and Poisson's ratio is viewed in one direction. Rayleigh Ritz technique has been applied to solve the frequency equation. The results (first two modes) of the study are presented with the help of graphs. A comparison is also made with the existing result.

Keywords: - Vibration, Square plate, Parabolic, Temperature variation.

NOMENCLATURE

a Length of the plate
 x, y Coordinates in the plane of plate
 M_x, M_y Bending moment intensities in x and y direction
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 Y Young's modulus
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 $T(t)$ Time function
 l Thickness of plate at x, y
 m Non-homogeneity in the plate's material
 β Tapering parameter
 α Temperature gradient
 λ Frequency parameter

1. INTRODUCTION

The behavior (dynamic) of plate structures is significant to many applications in sciences and engineering. Moreover, non-uniform and non-homogeneous plates are integral parts of power plants, aerospace industry, machines, ship building, nuclear, ocean and naval engineering. The vibration characteristics of non-uniform and non-homogeneous plate coupled with temperature is rigorously treated and well documented in relevant literature. A few published works on plates are available in this direction.

Vibrational analysis of plates based upon classical plate theory (CPT) has been provided by Leissa [1-5]. He analyzed vibration of different structure (plates of different shape) on different boundary (clamped, simply supported and free) conditions.

An asymmetric vibration of circular plates (non-homogeneous) analyzed by Sharma et al. [6] on the basis of classical plate theory. They considered parabolically varying thickness in the plate and exponential variation in Young's modulus as well as density along radial direction as a non-homogeneity effect. They showed the effects of taper parameter, non-homogeneity parameter, density parameter and

nodal diameter on vibration modes using Ritz method.

Zhang et al. [7] presented an improved Fourier series method to analyze free vibration of the rectangular plate with non-uniform boundary conditions. They treated all the coefficients of expansion series as the generalized coordinates and determined them using the Rayleigh Ritz technique. They also claimed that the presented method can universally applied to a wide spectrum of plate vibration problems. They compared the obtained result with FEM to show validity of their results.

Sharma et al. [8] studied the natural vibration of orthotropic rectangle plate. They studied parabolic variation in temperature and thickness of the plate. They calculated time period, deflection function and logarithmic decrement for first two modes of vibrations at different values of plate's parameters. Sharma and Sharma [9] studied natural frequency of non-uniform and non-homogeneous parallelogram plate. For non-uniformity and non-homogeneity, they considered linear variation in thickness and density. Sharma et al. [10] presented Rayleigh Ritz method to analyze vibration of C-S-C-S trapezoidal plate. In this paper they considered variation in thickness (parabolic in one and linear variation in other), density (linear in one direction) and temperature

135. Free vibration of square plate with temperature effect

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Abstract. In modern engineering, researchers/scientists are very keen to know first few modes of vibration because it provides how system/structure behaves under vibration. In this paper, author computed the natural vibration of non homogeneous tapered square plate. Here tapered means that plate's thickness varies linearly along x -axis. Here non homogeneity arises in the plate's material due to simultaneous variation in density (circular variation) and Poisson's ratio (exponential variation). Temperature variation on the plate is viewed bi-parabolic along the axes. Rayleigh-Ritz technique is applied to obtain the frequency equation and vibrational frequency modes under different combination of parameters. The findings of the papers are presented in tabular form.

Keywords: square plate, circular variation, parabolic temperature, free vibration.

1. Introduction

The vibrational phenomena (wanted or unwanted) in mechanical structure or in engineering are very much common. Excess amount of vibrations causes the loss of energy and some time down the performance of system. In order to improve structure design or increase the performance, we have to control the vibration.

In these directions, non homogeneous tapered plates with plays an essential role because of their high tensile strength, durability and elastic behaviour. Since almost all engineering structures (machines, mechanical structures) works under huge temperature, therefore to make trust worthy design, it is also essential to know vibration under temperature effect. A quite significant work has been reported on non homogeneous (linear and exponential variation in density or Poisson's ratio) tapered plate (linear, parabolic and exponential variation in thickness in one or two dimension) with temperature effect (linear or parabolic in one or two dimension). But negligible work is done on simultaneous variation of density and Poisson's ratio (as non homogeneity effect).

Leissa [1] presented plate's vibration of different shapes on different boundary conditions in his excellent monograph. Jain and Soni [2] studied free vibration of rectangular plates with parabolic variation in thickness. The transverse vibration of a rectangular plate with thickness variation in both the directions is presented by Singh and Sexena [3]. Lal and Dhanpati [4] provided the effect of non homogeneity on the vibration of orthotropic rectangular plates of varying thickness resting on Pasternak foundation. Vibrational analysis of non homogeneous orthotropic visco elastic rectangular plate of parabolically varying thickness with temperature effect is given by Singhal and Gupta [5]. Sharma and Sharma [6] presented a mathematical modeling of vibration on parallelogram plate with non homogeneity effect. Sharma et al. [7] studied the vibration of non-homogeneous square plate with thermal effect. Sharma et al. [8] presented mathematical model on frequency of rectangular plate with circular variation in Poisson's ratio. Mathematical study of vibration on non homogeneous parallelogram plate with temperature variation (exponential variation) in density and Poisson's ratio with linear temperature effect on vibration. Khanna and Singhal [11] gave effect of plate's parameters on vibration of isotropic tapered rectangular plate with different boundary conditions. Kalita, Shivakoti, Ghadai and Haldar [12, 13] presented two interesting companion papers which showed the effect of rotary inertia on dynamic behavior of rectangular plates. Gupta and Sharma [14] studied vibrational frequency of non homogeneous trapezoidal plates with temperature effect.

Analysis of service surrender queue model in fuzzy system

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Abstract: In this communication, the queuing system has two different types of queues namely primary and secondary queue. The existence of secondary queue is possible only when server has limited services to provide, and the system has a characteristic of service surrender facility. The paper deals with the analytical study of such system in which the parameter of the primary queue is probabilistic while parameter of the secondary queue is considered totally uncertain. We are the first to apply fuzzy logic to deal with the secondary queue. The average waiting time in the system by a customer and service wastage rate has been explored in our study through fuzzy arithmetic using α -cut. The service wastage rate is helpful in finding the level of amount of instability in the system when the secondary queue is in existence and is fuzzified.

Keywords: secondary queue; service surrender facility; service wastage rate; beta distribution.

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Targeting Multiple Tumors Using T-Cells Engineered to Express a Natural Cytotoxicity Receptor 2-Based Chimeric Receptor

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Recent developments in cancer treatment are demonstrating the increasing and powerful potential of immunotherapeutic strategies. In this regard, the adoptive transfer of tumor-specific T-lymphocytes approaches can lead to tumor regression in cancer patients. More recently, the use of T-cells genetically engineered to express cancer-specific receptors such as the anti-CD19 chimeric antigen receptor (CAR) continues to show promise for the treatment of hematological malignancies. Still, there is a crucial need to develop efficient CAR-T cell approaches for the treatment of solid tumors. It has been shown that other lymphocytes such as natural killer (NK) cells can demonstrate potent antitumor function—nonetheless, their use in immunotherapy is rather limited due to difficulties in expanding these cells to therapeutically relevant numbers and to suppression by endogenous inhibitory mechanisms. Cancer recognition by NK cells is partly mediated by molecules termed natural cytotoxicity receptors (NCRs). In the present study, we hypothesize that it is possible to endow T-cells with an NK recognition pattern, providing them with a mean to recognize tumor cells, in a non-MHC restricted way. To test this, we genetically modified human T-cells with different chimeric receptors based on the human NCR2 molecule and then assessed their antitumor activity *in vitro* and *in vivo*. Our results show that expression in primary lymphocytes of an NCR2-derived CAR, termed s4428z, confers T-cells with the ability to specifically recognize heterogeneous tumors and to mediate tumor cytotoxicity in a mouse model. This study demonstrates the benefit of combining tumor recognition capability of NK cells with T cell effectiveness to improve cancer immunotherapy.

Keywords: NCR2, T-cells engineering, chimeric receptors, adoptive T-cell transfer, T-cell immunotherapy, natural killer cells

INTRODUCTION

Recent advances in tumor immunotherapy have demonstrated a crucial role for immunosurveillance, as tumor development and progression can be often linked to a failure of the immune system to recognize tumors and to mount an adequate response (1–3). In that regard, natural killer (NK) cells represent a central component of the early anticancer immune response. The latter relies on the

A REVIEW ON FUZZY AND STOCHASTIC EXTENSIONS OF THE MULTI INDEX TRANSPORTATION PROBLEM

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Abstract: The classical transportation problem (having source and destination as indices) deals with the objective of minimizing a single criterion, i.e. cost of transporting a commodity. Additional indices such as commodities and modes of transport led to the Multi Index transportation problem. An additional fixed cost, independent of the units transported, led to the Multi Index Fixed Charge transportation problem. Criteria other than cost (such as time, profit etc.) led to the Multi Index Bi-criteria transportation problem. The application of fuzzy and stochastic concept in the above transportation problems would enable researchers not only to introduce real life uncertainties but also to obtain solutions of these transportation problems. The review article presents an organized study of the Multi Index transportation problem and its fuzzy and stochastic extensions till today, and aims to help researchers working with complex transportation problems.

Keywords: Multi Index Transportation Problem, Fixed Charge, Bi-Criteria, Fuzzy Numbers, Stochastic Concept.

MSC: 90B06, 03E72.

Study of Electroluminescence in Cadmium Sulfide Polymer Nanocomposite Films

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Keywords: CdS Nanoparticles, Polyvinyl Alcohol X Ray Diffraction, UV-Visible Absorption, Photoluminescence, Electroluminescence.

Abstract. Nanocrystalline cadmium sulfide/Polyvinyl alcohol composite films were prepared by chemical route using Cadmium acetate and hydrogen sulfide gas as cadmium and sulfur source respectively. Poly vinyl Alcohol (PVA) used as polymer matrix. The initially loading of cadmium precursor influences the size as well as photoluminescence and electroluminescence properties of the Composite film. The films were characterized by X Ray Diffraction (XRD), Atomic Force Microscopy (AFM) and UV-Visible Absorption spectra. The X-ray Diffraction result showed that CdS nanocrystals embedded in polymer matrix were in a zinc blend cubic structure. The UV-Visible absorption spectra of composite film reveal the blue shift in the band gap energy with respect to CdS bulk (2.42eV) material owing to quantum confinement effect. The Photoluminescence emission spectra show the green light emission at 510 nm arising from the defects states due to excess of cadmium or sulfur anion vacancies. Electroluminescence study indicates enhanced emission with low turn on voltage for higher loading of cadmium in polymer matrix due to increased oscillator strength. When higher electric field is applied, light emission start due to acceleration collision mechanism by charge carries inside the composite film.

1. Introduction

Electroluminescence (EL) is an optoelectronic phenomenon where a material emits light in response to an electric field. An EL device is consisting of an emitting layer sandwiched between two electrodes; one is transparent to view illumination. AC driven electroluminescence thin film device paid much attention due to ease of fabrication, stability, low cost and no vacuum processing requirement etc. [1]. Wide band gap semiconductor have widely used for optical application using blue and green light emission, including semiconductor laser and Electroluminescence application. By taking advantage of developments in the preparation and characterization of semiconductor nanocrystals many researchers have realized electroluminescence from semiconductor nanocrystals in powder form or in composite. CdS is a direct band gap semiconductor material (II-VI), used for detection of visible light having a maximum sensitivity near 2.4 eV; which corresponds to its band gap. It has high refractive index and transmittance in visible region. In the recent years, Mostly studies appeared on hybrid organic/ inorganic EL devices. The hybridization of organic and inorganic semiconductors is expected not only to permit wide range selection of emitters and carrier transport materials, but also to provide new approaches to fabricate high performance EL devices. Polymers are considered a good choice as matrix materials for such purpose due to their long time stability and flexible reprocessability. Polymer composite film increases quantum efficiency and lifetime of EL device. The incorporation of nanoparticles with polymer tend to agglomerate at the interface between materials and allow more charge carriers to move towards emitting layer, therefore polymer composite film increase quantum efficiency by improving the charge injection. For this purpose poly vinyl alcohol (PVA) used as good choice of matrix due to their high viscosity and transparency in visible range of spectrum [2].

Few reports are available in size variation with changing the molar ratio in polymer composite film for optical studies. S. Farjami et al have investigated the optical and structural properties of



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Superlattices and Microstructures

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Optimization of Type-II 'W' shaped InGaAsP/GaAsSb nanoscale-heterostructure under electric field and temperature

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Highlights

- Optimization of optical properties of type-II InGaAsP/GaAsSb Nano-Heterostructure.
- Finding of a very high optical gain at 1.85 μm wavelength (eye safe region).
- Controlling of optical gain and wavelength by Electric Field and Temperature.

Abstract



Zn-doped SnO₂ nanostructures: structural, morphological and spectroscopic properties

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Abstract : SnO₂ is a promising material for optoelectronic, catalytic and sensing applications and is highly sensitive to the small amount of impurities that can change its properties drastically. In the present work, co-precipitation method was employed to synthesize pure and Zn-doped SnO₂ nanostructures. The effect of Zn doping (1, 3 and 5% molar ratio) on crystallographic and spectroscopic properties of SnO₂ nanostructures has been studied. The X-ray diffraction results revealed that SnO₂ possesses tetragonal rutile crystal structure with predominant (110) plane and the same structure was retained after doping with Zn. Raman shifts also confirmed the typical feature of the tetragonal rutile phase in all samples. Fourier transform infrared spectra revealed stretching mode of Sn–O bond and vibrational mode of O–Sn–O bond complementing the Raman spectroscopy results. Field emission scanning electron micrographs confirmed the variation in morphology of synthesized samples with Zn-dopant concentration. High-resolution transmission electron micrographs showed that the synthesized nanostructures were nearly spherical and average particle size varies between ~20–26 nm. UV–Visible results revealed that the band gap of the synthesized

SnO₂ nanoparticles increased with increase in Zn content. Photoluminescence spectroscopic results showed that emission intensity increased with increase in Zn content. The increased intensity of emission peaks may be ascribed to the development of defect states in the band gap of Zn-doped SnO₂ nanoparticles.

1 Introduction

Wide band gap semiconductors including ZnO [1], TiO₂ [2], NiO [3] and SnO₂ [4] have become the centre of attraction of scientists and engineers due to their distinctive properties such as structural, morphological, electrical, optical and catalytic characteristics [5, 6]. In nanostructured form these materials are more suitable for various applications including solar cells based on oxides, flat displays, gas sensors, super-capacitors and catalysts [1–6] due to high chemical stability and large surface to volume ratio. Large surface to volume ratio in nanostructures contributed to the creation of extra electronic/defect states, which may affect the electronic as well as optical properties of the nanomaterials [7]. SnO₂ possess n-type semiconducting nature having band gap energy ~3.6 eV [8, 9]. Unique properties as well as applications of nanostructured SnO₂, makes it a common choice for scientists, engineers and industrial sector. Various potential applications of SnO₂ include fields such as gas sensors [8, 10–12], dye-sensitized solar cells [13], electrodes [14], photosensitive as well as microelectronic devices [15, 16]. Properties and practical characteristics of SnO₂ are critically influenced by its structural (crystallinity, presence of defects include oxygen vacancies, interstitials and surface faults) as well as morphological features. These properties can be tuned by varying synthesis methods, conditions [4, 17–19].

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Color image encryption using affine transform in fractional Hartley domain

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A novel scheme for color image encryption using the fractional Hartley and affine transforms is proposed. An input color image is first decomposed in its RGB (red, green and blue) components. Each component is bonded with a random phase mask and then subjected to a fractional Hartley transform followed by affine transform. Thereafter, a second random phase mask is applied to each component before the final transformation by fractional Hartley transform resulting in a component-wise encrypted image. Finally, all three components are combined to give a single channel encrypted image. The scheme is validated with numerical simulations performed on a color image of size $256 \times 256 \times 3$ pixels using MATLAB 7.14. The use of affine transform along with fractional Hartley transform adds to the security. The scheme is evaluated for its sensitivity to the parameters of the fractional Hartley and affine transforms. On analysing the plots of correlation coefficient and mean-squared-error, the scheme is found to be highly sensitive to the encryption parameters. Also, it is evaluated for its robustness against the usual noise and occlusion attacks. The proposed scheme is secure and robust owing to multiplicity of encryption parameters introduced through the type of transforms used.

Keywords: color image encryption, affine transform, fractional Hartley transform, occlusion and noise attacks.

1. Introduction

Rapid growth in internet connectivity leads to a serious concern about information systems security. With growing threats to information systems, it is absolutely important to consider system-level security to shield information resources against malicious attacks. Mathematical theories of cryptography play a big role in information security. Unauthorized use of sensing and imaging is a serious problem as image information can be invaded during transmission in the communication channels. There are limitations of digital security systems and therefore, it is beneficial to add physical parameters to increase security. With high processing speed, parallelism and high-dimensional



Phase-Image Encryption Based on 3D-Lorenz Chaotic System and Double Random Phase Encoding

Neha Sharma · Indu Saini · AK Yadav · Phool Singh

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Abstract In this paper, an encryption scheme for phase-images based on 3D-Lorenz chaotic system in Fourier domain under the 4f optical system is presented. The encryption scheme uses a random amplitude mask in the spatial domain and a random phase mask in the frequency domain. Its inputs are phase-images, which are relatively more secure as compared to the intensity images because of non-linearity. The proposed scheme further derives its strength from the use of 3D-Lorenz transform in the frequency domain. Although the experimental setup for optical realization of the proposed scheme has been provided, the results presented here are based on simulations on MATLAB. It has been validated for grayscale images, and is found to be sensitive to the encryption parameters of the Lorenz system. The attacks analysis shows that the key-space is large enough to resist brute-force attack, and the scheme is also resistant to the noise and occlusion attacks. Statistical analysis and the analysis based on correlation distribution of adjacent pixels have been performed to test the efficacy of the encryption scheme.

The results have indicated that the proposed encryption scheme possesses a high level of security.

Keywords Image encryption · Chaos · Lorenz system · Phase image · Double random phase encoding

1 Introduction

Information security has become a major concern in view of the rapid growth of web-based multimedia applications. It is very crucial to protect information due to ever-increasing threats from intruders. Information processing can be classified as digital, optical, and a mix of both [8–11, 20–22, 37–39, 41]. Mathematical theories of cryptography play a big role in information security. For example, Number theory offers a framework for many cryptographic systems and provides security for these schemes. Shannon's mathematical foundation of secrecy systems relies on probability theory. Finite fields, algebraic curves, and number fields serve as the basis for much of public key cryptography.

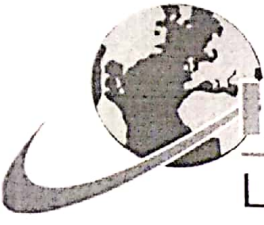
Optical encryption can provide a better and safe method for image transmission than digital encryption. During the past two decades, tremendous efforts have been made to develop the optical cryptography techniques because of the inherent advantages such as parallel processing, multidimensional capability, and high computation speed [8, 11, 26]. Among them, the

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Title: Analysis of Lorenz-chaos and exclusive-OR based image encryption scheme

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Abstract: In this paper, analysis of Lorenz-chaos and exclusive-OR based image encryption scheme has been presented. The Lorenz system is used in shuffling the positions of image pixels in the spatial-domain and gray values of pixels are altered with exclusive-OR operation. The encryption scheme has been validated for grayscale images using MATLAB 7.14 and is sensitive to the encryption parameters of the Lorenz system. The experimental results establish that the key-space is large enough to resist brute-force attack, and demonstrate the scheme's resistance to noise and occlusion attacks. Statistical and correlation analysis of adjacent pixels are also performed.

Keywords: image encryption; chaos; Lorenz system; exclusive-OR; XOR; occlusion and noise attack.

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



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Mechanical and thermophysical properties of lutetium monochalcogenides: an ultrasonic study

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The paper presents theoretical temperature dependent mechanical and thermophysical properties of lutetium monochalcogenides using ultrasonic analysis. The higher order elastic constants are evaluated using Coulomb and Born-Mayer potential upto second nearest neighbour. The second order elastic constants are used to compute mechanical parameters such as bulk modulus, shear modulus, tetragonal modulus, Poisson's ratio, Zener anisotropy factor and fracture to toughness ratio for finding future performance of the chosen materials at room temperature. The second order elastic constants are further applied to find out the ultrasonic velocities $\langle 100 \rangle$, $\langle 110 \rangle$ and $\langle 111 \rangle$ crystallographic directions in the temperature range 100-300 K. Finally Debye temperature, ultrasonic Grüneisen parameters and first order pressure derivatives of lutetium monochalcogenides are computed using the second and third order elastic constants. The obtained results are discussed in correlation with available results on these properties for the chosen materials.

Keywords: Lutetium monochalcogenides, elastic properties, ultrasonic properties.

Introduction

The materials characterization by ultrasonics plays very important role for materials' scientists and engineers since a long period¹⁻². The rare-earth monochalcogenides and monpnictides are uniformly valuable for materials devices especially for the advancement in the area of electronics and spintronics³⁻⁴. Several investigators have investigated the physical properties of rare-earth monochalcogenides and monpnictides⁵⁻⁸. Seddik *et al.*⁵ investigated the pressure induced structural phase transformation and mechanical properties of lutetium monochalcogenides. LuX (X:S, Se, Te) were studied by means of the full-potential augmented plane wave plus local orbitals method. Mir *et al.*⁶ applied density functional theory (DFT) within the framework of generalized gradient approximation to investigate the structural, elastic, mechanical, and phonon properties of lutetium monpnictides. The electronic structure calculations were performed for the rare-earth (RE) nitrides using DFT calculations within the LSDA+U

approach (local spin density approximation with Hubbard-U corrections) by Larson *et al.*⁷. With use of synchrotron radiation, the powder X-ray diffraction of rare-earth lanthanide monoarsenides LnAs (Ln = Pr, Nd, Sm, Gd, Dy and Ho) with a NaCl-type structure has been studied up to 60 GPa at room temperature by Shirovani *et al.*⁸.

Overall, we found only few studies on lutetium monochalcogenides. This motivates us to study elastic and ultrasonic properties of LuX. In present investigation, first we computed second and third order elastic constants (SOECs and TOECs) with the application of Coulomb and Born-Mayer potential using lattice and hardness parameters in the temperature range 100-300K. The evaluated values of SOECs are applied to compute mechanical properties of these materials such as bulk modulus, shear modulus, tetragonal modulus, Poisson's ratio, Zener anisotropy factor and fracture to toughness ratio for finding materials' future performance at room temperature. Further, SOECs and TOECs are used to find

Stability Analysis of a Human-Mosquito Model of Malaria with Infective Immigrants

Nisha Budhwar, Sunita Daniel

Abstract—In this paper, we analyse the stability of the SEIR model of malaria with infective immigrants which was recently formulated by the authors. The model consists of an SEIR model for the human population and SI Model for the mosquitoes. Susceptible humans become infected after they are bitten by infectious mosquitoes and move on to the Exposed, Infected and Recovered classes respectively. The susceptible mosquito becomes infected after biting an infected person and remains infected till death. We calculate the reproduction number R_0 using the next generation method and then discuss about the stability of the equilibrium points. We use the Lyapunov function to show the global stability of the equilibrium points.

Keywords—Susceptible, exposed, infective, recovered, infective immigrants, reproduction number, Lyapunov function, equilibrium points, global stability.

I. INTRODUCTION

ONE of the diseases that have constantly had its presence in human population is malaria. It is caused by the entry of the malarial parasite, *Plasmodium* into the bloodstream, due to the bite of an infected female *Anopheles* mosquito. Years have been spent in finding ways to control and completely eradicate malaria from the human population, but all efforts have been in vain. The disease was once endemic and confined to certain parts of the world, but has now even spread to areas which were previously free of the disease. Even when eradicated for a period of time, it recurs in certain areas repeatedly. One major factor which has contributed to the wide spread nature of malaria is human migration and travel. An area with an uninfected population of mosquitoes can also get infected when an infected individual enters the area and is bitten by these mosquitoes. There are no dormant forms of malaria. If the parasite enters the body, it will surely cause a disease, unlike certain other conditions in which the diseased state does not occur even for years after infection.

It is logical to assume that infected humans will be unable to travel or migrate due to the symptoms brought on by the disease. However, there is a period of around 10 days to 4 weeks from the moment of infection to the actual onset of disease, and unaware people might travel during this time. During this period, the disease cannot be diagnosed by blood tests either as the parasite multiplies in the liver, thus allowing the infection to be carried to a new place. Such people will become infectious after a certain period of dormancy. As a result of this, immigration of infected people has a huge impact on the spread of malaria within, as well as, among populations.

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Even if the infected immigrants are not introducing the parasite to a new population, their entry into an already infected population will cause an increase in the infected mosquitoes of the area as they will be biting more number of infected people.

Several SEIR models for vector-borne diseases, with reference to malaria have been formulated [4], [8]-[10] and studied. The global stability of SEIR and SEIS models have been discussed in [1], [3], [5]-[7]. However, these models have not considered the impact of infective immigrants. In [14], an SIR model for malaria with infective immigrants has been studied. So far there were no specific SEIR models for malaria with infective immigrants until recently studied in [13]. In this paper, we calculate the disease-free equilibrium point and the endemic equilibrium point of the model formulated in [13] and analyse the local and global stability of these points.

The paper is organized in the following way: In Section II, we calculate the equilibrium points and the reproduction number R_0 . In Section III, we have study the local stability of the equilibrium points and in Section IV, we have study the global asymptotical stability of the disease-free and unique endemic equilibrium points using the theory of Lyapunov function [11], [12].

A. Formulation of SEIR Model

Let us denote the total population of human hosts as $N_h(t)$ and the total population of the female mosquitoes as $N_m(t)$. The human population $N_h(t)$ is divided into the following epidemiological subclasses: Susceptible, Exposed, Infected and Recovered, denoted by $S_h(t)$, $E_h(t)$, $I_h(t)$ and $R_h(t)$ respectively. Thus,

$$N_h(t) = S_h(t) + E_h(t) + I_h(t) + R_h(t)$$

The mosquito population $N_m(t)$ is divided into two subclasses: Susceptible and Infected, and they are denoted by $S_m(t)$ and $I_m(t)$ respectively. We assume that the mosquito remains infectious for its entire lifespan. Thus,

$$N_m(t) = S_m(t) + I_m(t)$$

We now consider a model in which the new members that flow into the population are either infective or susceptible. This flow is assumed to occur through birth or immigration at constant rate Λ . We further assume that a fraction ϕ is infective and a fraction α is exposed and the remaining fraction $(1 - \phi - \alpha)$ is susceptible.

The system of non-linear differential equations which describe the dynamics of malaria are formulated as:

A ternary subdivision scheme for generating trigonometric splines and its application to geometric modeling

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Abstract—In this paper, we present a ternary non-stationary subdivision scheme for generating trigonometric splines of order n with uniform knots. As a particular cases for $n = 3$ and $n = 4$, we obtain ternary subdivision schemes for generating quadratic and cubic trigonometric splines respectively. These schemes, at every level retain all the points of the previous level if the initial control points lie on the graph of a function which is a linear combination of $\cos((n - 1)x)$ and $\sin((n - 1)x)$.

I. INTRODUCTION

In recent years, trigonometric splines have been used extensively in geometric modeling because of their shape preserving properties [10], [11], [6]. Efforts have been made to establish algorithms for trigonometric spline curves analogous to algorithms for polynomial spline curves. An algorithm for trigonometric splines analogous to Oslo algorithm is established in [8]. A binary non-stationary scheme for trigonometric spline curves analogous to Lane and Riesenfeld algorithm is introduced in [5]. In this paper we present a ternary non-stationary subdivision scheme for generating trigonometric splines of order n with uniform knots. As particular cases, for $n = 3$ and $n = 4$, we obtain ternary subdivision schemes for generating trigonometric splines of order 3 and 4. Interestingly, these schemes, at every level, retain all the points of the previous level if the initial control points lie on the graph of a function $f(x) \in \text{span}\{\cos(lx), \sin(lx)\}$, $0 < l < \frac{\pi}{n}$ when the values of f are given on equidistant points. Moreover, these schemes also reproduce functions spanned by $\{\cos(lx), \sin(lx)\}$, $0 < l < \frac{\pi}{n}$ and, in particular, circles, ellipses, astroids and so on.

Subdivision schemes generating or reproducing circular parts and parts of conics are of importance in computer graphics and geometric modelling. It is known that stationary (linear) schemes cannot generate circles and non-stationary schemes have such a capability. Some non-stationary schemes generating circles are already available in the literature [2], [7], [14], [15], [16].

The paper is organised as follows. In Section 2, we present some definitions. In Section 3 we introduce ternary schemes for generating trigonometric splines of order 3 and 4 and

present some of their properties. In Section 4, we introduce a ternary scheme for trigonometric splines of order n , $n > 0$. The schemes introduced in Section 3 are particular cases ($n = 3$ and $n = 4$) of the scheme presented in Section 4. In Section 5, we derive a refinement equation for a given trigonometric spline of any order. The refinement equation is used in Section 6 for carrying out the convergence analysis.

II. PRELIMINARIES AND DEFINITIONS

Given a set of control points $P^0 = \{p_i^0 \in \mathbb{R}^d : i \in \mathbb{Z}\}$ at level 0, a subdivision scheme $\{S_k\}_{k \in \mathbb{Z}_+}$ generates recursively a new set of control points $P^{k+1} = \{p_i^{k+1} : i \in \mathbb{Z}\}$ at the $(k + 1)^{\text{th}}$ level by the subdivision rule:

$$p_i^{k+1} = \{S_k P^k\}_i = \{S_k S_{k-1} \dots S_0 P^0\}_i = \sum_{j \in \mathbb{Z}} s_{i-N_j}^k p_j^k, \quad i \in \mathbb{Z}$$

where the set $\{s_i^k : i \in \mathbb{Z}, s_i^k \neq 0\}$ is finite for every $k \in \mathbb{Z}_+$. When $N = 2$, we deal with the binary subdivision scheme and when $N = 3$, the ternary subdivision scheme. The set $s^k := \{s_i^k : i \in \mathbb{Z}\}$ of coefficients is called the mask at the k^{th} level of the subdivision scheme. If the mask is independent of k , then the scheme is called stationary, otherwise it is called non-stationary. Suppose $\{S_k\}$ is a ternary subdivision scheme, then for $k = 0, 1, \dots$ the points $p_i^k, i \in \mathbb{Z}$ are assigned to the mesh points $3^{-k}il, i \in \mathbb{Z}$ for some fixed $l > 0$. Since the subdivision scheme is applied componentwise, it is sufficient to state the subdivision scheme for the initial points $p_i^0 \in \mathbb{R}$.

A ternary subdivision scheme $\{S_k\}$ is said to be C^m if for every initial data $P^0 \in l^\infty$ there exists a limit function $f \in C^m(\mathbb{R})$ such that

$$\lim_{k \rightarrow \infty} \sup_{i \in \mathbb{Z}} |p_i^k - f(3^{-k}il)| = 0$$

and f is not identically 0 for some initial data P^0 .

Trigonometric B-splines $T_j^m(x; l)$, $j = 0, 1, 2, \dots, m$ of order n , $n > 0$ (with the mesh size l) associated with the knot sequence

$$\Delta := \{t_i = il : i = 0, 1, \dots, m + n\}, \quad m > n, \quad 0 < l < \frac{\pi}{n},$$

Nanomaterial Fungicides: In Vitro and In Vivo Antimycotic Activity of Cobalt and Nickel Nanoferrites on Phytopathogenic Fungi

Parul Sharma, Adikshita Sharma, Monica Sharma, Nikhil Bhalla,* Pedro Estrela, Aditya Jain, Preeti Thakur, and Atul Thakur*

Recent advances in engineering lead to the fabrication of nanomaterials with unique properties targeted toward specific applications. The use of nanotechnology in agriculture, in particular for plant protection and production, is an under-explored area in the research community. Fungal diseases are one of the leading causes of crop destruction and, in this context, the antifungal effect of nanoparticles of cobalt and nickel ferrite against phytopathogenic fungi is reported here. As a proof of concept, it is also shown how such nanoparticles can be used as fungicides in plants. The developed cobalt and nickel ferrite nanoparticles (CoFe_2O_4 and NiFe_2O_4) are successfully tested for antimycotic activity against three plant-pathogenic fungi: *Fusarium oxysporum*, *Colletotrichum gloeosporioides*, and *Dematophora necatrix*. In addition, it is also observed that these ferrite nanoparticles reduce the incidence of *Fusarium* wilt in capsicum. The study suggests that nanoparticles of CoFe_2O_4 and NiFe_2O_4 can be used as an effective fungicide in plant disease management.

It is estimated that around 85% of all plant diseases are fungal in nature. To combat fungi, farmers have been evolving their practices by using various types of chemical fungicides such as mancozeb,^[4] kitazin,^[5] copper hydroxide,^[6] and many others.^[7] However, fungi respond to the use of fungicides by developing resistance against the compounds.^[8] The evolution of fungicide resistance can either be sudden or gradual. Consequently, farmers either use a combination of more than one fungicide or use excessive fungicides to control the disease. This can lead to either damaged crops or to residues of fungicides remaining in the plant, some of which are harmful to human health.^[9–11] Therefore, with the growing demand to control pathogens, especially fungi, there is an urgent need to tackle the excessive usage of fungicides by finding less harmful alternatives.

1. Introduction

Plant diseases have caused severe losses to humans ever since the beginning of agriculture.^[1] Organisms that cause infectious diseases in plants mainly include fungi, bacteria, viruses, protozoa, and plant parasites.^[2] Among these organisms, fungi are responsible for the most damaging diseases in plants.^[3]

Nanoparticle (NP) materials have received increasing attention due to their unique physical and chemical properties, which differ significantly from their conventional macroscale counterparts.^[12] The antimicrobial effect of various NP materials such as silver,^[13] copper,^[14] titanium dioxide,^[15] zinc oxide,^[16] and magnesium oxide^[17] has been demonstrated. However, most of these materials so far found

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Influence of Radiative Heat on Progress and Decline of Sonic Waves with Internal State Variables

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Abstract: In the current research work, idea of sonic-irregularities in fluids with internal state-variables is generalized. During course of discussions, only the properties of singular surfaces have been used. An attempt has been made to discuss the influence of radiative heat term on progress and decline of sonic waves. Velocity propagation is obtained and discussed. The critical-volume/size of (press or force into a smaller space) disturbance is serious and stubborn and it is decided that any (press or force into a smaller space)-wave with initial volume/size greater than the critical one, will grow into a shock-wave while any (press or force into a smaller space)-wave with an initial volume/size less than the critical one will result in a ruined state

In this paper we will find out the effects of radiative heat transfer on the growth and decay of sonic waves propagating with internal state variables. The radiative heat transfer term can be neglected except in the boundary layer region. We consider an optically thick gas with such a high temperature and low pressure that the radiation pressure number is not negligible but the profiles structured by radiant heat transfer are assumed to be imbedded in the discontinuities.

Keywords: Sonic waves, Radiative heat transfer, Internal state variables.

I. INTRODUCTION

Discontinuities in which the solution functions are continuous across the wave-front but their initial and elevated order differential coefficients are not continuous, are determined as sonic-waves or discontinuity of order one. Thomas¹¹ and Kaul¹ have studied the rise and corrosion of sonic-waves in ordinary gas flows, using the theory of singular surfaces. Many authors^{2, 3, 6, 7, 8, 9, 11} have used the theory of singular surfaces to study the development and decline of sonic waves in magneto-hydrodynamics, radiation-gas-dynamics, dissociating and relaxing gases. Pandey and Saxena⁴ and Pandey, Saxena & Shukla⁵ have studied the development and decline of sonic waves in two phase flows, when particles volume fraction becomes negligible.

In general, any gas has a number of relaxing internal energy modes whose excitation will exert an often dominant influence on either a part or on the whole motion of the flow field. Considering more than one slackening mode, frequently one

slackening time is exceedingly large compared with others, hence it is usual to presume that all short relaxation time modes are in equilibrium state of balance, diminishing the problem to the unimode type. As all gases are not diatomic and all relaxation time for different possible modes of internal energy storage do not differ by many (at least ten times as much/less than 1/10th as much), it is of interest to examine the movement of gas with many relaxation modes, all with different relaxation time. Thus, gas with several internal energy and relaxation mode has drawn the attention of many investigators. In present paper, an attempt has been made to generalize the idea of sonic-discontinuities in a fluid with several internal state variables.

Neglecting volume-forces, viscosity, energy flow due to heat-conduction, diffusion, radiation etc., and assuming sufficient continuity of field variables, equations governing the motion of gas with internal state variables are given by

$$\frac{Dp}{Dt} + \rho u_{i,i} = 0, \quad (1.1)$$

$$\frac{Du}{Dt} + \frac{1}{\rho} \text{grad } p = 0, \quad (1.2)$$

$$\frac{Dh}{Dt} - \frac{1}{\rho} \frac{Dp}{Dt} = -Q \quad (1.3)$$

and

$$\frac{Dq_{\alpha}}{Dt} = L_{\alpha}(p, \rho, q_1, q_2, \dots, q_n) \quad (1.4)$$

($\alpha = 1, 2, \dots, n$)

where $\frac{D}{Dt}$ is substantial derivative, h is enthalpy defined by

$$h = C_p T + \sum_{\alpha=1}^n C_{\alpha} R q_{\alpha} \quad (1.5)$$

C_p being specific heat (of frozen gas) at constant pressure, R the specific gas constant $C_{\alpha} R$, the specific heat of α^{th} internal degree of freedom, q_{α} ($\alpha = 1, 2, \dots, n$) are n internal state variables and

$$p = \rho RT \quad (1.6)$$

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Integral Transform of Fractional Derivatives

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Abstract: In this paper we deal with various integral transform of Fractional derivative based on the Riemann-Liouville Derivatives, Riemann-Liouville Derivatives and Caputo's Fractional derivatives. We anticipate perspective applications of fractional Transform in physical systems.

Keyword: Fractional Derivatives, Fourier Transform, Laplace Transform, Convolution of functions.

I. INTRODUCTION :

The Fourier Transform is a tool that breaks a waveform (a function or signal) into an alternate representation, characterized by sine and cosines. The Fourier Transform shows that any waveform can be re-written as the sum of sinusoidal functions. The Fourier Transform therefore gives us a unique way of viewing any function - as the sum of simple sinusoids. Its widespread popularity is due to its practical application in virtually every field of science and engineering. The Laplace transform is very similar [3] to the Fourier transform. While the Fourier transform of a function is a complex function of a real variable (frequency), the Laplace transform of a function is a complex function of a complex variable. Laplace transforms are usually restricted to functions of t with $t > 0$. A consequence of this restriction is that the Laplace transform of a function is a holomorphic function of the variable s . Unlike the Fourier transform, the Laplace transform of a distribution is generally a well-behaved function. Also techniques of complex variables can be used directly to study Laplace transforms. As a holomorphic function, the Laplace transform has a power series representation. This power series expresses a function as a linear superposition of moments of the function.

II. OVERVIEW: FRACTIONAL CALCULUS

Fractional Calculus is a term used for the theory of derivatives and integrals of arbitrary order, which generalize the notion of integer order differentiation and n -fold integration. The idea behind Fractional calculus is to generalize the definition of differentiation and integration with order $n \in \mathbb{N}$ to order $s \in \mathbb{R}$. The first discussion [9] on Fractional Calculus began in 1695 in a letter to L'Hopital by Leibniz in which he discussed about calculus of arbitrary order. Fractional Calculus is three centuries old. Few names that laid the foundation of Fractional Calculus are Abel, Liouville, Riemann, Euler, Caputo etc. Fractional Calculus has recently been applied in various areas of engineering, science, finance, applied mathematics and bio engineering. [10]. It has earlier been observed that derivatives of non-integer order are useful for describing the properties of various real materials like polymer, rocks etc. Also the fractional order models were found more logical to talk an

discuss about than the integer-order models. In this paper we are focusing on Fractional Derivatives. Different people gave different definitions for the Fractional Derivative. Few definitions are :

Grunwald-Letnikov Fractional Derivatives: Let us consider a continuous function

$f(t)$, We define

$${}_a D_t^p f(t) = \lim_{h \rightarrow 0} \lim_{nh=t-a} h^{-p} \sum_{r=0}^n (-1)^r \binom{p}{r} f(t-rh)$$

The above formula has been obtained under the assumption that the derivatives $f^{(k)}(t)$ ($k=1,2,3, \dots, m+1$) are continuous in the closed interval $[a,t]$ and that m is the integer number satisfying $m > p-1$

Riemann-Liouville Derivatives:

$${}_a D_t^p f(t) = \left(\frac{d}{dt}\right)^{m+1} \int_a^t (t-\tau)^{m-p} f(\tau) d\tau, \quad (m \leq p < m+1)$$

Caputo's Fractional Derivatives: The definition of the fractional differentiation of the Riemann-Liouville Derivatives type played an important role in the development of the theory

of fractional derivatives and for its applications in pure mathematics. However, the demands of modern technology require a certain revision of well established mathematical approach. The Caputo approach provides an interpolation between an integer order derivatives:

$${}^C D^\alpha f(x) = \frac{1}{\Gamma(\alpha-n)} \int_a^x \frac{f^{(n)}(u)}{(x-u)^{(\alpha-n+1)}} du, \quad n-1 < \alpha < n, \alpha \in \mathbb{R}, n \in \mathbb{N}$$

Euler's Fractional Derivatives:

$$\frac{d^\alpha}{dt^\alpha} [t^\beta] = D_t^\alpha [t^\beta] = \frac{\Gamma(\beta+1)}{\Gamma(\beta+1-\alpha)} t^{\beta-\alpha}, \quad \alpha \in \mathbb{R}$$

Sequential Fractional Derivatives: The main idea of differentiation and integration of arbitrary order is the generalization of iterated integration and differentiation. In all these approaches we replace the integer valued parameter n of an operator denoted by $\frac{d^n}{dt^n}$ with a non integer parameter p .



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Temperature dependent structural and magnetic study of Co-sputtered Fe-Al thin film

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Temperature dependent Structural and Magnetic Study of Co-Sputtered Fe-Al Thin Film

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Abstract. The authors have deposited co-sputtered Fe-Al thin film on a glass substrate. It is the first ever reporting of Fe and Al co-sputtering in an Argon atmosphere under vacuum conditions. The sample was annealed at 200°C, 300°C, 400°C, so as to allow different phase formation in it. To study the structural and magnetic properties of the samples the GIXRD, XRR and MOKE measurements were done. After annealing at 400°C we observed disordered FeAl formation and which after further converted to more ordered phase which is also confirmed from reflectivity measurements. The magnetic measurement shows the magnetic nature of the sample even after annealing at 400°C 5hr.

Keywords: FeAl alloy, Sputtering, GIXRD, MOKE, XRR, Annealing.

PACS: 75.50.Bb; 81.15.Cd; 61.05.Cc; 61.05.cm; 61.72.Cc;

INTRODUCTION

Fe-Al intermetallic phases are of current interest because of their potential applications as corrosion resistant and high temperature structural material [1, 2]. Apart from this fact they are also important due to their attractive magnetic properties. These magnetic properties—make them potential candidate for high density magnetic recording devices [3-5]. Various phase formation in Fe-Al system makes it even more interesting but reports state that the nature of their intermixing and phase formation sensitively depends upon the parameters of deposition process and thermal treatment [6-7]. Keeping in mind the the above fact, the authors have first time prepared Fe-Al co-sputtered thin film on float glass substrate under Argon environment. Previous co-sputtered samples which are found in literature were deposited in the presence of Oxygen. Hence the formation of Oxides was but obvious. In this work an atomic concentration of 1:1 between Fe and Al was maintained. The authors have tried to get into the study of structural, electronic and magnetic properties of these samples with a heat treatment.

EXPERIMENTAL DETAILS

The authors have prepared a co-sputtered Fe and Al thin film on Float Glass substrate with Magnetron Sputtering technique. The process of deposition was done under Vacuum conditions in Argon atmosphere. The Fe and Al deposition rates were 0.425 Å/s and 0.604 Å/s respectively. The deposition rates were set to achieve an atomic concentration ratio of 1:1 between Fe and Al. The sample was further cut in small pieces and then pieces were annealed at 200°C, 300°C, 400°C for 1hour duration and one piece was annealed at 400°C for 5hours duration. Then the annealed samples were undergone GIXRD, MOKE and XRR measurements.

RESULTS AND DISCUSSION

GIXRD Measurements:

The Figure-1 shows the GIXRD plots of all the five samples. It clearly depicts that there is only one peak at 44.5° which is FeAl alloy peak. No peak for pure Fe and pure Al are visible here. It suggests formation of FeAl alloy even for pristine one. It happened so because of two main reasons: (i) The sample is co-sputtered in Argon environment so formation of there Oxides was not possible and the only possibilities are

N,N'-Diphenyldecanediamide: A Fluoride Ion Sensitive and Selective Amide

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Abstract

A fluoride ion (F⁻) sensitive organic ligand N, N'-Diphenyldecanediamide (L1), has been synthesized by the reaction of sebacyl chloride with aniline in presence of triethylamine at room temperature. Spectroscopic investigation revealed F⁻ interacts strongly with L1 in comparison to other competitive anions (Cl⁻, Br⁻ and NO₃⁻) and as a consequence induces deprotonation in the NH fragment of L1. Different spectroscopic techniques such as ¹H NMR, UV-Vis and fluorescence emission spectroscopy supports the fast and distinct response behavior of N, N'-substituted polymethylene diamide towards F⁻.

Keywords: fluoride, responsive, selective, flexible, polymethylene diamide

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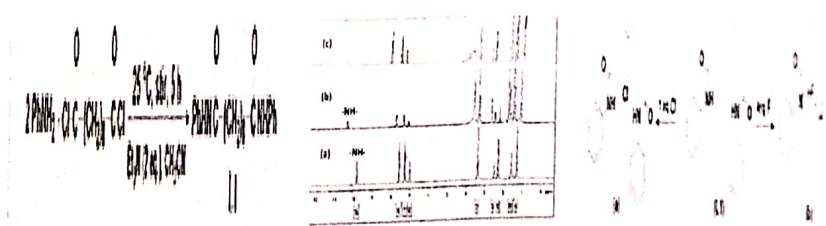
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At a glance: Figures



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1. Introduction

Recognition of inorganic and organic anions has becoming increasingly important because of their participation in chemical, biological and environmental processes [1, 2, 3, 4]. Among various inorganic anions, F⁻ is of prime concern as the critical presence of this ion in environment is associated with several health hazards such as neurotoxicity, fluorosis, and urolithiasis [5, 6, 7, 8, 9]. Therefore, the search of a molecular species that give quick response towards F⁻ remains of utmost importance at all times. In this direction, different types of sensor molecules have been synthesized [10-23][10]. Among these, the amide based organic molecules appear to be simplest and effective synthetic target because they have polarized NH bond, which can be easily approached by anions through H-bonding. Undoubtedly, the hydrogen bonding ability of different anions vary with an amide based receptor, among them F⁻ will have foremost and strongest H-bonding due to its small size and high

Paternity Suspicion: Current Scenario in India

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ABSTRACT:

DNA testing has now become a norm to adjudicate in the disputes in criminal and civil cases in various courts across India. It was observed that in majority of the medico-legal cases directed by Honourable Courts to the DNA Fingerprinting Laboratories are related to the establishment of paternity by DNA profiling. The present study was carried out with the aim to determine the non-paternity rate in India and its impact on the Indian population. It was interesting to note; that in 92% of such cases, paternity results by DNA fingerprinting technology went in favour of the mother. The study also concluded that a larger percentage of male petitioners sought to ascertain his non-parentage of the child born from wedlock was significantly higher, when compared to the number of women petitioners. Most significantly, these cases were registered either to get divorce, attest adultery of life partner or to avoid compensation for the child after divorce. Indian laws give the male partner right to DNA profiling to establish the identity of his child; but on the other side, such cases carry a major social stigma. The surreptitious, but with a mala-fide intent filed paternity cases; are generally attributed to severe psychological trauma for the child and mother. Even though, it may be a basic requirement for one parent to establish the identity of her/his progeny; the results may lead to a sense of insecurity, lack of trust and psychological impairment in the child.

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INTRODUCTION:

An old Indian Hindi saying "Maa pe poot, pita pe ghoda kuch nahi to thoda thoda" implying that progeny whether it is of horse or of human, inherits at least some traits from their parents and tend to look or behave like them. It is a vowed that the child inherits characters from both the maternal and paternal lineage and the phenotype depends on the expression of alleles (genotype) in accordance with the Mendelian laws¹¹. It is the basis of paternity testing.

Paternity is a legal and social acknowledgement of the parental relationship between a child and his / her father. In broader terms parentages can be defined in social/putative (within the wedlock) and biological parentage. Any dispute arising regarding the parentage of a child comes under paternity disputes. Questions on Paternity can arise in either of these two situation¹².

i) **Misattributed paternity^{13,14}/paternal discrepancy¹⁵(PD)** refers to non-judgmental identification of children who have

a biological father other than the man who think he is the biological father.

ii) **Paternity fraud** refers to cases where in men are coerced to obtain money from them, for example via the child support system.

Alleged fathers who strongly suspect that they are not the biological father tend to apply for in-person testing with the suitability of the test report for use in a legal setting (i.e. paternity testing on orders of a court); whilst alleged fathers who are merely satisfying a nagging doubt over paternity, opt first for the anonymous test (i.e. testing in a private laboratory, which does not have legal sanction)^{12,16}.

Akin to the developed countries, people in India too believe in free and open sexual relationship; however, a child born out of such a relationship is now becoming a major legal issue. In such a scenario, paternity tests are an essential tool to ensure child support (i.e. to establish or enforce) child custody, new-born last names, confirm new-born identity

Role of nanoparticle size in self-assemble processes of collagen for tissue engineering application.

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Abstract

Nanoparticle mediated extracellular matrix may offer new and improved biomaterial to wound healing and tissue engineering applications. However, influence of nanoparticle size in extracellular matrix is still unclear. In this work, we synthesized different size of silver nanoparticles (AgNPs) comprising of 10nm, 35nm and 55nm using nutraceuticals (pectin) as reducing as well as stabilization agents through microwave irradiation method. Synthesized Ag-pectin nanoparticles were assimilated in the self-assemble process of collagen leading to fabricated collagen-Ag-pectin nanoparticle based scaffolds. Physico-chemical properties and biocompatibility of scaffolds were analyzed through FT-IR, SEM, DSC, mechanical strength analyzer, antibacterial activity and MTT assay. Our results suggested that 10nm sized Ag-pectin nanoparticles significantly increased the denaturation temperature (57.83°C) and mechanical strength (0.045MPa) in comparison with native collagen (50.29°C and 0.011MPa). The in vitro biocompatibility assay reveals that, collagen-Ag-pectin nanoparticle based scaffold provided higher antibacterial activity against to Gram positive and Gram negative as well as enhanced cell viability toward keratinocytes. This work opens up a possibility of employing the pectin caged silver nanoparticles to develop collagen-based nanoconstructs for biomedical applications.

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KEYWORDS: Collagen; Self-assembly; Silver-pectin; Thermal stability and compressive modulus

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PAPER

Structural and dielectric properties of the fluorite-type $\text{La}_x\text{Ce}_{1-x}\text{O}_{2-\delta}$ ceramics

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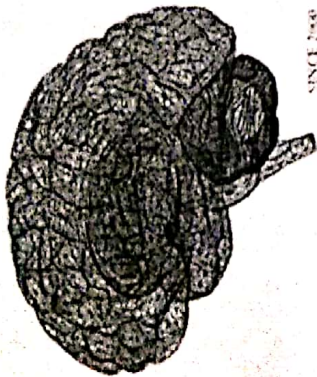
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Abstract



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Vibrational Frequency of Isotropic Square Plate on C-C-S-S Condition

Amit Sharma and Vijay Kumar

Abstract: In this study, researchers discuss the frequency modes (first two modes) of non-homogeneous isotropic square plate on C-C-S-S condition where C and S represent clamped and simply supported, respectively. Here, thickness varies linearly in one direction. For non homogeneity in the material, we considered circular variation in density. Bi-parabolic temperature variation on the plate is also being viewed. To find the vibrational frequency, Rayleigh Ritz technique has been applied for the different values of plate's parameters.

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Analysis of service surrender queue model in fuzzy system

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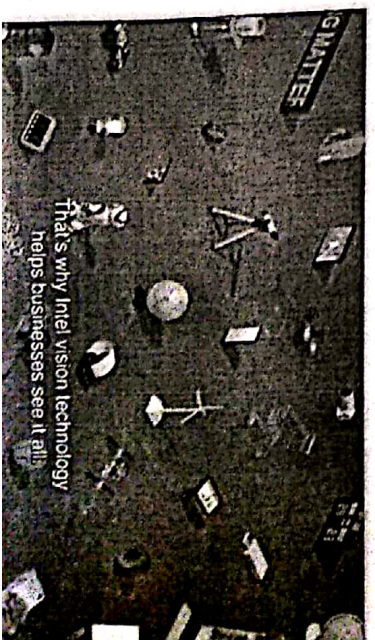


Vijay Kumar

Abstract

In this communication, the queuing system has two different types of queues namely primary and secondary queue. The existence of secondary queue is possible only when server has limited services to provide, and the system has a characteristic of service surrender facility. The paper deals with the analytical study of such system in which the parameter of the primary queue is probabilistic while parameter of the secondary queue is considered totally uncertain. We are the first to apply fuzzy logic to deal with the secondary queue. The average waiting time in the system by a customer and service wastage rate has been explored in our study through fuzzy arithmetic using α -cut. The service wastage rate is helpful in finding the level of amount of instability in the system when the secondary queue is in existence and is fuzzified.

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BULK TRANSPORTATION PROBLEM.

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RESEARCH ARTICLE

A SURVEY ON BULK TRANSPORTATION PROBLEM.

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Manuscript Info Abstract

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Bulk Transportation problem(BTP) is a special type of transportation problem having wide industrial applications. In a BTP the requirement of each destination has to be met from only one source; however,

A Simple Heuristic Algorithm to Solve the Bulk Transportation Problem

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Abstract— A Bulk Transportation Problem(BTP) deals with the problem of minimizing the total bulk transportation cost. It differs from the Classical transportation problem in the sense that the total requirement of each destination is to be satisfied from only one source; however subject to the availability of the product at the source, a source can supply to any number of destinations. In this paper, the minimum cost of BTP is obtained by a heuristic method hence providing a simple and alternative procedure to obtain the minimum cost of the BTP.

Index Terms— Transportation Problem, Bulk Transportation, Heuristic Method.

1 INTRODUCTION

THE Classical transportation problem is a subclass of linear programming problem, which has been studied extensively in literature. A large number of methods have been developed for solving the Classical transportation problem. The Classical transportation problem was presented by Hitchcock [1]. Dantzig [2] further developed the theory of Classical transportation problem. Several authors [3],[4],[5],[6],[7],[8],[9],[10],[11],[12] studied different single objective transportation problems. The BTP is a special class of transportation problems introduced in literature by Maio and Roveda [13] with the objective of minimizing the total bulk transportation cost. The authors solved the problem by an iterative procedure. The authors also gave an industrial application of the BTP wherein different warehouses of a firm are supplying to different shops; each shop was supplied from only one warehouse to maintain organizational efficiency. Later on, an algorithm based on the branch and bound method was presented by Srinivasan and Thompson [14]. A method based on lexicographic minimum to solve the BTP was developed by Murthy [15]. Bhatia [16], Foulds and Gibbons [17] discussed the cost minimizing BTP. Verma and Puri [18] proposed a branch and bound method for cost minimizing BTP. The present paper presents a much simpler and alternative solution procedure for the BTP, the application of which is very simple as compared to the existing methods. In Section 2, the formulation of the BTP is given. Section 3 discusses the steps of the proposed algorithm. In Section 4, a numerical example is considered. Section 5 gives a comparative study of the proposed method with existing methods [13],[14]. Lastly in Section 6, some concluding remarks are presented.

2 FORMULATION OF THE PROBLEM

Let there be 'm' sources (S_i) producing a particular product and 'n' destinations (D_j) having some requirement. Let C denote the total cost of bulk transportation. The mathematical formulation of the problem is as follows

$$\text{Minimize } C = \sum_{i=1}^m \sum_{j=1}^n c_{ij} x_{ij} \quad (1)$$

subject to the constraints

$$\sum_{j=1}^n b_j x_{ij} \leq a_i \quad (i = 1,2,3, \dots, m) \quad (2)$$

$$\sum_{i=1}^m x_{ij} = 1 \quad (j = 1,2,3, \dots, n) \quad (3)$$

$$x_{ij} = 0 \text{ or } 1 \quad (i = 1,2,3, \dots, m; j = 1,2,3, \dots, n) \quad (4)$$

where a_i, b_j and c_{ij} are non-negative real numbers defined below:

a_i is the number of units of a product available at the i th source.

b_j is the number of units of a product required at j th destination.

c_{ij} is the cost of bulk transportation of product from i th source to j th destination.

x_{ij} is the decision variables assuming the value 1 or 0 depending upon whether the demand at the destination j is met or not met from the source i .

3 PROPOSED ALGORITHM

Steps of the proposed algorithm:

Step 3.1

Delete cells (i, j) from the initial table for which availability a_i is less than requirement b_j .

Step 3.2

Select the two smallest bulk transportation costs for each row and column and find their difference. This difference indicates the penalty. This penalty indicates an extra cost which has to be paid if the cell having minimum bulk transportation cost remains unallocated.

Step 3.3

a) Select the maximum penalty corresponding to each row i and each column j and identify the least cost cell (i, j) and allocate 1 to this cell (i, j) . This means that requirement at destination j will be met from source i . In case of tie among the penalties, select the cell (i, j) where maximum allocation is possible in a selected row or column.

Pareto Optimal Solutions of the Fuzzy Multi-Index, Bi-Criteria Fixed Charge Transportation Problem

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Abstract. In this paper, a multi-index, bi-criteria, fixed charge transportation problem (MIBCFCTP) is considered in which the parameters of cost and duration are taken as trapezoidal fuzzy numbers. An algorithm incorporating an extended VAM and an extended MODI method is developed to find Pareto optimal solutions of the problem. The algorithm is illustrated with a numerical example and solutions obtained are compared with existing methods.

Keywords: Multi-index; transportation problem; bi-criteria; fixed charge; trapezoidal fuzzy numbers; ranking function.

AMS Mathematics Subject Classification (2010): 90B06

1. Introduction

The classical transportation problem (TP) which is well studied in literature is a two-index problem. Additional indices such as source, destination, and modes of transport extend the TP to a multi index transportation problem (MITP). Haley [12] has considered the MITP with three indices as origin, destination and commodity. He further solved the MITP with North-West corner rule and an extension of the modified distribution (MODI) method. Haley [13], Haley [14], Moravek and Vlach [23], Smith [30], Vlach [34], Korsnikov [20], Bandopadhyaya and Puri [6], Junginger [16], Pandian and Anuradha [26], Bulut and Bulut [10], Zitouni [37], Djamel et al [11] are names of few researchers who considered MITP.

Sometimes in TPs there may be multiple objectives such as minimizing transportation time in addition to minimizing the transportation cost. The TP having two objective functions such as minimizing cost and time is called bi-criteria transportation problem (BCTP). Solutions of BCTP's are Pareto optimal. A solution (c, t) of bi-criteria problem is Pareto optimal if there is no other solution (C, T) of the problem satisfying $C \leq c$ and $T \leq t$ with strict inequality holding in at least one case. Bandopadhyaya [7] has studied the multi index bi-criteria transportation problem (MIBCTP).

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Near-edge X-ray absorption fine structure spectroscopy and structural properties of Ni-doped CeO₂ nanoparticles




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ABSTRACT

Ni-doped CeO₂ nanoparticles were prepared by using the co-precipitation method. The prepared nanoparticles were characterized using X-ray diffraction (XRD). Fourier transform infrared (FTIR) spectroscopy, Raman

Genetic Ancestry of Delhi Population Inferred from Autosomal Short Tandem Repeats: Genetic Diversity Analysis

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KEYWORDS Genetic Variation Population Data Short Tandem Repeats

ABSTRACT Population substructure analysis and ancestry tracing are the critical issues for association studies of health, behaviors and forensic genetics. STR (short tandem repeat) markers are being extensively used to analyze genetic diversity among the populations. In the present study, allele frequencies and statistical parameters were estimated with 15 STR loci from 208 unrelated individuals from Delhi (India). A total of 146 alleles was found with corresponding allelic frequencies ranging from 0.001 to 0.3869. The MP (matching probability), PD (power of discrimination), PIC (polymorphism information content), PE (power of exclusion) and TPI (typical paternity index) ranged from 0.035 to 0.146, 0.854 to 0.965, 0.65 to 0.850, 0.416 to 0.774, and 1.76 to 4.52, respectively. Deviations were observed from the Hardy-Weinberg Equilibrium for D16S539, D18S51, D21S11 and TPOX Markers. The genetic proximity of the studied population was observed with central Indian population. The population's genetic structure analysis of this population can assist to contrive future genetic studies.

INTRODUCTION

Short tandem repeats are repeated after every ten thousand nucleotides and constitute three percent of the total genome (Butler 2015). Their widespread distribution, relatively low incidence of mutation, ease of multiplexing and high statistical capability of discrimination and individualization made these markers routine for forensic, anthropological and medical studies since last two decades (Osman et al. 2015). These markers are suitable for analyzing degraded, contaminated and minute amounts of human DNA samples (Jha et al. 2012; Brinkmann 1992). Throughout history, society had been ranked on the basis of caste, race, region, ethnicity, gender, age and socioeconomic status. It is ethnicity and racial discrimination that distinguishes one nation from the other (Tamang et al. 2012). The STR based population data is increasing

with add-on numbers of laboratories employing this technology (Narkuti et al. 2008; Dubey et al. 2009; Ghosh et al. 2011; Chaudhari and Dahiya 2014; Preet et al. 2016; Yadav et al. 2016; Shrivastava et al. 2017). The studies have been conducted on Delhi random and Rajput population (Chauhan et al. 2015, Raina et al. 2009) and the allelic frequencies were observed for these populations.

The present study was accomplished to determine the allele frequencies for 15 short tandem repeats (STR) loci, forensic and genetic diversity parameters from 208 individuals undergoing paternity testing from the capital region of India. The National Capital Territory of Delhi is located at 28.61°N 77.23°E and lies in northern India. It is the largest city in the country as it covers an area of 1484 km², of which approximately fifty-three percent area is designated as rural, and rest forty-seven percent is urban (Census of India 2011). Delhi is the second most populated city in the world with 18.25 million people with 79.8 percent Hindu population (Statistical Abstract of Delhi 2016). Approximately 2-3 lakh people settle in Delhi permanently from other states of India per year due to higher employment and education opportunities.

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