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1)

ITERATIVE SOLUTION OF CERTAIN NONLINEAR OPERATOR EQUATIONS ARISING IN MATHEMATICAL PHYSICS

(*page1 – 8 of Vol 1 Namp Journal*s)

by C. Moore

Department of Mathematics Nnamdi Azikiwe University Awka, Nigeria.

Abstract

Let Ω be an open domain bounded in R^n and let L be some differential operator. The mixed initial-boundary value problem:

$$u_t + Lu = f(x,u) \text{ in } \Omega\times(0,T)$$
$$Bu = g(x,u) \text{ on } \Gamma = \partial\Omega\times(0,T)$$
$$u(0,x) = u_0(x) \text{ in } \Omega,$$

is often a suitable mathematical model for several situations arising in chemical flows, gas dynamics, heat conduction, and other physical processes. Using a purely abstract approach, the existence, uniqueness, and strong convergence of fixed-point iterations to a solution to the above problem is established.

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2)

AN ERROR ESTIMATE FOR TREMOLIERES' METHOD FOR THE DISCRETIZATION OF PARABOLIC VARIATIONAL INEQUALITIES

(page 9 – 14 of Vol 1 Namp Journals)

by L. U. Uko
Department of Mathematics, University of Ibadan, Ibadan, Nigeria

Abstract
We study a scheme for the time-discretization of parabolic variational inequalities that is often easier to use than the classical method of Rothe. We show that if the data are compatible in a certain sense, then this scheme is of order greater than or equal to ½ .

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3)

ITERATIVE SOLUTION OF THE DIRICHLET PROBLEM FOR THE SEMILINEAR WAVE EQUATION

(page 15 - 22 of Vol 1 Namp Journals)

by C. Moore
Department of Mathematics, Nnamdi Azikiwe University, Awka, Nigeria

Abstract
Let Ω be an open bounded domain in R^n. A solution to the Dirichlet problem for the semilinear wave equation;
$$u_{tt} - \Delta u + g(t,x,u) = f(t,x) \text{ in } Q_T$$
$$u = 0 \text{ on } \Gamma = \partial\Omega\times[0,T]$$

where $Q_T = \Omega \times [0,T]$ is constructed using the equivalent abstract formulation

$$Lu + Nu = f$$

in the case where *L* and *N* satisfy monotonicity conditions. We also discuss an application to control theory.

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4)

AN EXACT SOLUTION OF THE HUBBARD HAMILTONIAN MODEL FOR HIGH TEMPERATURE SUPERCONDUCTORS

(page 22 – 28 of Vol 1 Namp Journals)

by C.N. Animalu
Department of Physics and Astronomy, University of Nigeria, Nsukka, Nigeria

Abstract
Using a 2^N x 2^N matrix representation of the creation and annihilation operators for an N-fermion system, we present an exact diagonalization of the Hubbard Hamiltonian for a strongly correlated many-electron system. The result is applied to the thermodynamic properties and spin susceptibility of high-temperature superconductors, such as *YBa2Cu307-X* (with Tc = 90K) in which superconductivity is believed to occur in Cu02 planes, and whose electronic structure is described by the Hubbard Hamiltonian. Effects of correlation are observed in the electronic specific heat, which are not seen in results obtained by the standard mean-field approximation method, such as the Gutzwiller variational method. The magnetic spin susceptibility compares favourably with the quantum Monte Carlo simulations of White et al. Other applications of the method to the many-body problem are discussed.

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5)

A HAMILTONIAN FOR SUPERCONDUCTORS

(page 29 – 31 of Vol 1 Namp Journals)

by E.O. Aiyohuyin*, A. Maduemezia**, G.K. Oyanna*

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Abstract
From consideration of the physical situation in the normal state of superconductors, namely that there are electron-electron, electron-ion, and ion-ion interactions, we show that the Hamiltonian for superconductors is similar to those obtained by the BCS group, as well as the Hubbard

Hamiltonian. In our approximations, the electron-electron interaction is separated into two parts, namely the screened Coulombic, and collective interactions. Finally, only those terms in which electrons are paired, such as $(\underline{k}, -\underline{k})$, are chosen.

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6)

ON QUANTUM CHAOS

(page 33 – 38 of Vol 1 Namp Journals)

by R. Akin-Ojo
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Abstract

Given a closed Hamiltonian system of n degrees of freedom, with Hamiltonian $H(p, q) = T(p) + V(q) = E$, where E is a constant and $n \geq 2$, we now know that the system exhibits deterministic (classical) chaos, if H is nonlinear and completely nonintegrable. The question often arises: How should such a system be quantized, and is there any manifestation of the (classical) chaoticity in its quantal counterpart? Seeking answers by the method of reduction of numbers of degrees of freedom, we demonstrate that some attribute L (related to one of the momenta p) can be quantized, provided the coordinates q satisfy some relationships. These relationships are obtained by the method for the "Lax pair" – the potential V(q) must satisfy some "KdV equation" of "solitary waves". Moreover, the relationships reveal that the KdV engenders multiple Schroedinger operators and this is the manifestation of the chaoticity. Hence, such a quantum-mechanical system has multiple spectra and therefore it is noisy.

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PERTURBATIVE QUANTUM CHROMODYNAMICS

(page 39 – 46 of Vol 1 Namp Journals)

by O.A. Odundun,
Department of Physics, Obafemi Awolowo University, Ile-Ife, Nigeria

Abstract

Introductory covariant perturbation theory for quantum chromodynamics is discussed, with examples to serve as qualitative illustrative applications.

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EQUILIBRIUM STATISTICAL MECHANICS OF HARD PARTICLE FLUIDS

(page 47 – 53 of Vol 1 Namp Journals)

by U.F. Edgal
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Abstract
The governing equation for the ϵ-parameter which features in the density function in classical phase space is solved in low and high density regimes for the special case of the hard particle system. The results obtained for the equation of state are shown to compare favourably with those in the literature. The new solutions also suggest a re-examination of the nature of critical behaviour in the presence of hard-core interaction close to “Bernal” density.

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9)

HEAT TRANSFER TO A LIQUID FILM ON AN UNSTEADY STRETCHING SURFACE

(page 55 – 59 of Vol 1 Namp Journals)

by R.O. Ayeni & J.O. Oladele
Department of Pure and Applied Mathematics, Oyo State University of Technology, Ogbomoso, Nigeria

Abstract
An investigation into heat transfer into a liquid film on an unsteady stretching surface is carried out. Using similarity transformations, both momentum and energy equations are reduced to ordinary differential equations. To obtain heat transfer, we use both asymptotic and numerical techniques.

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10)

SOLAR RADIATION MODELS IN NIGERIA: A CASE FOR VALIDATION OF RESULTS

(page 61 – 69 of Vol 1 Namp Journals)

by A.A.L. Maduekwe
Department of Physics, University of Lagos, Lagos, Nigeria

Abstract
Solar radiation regression models developed for the Nigerian environment are rarely validated. Authors of such models appear to ignore the dangers of publishing models which are not validated. A case study is made with monthly mean data for a period of ten years in Sokoto, Nigeria. Regression models were created for predicting solar radiation which is horizontal when it reaches the earth’s surface. Two methods of validation were used: (a) the collection of fresh data, and (b) data splitting or cross-validation. The results depend on whether prediction

data sets are different from estimation data sets. The method of data splitting introduces difficulties when the estimation data set and the prediction data set differ in predictive performance and coefficient estimates.

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11)

A BASIC CODE FOR PLOTTING DISPERSION CURVES IN A COLD PLASMA

(page 71 – 75 of Vol 1 Namp Journals)

by S.D. Salihu, B. Chike-Obi
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Abstract
We have developed a BASIC code for plotting the dispersion curves for waves in a cold plasma. The programme algorithm is based on the evaluation of a many-valued polynomial function of wave frequency and angle of propagation. Typical dispersion curves are discussed. Design efforts to minimize the effects of singularities on the curves are analyzed.

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ENTROPY RATE IN SOLAR WIND FLOW

(page 77 – 80 of Vol 1 Namp Journals)

by O.D. Makinde & S. Idowu
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Abstract
In this paper, the entropy rate in solar wind flow is analyzed by considering fluid dynamical models of a spherically symmetric, expanding, and heat conducting gas under gravity. Based on certain simplifying postulates, the fluid equations of continuity, momentum, energy, and a thermodynamic relation that involves entropy, are obtained and solved analytically. The entropy rate is shown to give two critical solutions, one increasing and the other decreasing.

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13)

THE ONSET AND SATURATION OF THE IONOSPHERIC LOWER HYBRID MODE

(page 81 – 85 of Vol 1 Namp Journals)

by B. Chike-Obi
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Abstract
Ionospheric noise shows strong peaks at lower hybrid frequencies. It is proposed that wave-particle energy exchange processes lead to the growth of a beam instability which has mode frequencies centred on the lower hybrid frequency. The onset of the beam instability and its saturation through energy transfer to part of the ion population are analyzed. The theory has implications for ionospheric radio communications.

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A MAGNETOTELLURIC METHOD FOR DETERMINING AQUIFER DEPTHS

(page 87 – 94 of Vol 1 Namp Journals)

by M.B. Asokhia
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Abstract
A magnetotelluric method for determining aquifer depths is described, which was tested along the “Blue Road Traverse” in central Sweden. It was necessary to choose a sampling interval as low as 0.04s, to ensure that thin aquifers were not missed in interpretation. The depth of the “Blue Road” aquifer was estimated to be about 38m, for a depth of about 1km investigated. The merits of the magnetotelluric method over other methods of investigating aquifer depths are discussed.

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