

Quantum geometrodynamics

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Abstract

In this paper we construct the whole of physics on the basis of three geometrical principles, namely, invariance of dimensionality, Lorentz invariant operators, and parity transformation. We call this scheme quantum geometrodynamics. We extract from the scheme the Nature's Blue Print (that is the basic ingredients from which all the furniture of the Universe are built); ipso facto we have constructed the theory of everything.

Keywords: Manifold, geometry, state, dimensionality, 4-operators, Invariant operators, fermions, bosons, fermion-bosons Interaction.

Precision measurement of the electron/muon gyromagnetic factors

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Abstract

Clear, persuasive arguments are brought forward to motivate the need for highly precise measurements of the electron/ muon orbital g , i.e. g_L . First, we briefly review results obtained using an extended Dirac equation, which conclusively showed that, as a consequence of quantum relativistic correction arising from the time-dependence of the rest-energy, the electron gyromagnetic factors are corrected. It is next demonstrated, using the data of Kusch and Foley on the measurement of $(\delta_S - 2\delta_L)$ together with the modern precise measurements of the electron $\delta_S(\delta_S \equiv g_S - 2)$, that δ_L may be small (-0.6×10^{-4}), non-zero quantity, where we have assumed Russel-Saunders (LS) coupling and proposed, along with Kusch and Foley, that $g_S = 2 + \delta_S$ and $g_L = 1 + \delta_L$. Therefore, there is probable evidence from experimental data that g_L is not exactly equal to 1: the expectation that quantum effects will significantly modify the classical value of the orbital g is therefore reasonable. Finally, we show that if, as suggested by the results obtained from the modified Dirac theory, δ_S and δ_L depend linearly on a dimensionless parameter Δ such that the gyromagnetic factors are considered corrected as follows; $g_S = 2(1 + \Delta)$ and $g_L = 1 - \Delta$, then the Kusch-Foley data implies that the correction $\Delta \approx 1.0 \times 10^{-3}$; it is noteworthy that Δ is of the same order of magnitude as the measured $(g_S - 2)/2$ which, to five places of decimal, is equal to 1.12×10^{-3} . Thus, available spectroscopic data indicate that g_S and g_L may both be significantly modified, such that g_S that is increased by 2Δ , while g_L is decreased by Δ , the quantity 2Δ being equal to the precisely measured $g_S - 2$. Modern, high precision measurements of the electron and muon orbital g_L are therefore required, in order to properly determine by experiments

the true value of $g_S - 1$, perhaps to about one part in a trillion as was recently done for $g_S - 2$.

Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 17 - 20
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On the coefficients of holomorphic functions and the identity $S_n - S_{n-1} = \binom{2n}{n}$

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Abstract

We give, in this note, a simple proof of the identity.

$$S_n - S_{n-1} = \binom{2n}{n}, n \geq 1 \text{ where } S_n = \sum_{i+j+k=n} \binom{i+j}{i} \binom{j+k}{j} \binom{k+i}{k}$$

by relating it to the coefficients of the series expansion of a holomorphic function of several complex variables where the summation is taken over all non-negative integers i, j, k such that $i + j + k = n$.

Keywords: Holomorphic functions, series expansion of holomorphic functions, coefficients of series expansion, absolute terms of an identity.

2000 Mathematics Subject Classification: 05A19, 32A10, 32A05

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 21 - 22
© J. of NAMP

On Rouché's theorem as a criterion for irreducibility of polynomial maps.

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Abstract

In this paper, a proof of Rouché's Theorem for irreducible polynomials is presented using the unit circle as our closed curve under consideration. It will be noted that, use is made of the Fundamental Theorem of Algebra just as it is well known that the Fundamental Theorem of Algebra can also be proved using Rouché's Theorem. Thus, one may rightly view this paper as establishing that Rouché's Theorem for polynomial maps is equivalent to the Fundamental Theorem of Algebra. (i.e. that each is easily derivable from the other.)

Keywords: argument, irreducible, multiplicity of zeros, poles, unit circle.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 23 - 26
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Number of fixed point free element in the subgroup of orientation reversing mappings

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Abstract

Let ORD_n be the subgroup of all orientation reversing bijective mappings of n -element set. It is shown that for m even: if $m = 2k + 1$, then $\rho_m \in ORD_n$ has no fixed point. And if m is odd there are exactly $n/2$ derangements.

Keywords: Permutation, derangement, symmetries, full transformation, partial transformation, partial one-one transformation.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 27 - 30
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Some results on the generalized projection and asymptotic operators

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Keywords: Asymptotic Operators, Contractive and Suppressive mappings, fixed point, Generalized projection, Ishikawa iteration, uniformly convex and uniformly smooth Banach spaces.

2000 Mathematics Subject Classification:
47H04, 47H06, 47H10, 47J05, 47J25.

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On the isomorphism of $\text{aut}(\mathbb{Z}_n)$, U -group $U(n)$ and permutation group $U(n)^*$

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Abstract

In this paper, we compute $\text{Aut}(\mathbb{Z}_n)$ and U -group, $U(n)$ and establish that these groups are isomorphic and give the systematic construction of the permutation group, $U(n)^$ which is isomorphic to $U(n)$. Hence we establish the isomorphism of $\text{Aut}(\mathbb{Z}_n)$, U -group $U(n)$ and Permutation group $U(n)^*$. We consider only when $n = 20$.*

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Computational analysis of the Van der Pol equation using the Krylov-Bogolobov technique

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Abstract

Analysis of non-linear equations has been a very difficult aspect of mathematics. This paper ventures into the specifics of Van Der Pol equation as related to the use of perturbation method of its analysis, finally employs the Krylov-Bogolobov techniques. Our purpose here is to describe the main features of the method of asymptotic expansion an example, that of Van Der Pol equation.

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Derivative of biconfluent Heun's equation from some properties of hypergeometric function

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Abstract

The paper determines the solutions derived from the transformation of some confluent Heun's equation to hypergeometric equations by rational substitution. We show that the derivative of the original solution of the transformed confluent form of Heun's equation can be expressed in terms of another solution of the confluent form.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 41 - 48
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On coefficients in the partial fractions of some trigonometric and exponential functions

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Abstract

Several works have been done in this area including Daniel S. and Tella Y. [2]. In this paper, we consider resolving rational functions containing trigonometric and exponential functions in their denominators into the sum of its partial fractions equivalent where all the unknown constants and coefficients are obtained by recursive method; an extension of [2]. Also, a general formula for obtaining these coefficients as n tends to infinity is obtained.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 49 - 54
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Recursive backstepping design for controlling chaos of three nonlinear Bloch equations.

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Abstract

Recursive backstepping nonlinear control technique has become a powerful tool for controlling and synchronizing chaotic systems, because

backstepping enhances global stability. The purpose of this study is to make use of recursive backstepping technique in controlling chaotic dynamics and attractors generated by dynamic states of three nonlinear modified Bloch systems described with different values of system constants and initial conditions. Numerical simulations are performed to verify that the three controllers achieve the control goals for the three dynamic states equations.

Keywords: Chaos control; Nonlinear Bloch Equations; recursive backstepping control.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 55 - 58
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On the numerical solution of the Gross-Pitaevskii equation for an isolated vortex in trapped gas

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Abstract

In this paper, the solution of the Gross-Pitaevskii equation is obtained numerically and the spread of the boson molecules in the vortex examined. In our study, we considered the attractive interaction for which the coupling constant is negative and the vortex is generated in harmonic potential. Our results show that, for attractive interaction, the boson molecules spread out from the centre of the vortex as the strength of the interaction increases.

Keywords: Bose-Einstein condensation; Vortex; Harmonic potential

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 59 - 62
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Improved continuous method for direct solution of general second order ordinary differential equation

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Abstract

In this paper a numerical method of solving general second order initial value problems with step length $k = 4$ is developed. The approach is based on the collocation of the differential system and interpolation of the approximate solution. Some predictors for calculating the unknown in the corrector were also derived. The efficiency of this scheme was tested with some numerical examples.

Keywords: Collocation, interpolation, approximate solution, predictors, correctors, step length.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 63 - 68
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One-leg multistep methods for the numerical integration of periodic second order initial value problems

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Abstract

The need to develop some efficient schemes that is suitable for second order initial value problems in ordinary differential equations is of interest. We observe that some second order differential equations do exist that will not contain the first derivative of the dependent variable in the equation. Such equations may be highly oscillatory or periodic in nature and require some efficient algorithms in terms of accuracy and stability. This paper discusses some one-leg methods that are suitable for such problems.

Keywords: One-leg, twin- multistep, Periodic, stability

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 69 - 82
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On delay-type behaviour of thermal explosion in a combustible gas mixture containing fuel droplets with Arrhenius power-law model

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Abstract

The problem of thermal explosion in combustible gas mixtures containing fuel droplets is extended to permit a more general temperature dependent rate of reaction for most typical practical reactions based on Arrhenius equation under physically reasonable assumptions. A detailed numerical analysis of the resulting system of coupled non-linear ordinary differential equations is performed to account for numeric exponent effects relating to most typical practical reactions such as sensitized, Arrhenius and bimolecular reactions respectively. The computed results reveal different dynamic delay-type behaviours and are illustrated graphically in this study.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 83 - 86
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On a differential and integral characterization of real-valued convex functions of several variables

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Abstract

Convex functions play important roles in the study of optimization. These functions have many important properties which can be used to develop suitable optimality conditions and computational schemes for optimization problems. With a growing need for deeper understanding of these properties comes the need for a wider definition of convex functions. In this work we present a characterization of real valued convex functions of several variables through the derivative and integral. This characterization provides an equivalence for the definitions of convexity.

Keywords: Convex Functions, Convex Sets, Monotone Mapping

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 87 - 94
© J. of NAMP

Oscillation in solutions of stochastic delay differential equations with real coefficients and several constant time lags

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Abstract

We study the role played by multiplicative noise perturbation in the oscillatory and non-oscillatory behaviour of the solution of first order linear scalar stochastic delay differential equation (SDDE)

$$dX(t) = \left[aX(t) + \sum_{i=1}^n b_i x(t-r_i) \right] dt + \mu X(t) dB(t),$$
$$t \geq 0 \quad X(t) = \psi(t), \quad t \in [-r, 0]$$

We explain the interplay between the time lags and the multiplicative noise in the oscillatory behaviour of the solutions of the SDDE. It is proved that the presence of the multiplicative noise ensures that all solutions of the SDDE oscillate under negative feedback even if its corresponding deterministic equation has a non-oscillatory solution.

Keywords: Stochastic delay differential equation, oscillation, non-oscillation, noise perturbation.

On a stochastically imperfect quadratic-cubic column pressurized by a random dynamic load

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Abstract

This investigation explores the dynamic stability of a randomly stochastic viscously damped finite imperfect column lying on a quadratic-cubic nonlinear elastic foundation but trapped by a dynamically random load applied just after the initial time. Non-vanishing statistical means and autocorrelations of both the imperfection and dynamic load are assumed. In particular, the autocorrelation of the imperfection is assumed to be correlated as an exponentially decaying function of the space variable. The statistical mean of the normal displacement is determined and is assumed to be a suitable parameter for determining the dynamic buckling load. The dynamic buckling load is determined asymptotically and various deductions are made. The result is particularized to that of a finite column on a purely cubic nonlinear elastic foundation.

Time-dependent random forcing and buckling of a damped finite column on non-linear elastic foundations

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Abstract

This paper is concerned with time-dependent random vibrations and dynamic buckling of a finite deterministically imperfect column resting on “softening” nonlinear (cubic) elastic foundations but trapped by a stochastically random, zero-mean, time-dependent load. The random load is imbued with certain statistical characterizations including a correlated exponential cosine autocorrelation which confers some form of randomness on the response statistic. Assuming the mean square lateral displacement to be a suitable statistical characterization of the random response, the dynamic buckling load of the nonlinear structure is determined asymptotically via regular perturbation procedures. It is found out that the dynamic buckling load is of order $R_0^{-\frac{1}{2}}$, where R_0 is the variance of the random load. It is also established that the value of the dynamic buckling load, in the case where the buckling modes are strictly in the shape of imperfection, is less than its value in a similar case where the buckling modes are not strictly in the shape of imperfection.

Effects of damping and exponentially decaying foundation on the motions of finite thin beam subjected to travelling loads

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Abstract

The dynamic response of a finite elastic thin beam to fast moving heavy concentrated forces is investigated. The beam is assumed to be under tensile stress and have simple supports at both ends. Furthermore, the beam is assumed to rest on elastic foundation of the exponential rigidity and the moving concentrated forces is assumed to move with constant velocity type of motion. The fourth order partial differential equation governing the flexural motions of the elastic systems is solved using mode superimposition and Integral transform method and the closed-form solutions to this beam problem is obtained. Effects of some beam parameters on the response of the

beam are classified. Results presented both analytically and numerically in this paper are readily applicable in engineering design and analysis and for further investigation in structural dynamics.

Keywords: Dynamic response, Concentrated forces, Exponential rigidity, Flexural motions, Beam parameters

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 127 - 140
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Influence of prestress on the response to moving loads of rectangular plates incorporating rotatory inertia correction factor.

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Abstract

In this paper, the influence of axial force on the dynamic response to moving concentrated masses of rectangular plate incorporating rotatory inertia correction factor is investigated. The solution technique is based on the versatile two-dimensional generalized integral transform with the normal modes of the plate as the kernel of transformation and a modification of the Struble's asymptotic technique. The closed form solutions are analyzed and numerical analyses in plotted curves are presented. The results show that as the axial force (prestress), N_x and N_y , foundation moduli K and rotatory R_o increase, the response amplitudes of the dynamic system decrease for both illustrative examples. However, higher values of N_x , N_y , K and R_o are required for a more noticeable effect in the case of simple-clamped boundary conditions than those of simply supported boundary conditions. Furthermore, for the same natural frequency, the critical speed for the moving mass problem is smaller than that of the moving force problem. Hence resonance is reached earlier in moving mass problem.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 141 - 160
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Transverse vibration under a moving load of a highly prestressed isotropic rectangular plate on a bi-parametric subgrade

S. T Oni and O. K Ogunbamike

Abstract

This paper investigates the dynamic response of a highly prestressed isotropic rectangular plate resting on a bi-parametric subgrade under the action of a moving load. Using the singular perturbation technique, specifically the Method of Matched Asymptotic Expansion (MMAE), in conjunction with the method of integral transformations and Cauchy Residue theorem, a uniformly valid analytical solution in the entire domain of definition of the rectangular plate is obtained. Analyses of analytical solutions and numerical results show that the leading order solution and the first order correction are affected by the bi-parametric subgrade and anisotropic prestress to the response of $O(\epsilon^4)$ of the rectangular plate. It is also found that the critical velocities of the dynamical system increase with prestress for all values of shear modulus and foundation stiffness used. Thus, resonance is reached earlier for lower values of prestress, shear modulus and foundation stiffness than for high values.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 161 - 166
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Acoustic wave in viscous fluid

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Abstract

This discussion is concerned with an acoustic wave in a viscous Newtonian fluid and examines the wave equation in this case. The governing partial differential equations for the wave are derived using the Navier-Stokes momentum equation, the equation of continuity (assuming an adiabatic equation of state) and the acoustic wave condition. One advantage of this formulation is that the wave equation is expressed in a form suitable for finite difference time domain discretization. The formulation shows that, in general, acoustic wave propagation in a viscous fluid is associated with both shearing (tangential) and non-shearing (normal) viscous forces, which account for dissipation of wave energy in the medium. In a liquid or for a plane acoustic wave the non-shearing (normal) viscous force is the dominant contributor to wave energy dissipation.

Keywords: acoustic wave; viscous loss.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 167 - 172

Linear stability analysis of a radiating fluid layer with temperature-dependent viscosity heated from below

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Abstract

Experiments with fluid whose viscosity depends on temperature are used to study the effect of viscosity variations. At large viscosity, Rayleigh number can either be conductive or convective depending on whether the Rayleigh number is high or low or decreased from a pre-existing convective state. At high Rayleigh numbers and for the entire range of viscosity variation, the stability occurs at $Ra_{cri} = 407.70$. From the viscous fluid when the Rayleigh is defined in terms of wave number corresponding to a temperature equal to the average of the boundary temperatures. The relationship between critical Rayleigh number and the temperature appears not to depend on the Rayleigh number.

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Journal of the Nigerian Association of Mathematical Physics
 Volume 13 (November, 2008), 173 - 178
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Shear fields in a material weakened by cracks at the boundary of a hole

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Abstract

A sheared elastic material containing a central hole and two cracks has been investigated. One of the cracks propagated from a far distance and terminated at the hole which acted as a crack breaker. The other one originated from the boundary of the hole opposite the one of infinite extent and moved a finite distance, $b-a$, where a is the radius of the hole. The fields close to the tip of the finite crack were derived in terms of the complete elliptic integral of the first kind. The stress intensity factor, $K_{III}(b-a; T)$ was derived in the standard form and is comparable with known stress intensity factor, $K_{III}^0(a, T)$ for a tunnel crack of width, $2a$ under remote shear stress. The dependence of $K_{III}^N(b-a; T) = \frac{K_{III}(b-a; T)}{K_{III}^0(a; T)}$

on the ratio $\frac{a}{b}$ was displayed in a graph.

Mathematical model for flow around two-dimensional aerofoils at small angles of attack

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Abstract

The sole aim of this work is to develop a mathematical model for calculating certain parameters like velocity, angle of incidence, lift coefficient and geometric characteristics like maximum thickness and camber for both same and related aerofoils using Prandtl-Glauert [1, 2] and Gothert [3] similarity rules. The model is extended to include pressure at any point on the aerofoil profile as well as other geometric characteristics like chord, wing area and span. Applying the model to a numerical example, based on flight problem, these parameters are determined in compressible flow and compared with those in incompressible flow. Furthermore, the model which includes ratios of geometric characteristics of aerofoil like thickness/chord ratio and camber/chord ratio is extended to include wing area/span ratio, and these parameters are also determined in the example and compared for both same and related aerofoil.

Keywords: Mathematical model, two-dimensional aerofoils, similarity rules, small angles of attack.

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A coupled mathematical model for a temperature dependant blood perfusion in a homogenous biological tissue during microwave heating.

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Abstract

The steady state temperature field of a homogenous biological tissues is discussed when the blood perfusion is temperature dependant. The solution to the steady Maxwell equations provoke a two regional compartments. Our solution is obtained for the temperature field using an adequate matching condition at the interface of the two regions. The results revealed the effects of varying blood perfusion, tissue thickness, Electric field and the matching temperature on the temperature pattern in the tissue. Great care is needed before treatment and modality is administered.

Approximate solution to laminar falling liquid film with variable viscosity along an inclined heated plate

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Abstract

This paper examines the steady-state solution of a laminar falling liquid film with variable viscosity along an inclined heated plate. The existence and uniqueness of solution to this problem was investigated and it was found that the problem has a unique solution. Numerical solution via shooting techniques were employed in tackling the non-linear coupled momentum and energy balance equations. The Brinkman number (λ) and variable viscous parameter (β) play a prominent roll in the construction of the numerical solution. The velocity and temperature profile of the liquid film are displayed in graphs.

Keywords: Numerical solution, laminar, viscosity, film, steady-state.

Viscous dissipation effect on the flow through a very porous media

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Abstract

In this paper we present similarity solutions to the flow of fluid through a very porous media bounded by a semi-infinite horizontal plate with viscous dissipation effect. The effect of Prandtl Number and permeability parameter are considered. It is observed that as the

permeability parameter increases the dimensionless temperature decreases, it is also observed that the dimensionless temperature also increase with a decrease in the Prandtl number.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 197 - 200
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Viscous dissipation effect on the hydro-magnetic flow through a very porous horizontal plate

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Abstract

We analyse heat transfer characteristics of a steady hydro-magnetic flow in a horizontal plate. The effect of the Darcy number, Hartmann number and the Brinkman number were effectively determined. Results obtained shows that there is an increase in temperature as the Hartmann number increases and an increase in the Darcy number leads to a decrease in the temperature.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 201 - 210
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Effects of variable viscosity on MHD boundary layer flow on a continuously moving vertical plate in the presence of radiation and a chemical reaction of order 1

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Abstract

This work presents a study of the flow and heat transfer of an incompressible viscous electrically conducting fluid over a continuously moving vertical infinite plate with uniform suction and heat flux in the presence of radiation and a chemical reaction of order 1 taking into account the effects of variable viscosity. It is found that the velocity increases as the viscosity of fluid or the magnetic parameter decreases and the thermal boundary layer thickness increases as the radiation parameter increases. The skin-friction coefficient is computed and discussed for

various values of the parameters. A parametric study was conducted and reported.

Keywords: MHD, variable viscosity, radiation.
Mathematics Subject Classification: 76W05

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 211 - 220
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MHD flow of a uniformly stretched vertical permeable surface under oscillatory suction velocity

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Abstract

The study of unsteady magnetohydrodynamic heat and mass transfer in MHD flow of an incompressible, electrically conducting, viscous fluid past an infinite vertical porous plate along with porous medium of time dependent permeability under oscillatory suction velocity normal to the plate has been made. It was considered that the influence of the uniform magnetic field acts normal to the flow and the permeability of the porous medium fluctuate with time. The problem is solved, analytically by asymptotic expansion in order of epsilon for velocity, temperature and concentration fields. The results obtained are discussed for thermal Grashof number ($Gr\tau > 0$) corresponding to the cooling of the plate and ($Gr\tau < 0$) corresponding to heating of the plate with the help of graphs to observe the effect of various parameters. A parametric study of all parameters involved was considered, and a representative set of results showing the effect of heat generation, reaction parameter, grashof numbers Hartmann number and free stream oscillatory frequency were illustrated.

Keywords: Mass transfer, MHD flow, vertical plate, suction velocity, viscous, oscillatory, Grashof number, permeable surface.
Classification: 76W05

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 221 - 226
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Steady flow of reacting temperature-dependent fluid past an impulsively started porous vertical surface with Newtonian heating

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Abstract

This paper studies the steady flow of a reacting temperature-dependent viscous incompressible fluid past an infinite vertical porous plate, with the flow generated by Newtonian heating and impulsive motion. The resulting momentum equation is non-dimensionalized and the solution is obtained numerically by shooting method. A parametric study of all involved parameters is conducted and illustrated graphically.

Keywords: Reacting fluid, temperature-dependent, heat transfer, Newtonian heating.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 227 - 230
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Application of thermo-acoustic engines to heat transfer in microcircuits: An analytical approach

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Abstract

As a result of miniaturization, electronic products are shrinking in size and weight but with greater pressure for cost reduction. Heat fluxes have increased considerably and hence thermal management becomes crucial from the reliability point of view. This paper presents an analytical model of heat transfer in microcircuits. The analytical solution is obtained for temperature field of the fin. It is shown that the minimum temperature of the fin decreases as both time and convection coefficient increases and thermal conductivity decreases.

Keywords: heat transfer, engines, microcircuit, variable separation

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 231 - 234
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Effect of power-law exponent in endothermic reactions

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Abstract

We present the solutions of a steady Arrhenious endothermic reaction. We reduced the exponential term to a power-law approximation. We solved the problem by using shooting method technique. It is shown that the heat generated by the endothermic reaction depends on the power-law exponent. The minimum temperature increases as the power-law index α increases, whereas the minimum temperature decreases as the Frank-Kamenestkii parameter β increases.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 235 - 242
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Solitons of flexual deformation of the basilar membrane

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Abstract

Solitons are very stable solitary waves in a solution of the plate equation obtain from the three dimensional equations of the linearized director theory for an elastic body (the basilar membrane) which were solve and solution shows solitons. We show that the solitary waves behave like particle. When there are located mutually far apart, each of them is approximately a travelling wave with constant shape and velocity. The stability of the solitons stems from the delicate balance of "nonlinearity" and "dispersion" in the model equations. Nonlinearity drives a solitary wave to concentrate further; dispersion is the effects to spread such a localized wave. In this exhibition, we present equation of soliton phenomena along with soliton solution.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 243 - 252
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Effect of noise on the level of hearing

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Abstract

Mathematical models describing the effects of noise on the level of hearing were formulated. It is shown that sound above 85dB affect the position or orientation of the Hair Cells on the basilar membrane in the inner ear. This change in the orientation of HC affects the ionic exchange at the foot the HC. This allows the release of neuron transmitters, which set up potentials that will transmit impulse to the auditory nerve. The noise so received and transmitted as impulse signal to the auditory nerve is sent to the hypothalamus section of the brain, for interpretations.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 253 - 260
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A new analytical solution to the optimal control problem for the control of higher-order non-dispersive wave

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Abstract

The explicit expressions of the functions: $z(x,y,t)$ and $u(x,y,t)$ were obtained in this paper. These two functions are known as the state and the control variables for the optimal control model of higher order nondispersive wave equation. They are indispensable in the implementation of the model using the extended conjugate gradient method [2].

Keywords: optimal control, maximum principle, state variable, control variable

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 261 - 266
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Relative controllability of neutral functional differential systems with nonlinear base

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Abstract

In this paper, sufficient conditions are established for the relative controllability of a special class of nonlinear neutral systems in which the

base is strongly nonlinear and with time varying multiple delays in control. The results are established by using the Schauder fixed point theorem.

Keywords: Controllability, neutral functional differential system, nonlinear base, multiple delays, Schauder fixed point theorem.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 267 - 272
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Asymptotic null controllability of nonlinear neutral volterra integrodifferential system with delays in control

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Abstract

In this paper by using Larry-Schauder's fixed point theorem, we; obtained sufficient conditions for the asymptotic null controllability of nonlinear neutral volterra integrodifferential system.

Keywords: Asymptotic null controllability, volterra integral system, Larry-Schauder's Fixed point theorem.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 273 - 280
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Design of provably secure cryptographic hash functions

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Abstract

It was shown in this paper that the size w of the internal hash values is a security parameter of its own right, with $w \geq n$ but otherwise independent from the final hash size n . Given "good" compression functions, this paper shows how to compose "good" hashes. Though the random oracle model is quite useless to define what it means to be a "good" compression function [6], the given lemmas provide some specific requirements for the compression functions.

Dynamic hashing algorithm for searching time-series databases

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Abstract

Sequence data searching using the Euclidean distance between two sequences as the only criterion for similarity suffers from some deficiencies: It is sensitive to the vertical positions of the two sequences and so is not a good measure of similarity in terms of their shapes. We propose a new definition for similarity that overcomes these deficiencies. A fast searching algorithm based on dynamic hashing, which guarantees that no qualified data subsequence similar to the query sequence will be falsely rejected, is also proposed. The algorithm can also find data subsequences similar to the query sequence with different scaling factors in both amplitude and time dimensions. Several experiments were performed to evaluate the proposed algorithm using both synthetic and real data (stock price movement).

Keywords: Euclidean distance, hashing, time-series, sequence similarity, statistical noise.

Comparative analysis of Rivest Shamir Adleman (RSA), Rabin and El Gamal public key cryptosystems

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Abstract

Eavesdropping is as old as human race. The ever increasing dependence on the use of computer and the telecommunications technology (ICT) has heightened the desire to protect and preserve the integrity of networks. This takes the challenge to the level of security. This paper attempts to conduct a comparative analysis of the three public key cryptosystems (RSA, Rabin and El Gamal) that are thought to be secure. Each of the cryptographic schemes is appraised with a view to exposing their strengths and weaknesses. A platform is considered in the paper for the schemes based on some denominators for indepth comparisons.

Simulation of the performance of photovoltaic system using heliophysical variables

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Abstract

A method of simulating the long-term average performance of photovoltaic systems based on the observed time series of some heliophysical variables was developed and explored in this research. The data used were the sunshine duration and solar radiation intensity for years 1990 to 2004 for eleven Nigerian stations namely Calabar, Ibadan, Ilorin, Kaduna, Kano, Lagos, Lokoja, Maiduguri, Minna, Sokoto and Zaria obtained from the archives of the Nigeria Meteorological Agency, NIMET. Appropriate programs were developed using Matlab^R code to model the performance of a photovoltaic system. Input parameters which were estimated from the obtained heliophysical variables and used in the simulation were clearness index and total radiation on an inclined surface. The output parameters include utilizability, monthly-average fraction of the load covered by the photovoltaic system with battery storage, monthly-average fraction of the load covered by the photovoltaic system without battery storage and the increase in the solar load fraction due to storage. Solar load fraction with storage gotten from this work ranges between 27.2% and 28.2% conversion efficiency of solar cell. Maximum incident solar radiation onto the photovoltaic array is obtainable in dry season which lead to better performance of photovoltaic electrical output and lower values of utilizability either when the excess solar load fractions are being stored or not. Minimum incident solar radiation onto the photovoltaic array is also obtainable in wet season which lead to poor performance of photovoltaic electrical output and higher values of utilizability either when the excess solar load fractions are being stored or not.

Keywords: photovoltaic systems, utilizability, performance, atmospheres

The performance of FPE for the maximum entropy estimation method

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Abstract

The performance of $FPE\alpha$, as defined by Bhansali and Downham (1977) is investigated here for $\alpha = 1, 2, 3, 4$ and for the maximum entropy method of autoregression estimation. Here it is demonstrated using both artificial and real series that the optimum α is between 2 and 4, inclusive.

Keywords: Autoregressive modeling, FPE, maximum entropy method.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 309 - 314
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The performance of inverse autocorrelation function in model order determination especially with outliers.

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Abstract

Noting that the effect of outliers in model order determination could be serious, this paper is concerned with the problem of examining the performance of inverse autocorrelation function in model order determination especially with outliers. Tsay (1986) iterative procedure was used to identify the outliers, remove their effects and then specify a tentative model using the inverse autocorrelation function. An example is also presented.

Keywords: Inverse autocorrelation function; outliers; model order determination.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 315 - 320
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Physical model of income distribution

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Abstract

In this study, a self-organized model was developed to demonstrate the inequality of income distribution. We assumed that income depends on two quantifiable parameters, namely, work and

potential. Since every member of a population (or every nation) is free to decide how much work he/she will do, we model work by a random variable, called, the work index. The potential of each member of the population depends on biological (skill, intelligence), social and economic factors. For a state, the factors that affect the potential include the quality and quantity of a country's stock of the factors of production, technical knowledge, natural resources etc. In this model, a basic computer program was developed to compute the income distribution among population sample of 27. The results show that the wealth increases exponentially with the potential. Work however, has a linear relationship with potential; hence, the acquired resources also depend exponentially on work. There is no relationship between the initial potential, the final potential, and the final wealth. The model shows that although work is very important in the final potential and wealth, the time of work is more important to avoid lasting poverty.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 321 - 324
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Optimality of MRPP policies for inventory problem with stochastic demand

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Abstract

Material requirements and production planning (MRPP) is absolutely an essential activity which holds some form of detail lists in any production industry. This paper addresses a discrete time inventory problem when the demand for finished products is a random variable. Policies that make material requirements and production planning optimal are presented. Data from a typical plastic industry are analysed to evaluate the performance of MRPP, and quick response time is recommended.

Keywords: Inventory Models, Stochastic Demand, Material Requirements, Cost Control, Probability.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 325 - 330
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Batch arrival discrete time queue with server vacation

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Abstract

A class of single server vacation queues, which have batch arrivals and single server, is considered in discrete time. Here the server goes on vacation of random length as soon as the system becomes empty. On return from vacation, if he finds any customers waiting in the queue, the server starts serving the customers one by one until the queue size is zero (the queue discipline is FIFO); otherwise he takes another vacation and so on. The vacation model we consider here is the ungated system i.e. exhaustive system. It is shown here that the interarrival, service, vacation and server operation time can be cast with markov based representation then this class of vacation models can then be studied as matrix-product problem which belongs to a class of matrix analytic family- thereby allowing us to use result from Alfa (2003) to solve the resulting matrix product problem. Most importantly it is shown that using discrete time modelling approach to study some vacation model is more appropriate and makes the model much more algorithmically tractable.

Keywords: Batch Arrival, Discrete time model, matrix product problem, vacation queues.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 331 - 336
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Mathematical application of time study model in a glass company

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Abstract

This paper presents a case study in the development and application of a time study model in a glass manufacturing plant. The organization engages in the production of different types of glass wares which are versatile and enigmatic. The motivation for this study was the need to intervene in frequent crises that normally arose between the employee-association and the management of the company regarding questions of productivity. The mathematical model was developed with the application of differential calculus to the elements of the production systems that have significant effect on the production output from the system. Our model incorporates some uncontrollable factors such as irregular supply of electricity, unavailability of raw materials as well as excessive machine breakdown due to old age. The study is however considered to be very beneficial to practicing managers in the industries and is therefore recommended for use.

Keywords: Time Study Model, Production System, Production Output, Uncontrollable Factors.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 337 - 342
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A measure of confidence for examination process

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Abstract

The zeal of candidates to pass examinations at all costs in order to progress in their educational pursuit or gain undue advantage over others has resulted to examination malpractice. To curb this, new strategies for examination have evolved over the years. In this study, we derive mathematical models to measure the level of confidence on the effectiveness of new strategies that are being introduced to remedy examination malpractice. The model is extended to the case where the previous strategies are claimed to be effective. The methods presented in this paper have the advantage of summarizing in one figure the confidence level on examination process.

Keywords: beta function; confidence level; gamma function; examination; estimate.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 343 - 350
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Application of mathematical models to educational planning: A review

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Abstract

This paper offers critical evaluation of previous works relevant to educational planning, school choice modelling and mode choice of student travel to school. In the review, the practical relevance of existing models is reported as well as the roles played by exploratory and normative models. The purpose of this paper is to give educational planners a realistic appraisal of the previous and current practice in educational planning, school choice modelling and mode choice of student travel and to provide pointers to areas where further research are needed.

Keywords: educational planning; log-normal model; manpower planning; mathematical model; multinomial logit model.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 351 - 356
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First-principles study of structural and electronic properties of GaP and InP

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Abstact

The full-potential linearized augmented plane wave method (FP-LAPW) within the generalized gradient approximation (GGA) is used to calculate the structural and electronic properties of zinc blende GaP and InP. In this approach we obtained ground state properties such as equilibrium lattice constants, bulk modulus and its pressure derivative which are in good agreement with previous results. However our study shows that the GGA underestimates the energy band gap of both semiconductors.

Keywords: Full-Potential Linearized Augmented Plane Wave (FP-LAPW), Density Functional Theory (DFT), Generalized Gradient Approximation (GGA)

PACS: 71.15. Ap; 71.15.Mb; 71.15.-m

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 357 - 362
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Calculations of total energy in the density functional theory using FHI98MD code

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Abstract

We have computed total energy for Al, Si, Ga, and As in the framework of density-function theory within LDA approximation by using the Williams-Solar minimization scheme to iterate the wave functions. Different values for the electronic time step, delt, an energy cutoff, Ecut and damping parameter, gamma are used. The Monkhorst-Pack k-point mesh was taken as 4x4x4 with the initial k-point (0.5,0.5,0.5) . E_o is the well-converged value of the total energy approached. Each computation gives an optimal convergence for all the four elements.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 363 - 366
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Einstein's equation of motion for a photon in fields exterior to astrophysically real or imaginary spherical mass distributions whose tensor field varies with azimuthal angle only

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Abstract

The metric exterior to an astrophysically real or hypothetical spherical mass distribution whose tensor field varies with azimuthal angle only is used to study the motion of a photon in this gravitational field. The general relativistic equation of motion for a photon moving round this spherical distribution of mass is derived. The second-order differential equation obtained differs from that in Schwarzschild's field.

Keywords: equation of motion, astrophysical, spherical, mass, photon, tensor field, azimuthal angle

**I–electrophoresis of deoxyhemoglobin S:
Theoretical study of the deformation induced by the applied field and the
mechanical stresses**

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Abstract

A more efficient technique for the study of red cell is electrophoresis. More precisely, if a constant external field is applied to a protein, the later migrates to anode or cathode according to his net charge. Compared to Hemoglobin A (HbA) which is the normal constituent, it was observed that Hemoglobin S (HbS) have a charge difference which is due to a genetic mutation $\beta 6(A3) Glu \rightarrow Val$, and consequently, a less anodic migration [1]. For the patients with HbS disease, the red cell instead to stay binocave takes the sickle form when there are deoxygenated. This deformation leads to the vaso-occlusives crisis very painful which can provoke different lesions in organelles [2]. In this work, we paid our attention on a particular phenomenon, viz, the account of the deformation which result exclusively from the conjugated action of the applied field and the mechanical stress acting on the deoxy-HbS during the electrophoresis process. In these conditions, a molecule of deoxy-HbS which is not deformed is considered as a dielectric sphere with dielectric constant ϵ_0 , while a defined HbS molecule is considered as a dielectric ellipsoid of revolution with dielectric constant ϵ_i along the j axis where the field is applied. The results obtained clearly indicate that the deformation ζ is an analytical function of the form:

$\zeta = f(E, \mu, \varepsilon_0, \varepsilon)$ where E is the electric field intensity, μ the slide modulus of the molecule, and ε

Keywords: Hemoglobine S, Electrophoresis, Deformation, Critical Value

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 373 - 376
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II–electrophoresis of deoxyhemoglobin S
Theoretical study of the volume variation and electrocalorific effect

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Abstract

In the first part of this work by Olatunji and Ayeni [1], we consider the deformation of HbS molecule without volume variation during the electrophoresis process. In this second part, we consider the inverse case where the ellipsoid do not change the form but only his volume changes. We also consider the induced electro calorific effect. The results obtains are:

$$V - V_0 = \frac{VE^2}{8\pi} \left[\left(\frac{f}{g} \right) \beta_x - \frac{h\beta_x(\varepsilon_x - 1)(\varepsilon_x + 2) + k\beta(\varepsilon - 1)(\varepsilon + 2)}{3g^2} \right]$$
$$Q - Q_0 = \frac{TVE^2}{8\pi} \left[\left(\frac{f}{g} \right) \chi_x - \frac{h\chi_x(\varepsilon_x - 1)(\varepsilon_x + 2) + k\chi(\varepsilon - 1)(\varepsilon + 2)}{3g^2} \right]$$

where β_x and χ_x are the isothermal coefficient of compressibility and the coefficient of thermal dialation of the molecule, β and χ the corresponding coefficients for the solvent. (f, g, h, k) are analytical functions which depend on dielectric constants and coefficient of depolarization A_x .

Keyword: Hemoglobin S, Volume Variation, electrocalorific Effect

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 377 - 386
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Non linear dynamic equation for deoxyhemoglobins aggregation: A phenomenological approach

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Abstract

In a previous work Dejardin and Olatunji [1], a mathematical model is derived for the kinetics of the Deoxyhemoglobin S (deoxy-HbS). The analytical function $A(t)$ obtained for the time evolution of the absorbance measured in turbidity, satisfactorily fits the experimental data of Poyart et al [2]. In the present paper, starting with the function $A(t)$, we used a phenomenological approach to derive a nonlinear dynamic equation for the aggregation of deoxy-HbS. Every parameter of the governing equation can be assigned a clear physical meaning. Moreover, drawing on the work of Quemada [3], we introduced in the parameters base a scalar structural parameter $\lambda(t, x)$ which depends on the time t and on a set of controlling factors denoted x . Furthermore, the set of controlling factor x can be limited to, say, the volume fraction ϕ , a constant shear rate $\dot{\gamma}$, the deoxy-HbS concentration c , the temperature T , and other factors which influence the aggregation dynamics. In this paper, we developed the solution of the governing equation under steady conditions and applied the results to some rheological properties of deoxy-HbS gel.

Keywords: Deoxyhemoglobin S aggregation, Nonlinear dynamic equation, Steady properties of HbS gel.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 387 - 390
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Egyptian fractions and practical numbers

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Abstract

It is easily seen that if p can be written as the sum of distinct divisors of q , then the fraction $\frac{p}{q}$ can be expanded with no denominator greater than q itself. The idea behind this concept has provided another method for writing the Egyptian fractions (sum of Unit fractions) for any rational $\frac{p}{q}$, $q \neq 0$.

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Journal of the Nigerian Association of Mathematical Physics
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Enhancing refraction statics correction from first break interpretation - the Niger Delta example

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Abstract

The focus of this paper is on improving the statics corrections obtained from first break interpretation using generalized linear inversion GLI3D by effective incorporation of uphole data. Different near surface velocity models were compared by computing the corresponding statics and evaluating their impact on seismic image. The results show that to maximise first break interpretation using the generalized linear inversion method, the uphole information regarding the actual number of layers and velocities should be incorporated into the GLI3D scheme so as to allow for faster convergence between the model breaks and the field breaks resulting in better statics application.

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 397 - 404
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On the equivalence of some iteration schemes for a class of quasi-contractive operators

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Abstract

We prove that Picard, Mann, Mann with errors, Ishikawa, Ishikawa with errors, Noor, Noor with errors, multistep and multistep iterations with errors are all equivalent when applied to a class of quasi-contractive operators. Our results are extensions and generalisations of the known results of Soltuz [11, 12].

Keywords: Picard, Mann, Ishikawa, Noor, Multistep, iterations with their respective errors, quasi-contractive operators.

2000 AMS Mathematics Classification: 47H10

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Journal of the Nigerian Association of Mathematical Physics
Volume 13 (November, 2008), 405 - 410

Temperature and velocity profile on thermal ignition in a reactive variable viscosity poiseuille flow.

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Abstract

This study evaluates the physio-chemical properties that are associated with thermal ignition in a strong exothermic reaction of variable viscosity combustible material flowing through a channel with isothermal walls under Arrhenius kinetics, neglecting the construction of the material under physical and reasonable conditions to give further insight into the theory of combustion. It shows that these properties has greater influence on thermal ignition. Temperature and velocity profiles were also considered. The procedure reveals accurately the state thermal ignition criticality conditions for as well as their dependent on viscous heating parameter. The numerical method used can be used as an effective tool to investigate several other dependent nonlinear boundary – value problem.

Development of data encryption and decryption algorithm using 4-row rail fence cipher

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Abstract

The increase use of electronic means of data transfer from one point to the other coupled with growth in networking and internet has really called for vital security. This security is usually achieved by encryption and digital signature. Data encryption is the automated process of securing data so that no unauthorized person can access them. It makes use of different algorithm to scramble (encrypt) the original message called plaintext into an unintelligible message called cipher text. Key is an important object in data encryption. There are some data encryption algorithm that uses same key for both its encryption and decryption while some uses two keys, one for encryption and the other for decryption. Rail fence cipher is categorized under data encryption algorithm that uses same key for both its encryption and decryption. The number of rows used to break up text/data to be encrypted into rows and column arrangement serves as the key in Rail fence cipher. In this paper we present the algorithm that can encrypt and decrypt data using a 4-row Rail Fence Cipher.

Effect of matrix transformation on minimization of quadratic functional

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Abstract

The convergence profile of the conventional Conjugate Gradient Method (CGM) algorithm is based on the symmetry of the control operator for quadratic functions. This work considers the quadratic functions with non-symmetric control operator under suitable matrix transformations: it is proved that the conventional CGM algorithm produces results that are favourably comparable to problems with symmetric control operator equivalent.

C.R. Category: G. 1.7

Instantaneous source functions of a 3D source subject to edge water drive mechanism

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Abstract

This paper derives necessary instantaneous source functions of some reservoir systems with horizontal wells (3D sources) experiencing edge water drive. Eleven (11) different systems were considered for which thirty six (36) instantaneous source functions were derived.
