

Nasir Ganikhodjaev
Farrukh Mukhamedov
Pah Chin Hee

VOLUME 1

$$x' = 2xy$$

$$y' = 2xz$$

INVESTIGATIONS ON PURE MATHEMATICS, FINANCE MATHEMATICS AND OPTICS

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$$\varphi_1(x, y, z) = z$$

$$\pi_1 = \begin{pmatrix} x & y & z \\ y & z & x \end{pmatrix}$$

$$z' = x^2 + y^2 + z^2 + 2yz$$

$$\pi_1 V_1 \pi_1 = V_{17}$$



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Investigations on Pure Mathematics, Finance Mathematics and Optics

Nasir Ganikhodjaev
Farrukh Mukhamedov
Pah Chin Hee



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Contents

Preface

Part I Pure Mathematics Concentration

| | | |
|------------|--|-----|
| Chapter 1 | THE BEHAVIOR OF TRAJECTORY OF ξ^s QUADRATIC STOCHASTIC OPERATIONS | 2 |
| Chapter 2 | THEORY OF MARKOV CHAINS IN PEDIATRIC DISEASES | 8 |
| Chapter 3 | ON NONLINEAR DYNAMIC SYSTEMS ARISING IN POTTS MODEL | 14 |
| Chapter 4 | THE FIRST RETURN TIME AND DIMENSION | 22 |
| Chapter 5 | ON AS SOCIATIVE ALGEBRAIC STRUCTURE OF GENETIC INHERITANCE | 31 |
| Chapter 6 | INTERACTING PARTICLE SYSTEM | 37 |
| Chapter 7 | DYNAMICS OF GENERALIZED LOGISTIC MAPS | 43 |
| Chapter 8 | GEOMETRIC BROWNIAN MOTION AND CALCULATION OF OPTION PREMIUM IN BLACK-SCHOLES MODEL | 50 |
| Chapter 9 | ON THE ELEMENTARY CHARACTERIZATION OF PRIMES IN PRIMALITY TESTS: TWO SHORT STUDIES. | 57 |
| Chapter 10 | ON ASSOCIATIVE ALGEBRAIC STRUCTURE OF GENETIC INHERITANCE | 64 |
| Chapter 11 | SOME APPLICATION OF ERGODIC THEORY IN NUMBER THEORY | 70 |
| Chapter 12 | STUDY OF ROLES OF EXTERNAL MAGNETIC FIELD ON ISING AND POTTS MODEL | 76 |
| Chapter 13 | INVESTIGATION OF STABILITY OF FIXED POINTS OF NONLINEAR DISCRETE DYNAMICAL SYSTEMS | 82 |
| Chapter 14 | MARKOV CHAINS AND ITS APPLICATION: THE INVENTORY MODEL | 90 |
| Chapter 15 | PHASE TRANSITION FOR ISING MODEL WITH TWO COMPETING INTERACTION ON CAYLEY TREE OF ORDER 4 | 96 |
| Chapter 16 | LIMIT BEHAVIOR OF DYNAMIC SYSTEMS CORRESPONDING TO LATTICE MODELS WITH COMPETING PROLONGED AND ONE-LEVEL BINARY INTERACTIONS | 101 |
| Chapter 17 | ASSOCIATIVE ALGEBRA IN GENETIC INHERITANCE | 109 |
| Chapter 18 | ON ξ^a - QUADRATIC STOCHASTIC OPERATORS AND THEIR CLASSIFICATIONS | 115 |

Part II Finance Mathematics Concentration

| | | |
|------------|--|-----|
| Chapter 19 | ANALYZING THE PERFORMANCE OF INVESTMENT STRATEGY OF EPF | 123 |
| Chapter 20 | PREDICTION OF STOCK PRICE USING NEURAL NETWORK | 130 |
| Chapter 21 | COMPARISON BETWEEN CONVENTIONAL AND ISLAMIC BOND IN MALAYSIA | 136 |
| Chapter 22 | STOCK PERFORMANCE ANALYSIS BETWEEN MALAYSIAN AIRLINES SYSTEM BERHAD AND AIRASIA BERHAD | 144 |
| Chapter 23 | ISLAMIC PAWNBROKING (AR-RAHNU) AS A MICRO CREDIT INSTRUMENT IN MALAYSIA | 151 |
| Chapter 24 | ANALYSIS OF CRUDE PALM OIL FUTURES PRICES TRADED ON BURSA MALAYSIA | 160 |
| Chapter 25 | AN EMPIRICAL STUDY ON THE EFFICIENCY OF THE TRIM AND FILL METHOD IN CORRECTING PUBLICATION BIAS IN META ANALYSIS | 166 |
| Chapter 26 | PERFORMANCE ANALYSIS OF INSURANCE AND TAKAFUL INDUSTRIES IN MALAYSIA | 171 |
| Chapter 27 | ANALYSIS OF DATA USING MULTILEVEL MODELLING WITH MLwiN | 179 |
| Chapter 28 | FINANCIAL PERFORMANCE OF ISLAMIC BANKING AND CONVENTIONAL BANKING IN MALAYSIA | 186 |
| Chapter 29 | A STUDY ON THE EFFECT OF PUBLICATION BIAS IN META ANALYSIS | 194 |
| Chapter 30 | RATIO ANALYSIS: BANK ISLAM MALAYSIA BERHAD (BIMB) & MALAYAN BANKING BERHAD (MAYBANK) | 201 |
| Chapter 31 | AN ANALYSIS OF MALAYSIAN UNIT TRUST FUNDS: ISLAMIC VS CONVENTIONAL | 207 |

Part III Optics Concentration

| | | |
|------------|---|-----|
| Chapter 32 | QUANTUM TRAJECTORY METHOD USING MPI PARALLEL COMPUTING | 214 |
| Chapter 33 | LINEAR WAVE PROPAGATION IN SINGLE MODE OPTICAL FIBRE | 220 |
| Chapter 34 | THE OPTICAL RAY TRACING TECHNIQUE IN LENS SYSTEM WITHIN AND BEYOND PARAXIAL APPROXIMATION | 226 |
| Chapter 35 | WAVE PROPAGATION IN NONLINEAR AND HOMOGENEOUS MEDIA: KERR MEDIA | 234 |
| Chapter 36 | MATRIX METHODS OF OPTICAL RESONATORS | 240 |

WAVE PROPAGATION IN NONLINEAR AND HOMOGENEOUS MEDIA: KERR MEDIA

Normala Abdul Khahar
Assoc. Prof. Dr. Bakhrum Umarov

Abstract. *The basic structure and the propagation of wave has been study in this paper by implementing a numerical routine to solve the nonlinear paraxial equation. Start by implement the basic wave equation, we be able to derive the nonlinear Schrödinger equation which is define by the special character of Kerr media. Along the process of propagation, both linear (dispersion) and nonlinear operator undergo the special method known as split step method. This method involves the separation of calculation between two non commuting operators. This paper also provides the solution of nonlinear Schrödinger equation in the form of spatial soliton. The solitary wave (soliton) is a wave that propagates at uniform velocity without changing its form It can maintain it form because the Kerr effect help to balance the group dispersion in optical propagation medium. The resulting effect of this balance is the propagation of solitons, which has the form of a hyperbolic secant. Throughout the process of calculating, several notations have been normalizing in order to develop the code using the MATLAB software. By relies on pulse propagation*

1 Introduction

Wave is disturbance that propagates through space and time, with transference of energy. Wave travels and transfer energy from one point to another and often with little or no associated mass transport; they consist instead of oscillations or vibrations around almost fixed locations. Wave propagates in any ways which enable it to travel. All waves can experience reflection, refraction, diffraction, interference, dispersion and rectilinear propagation. The waves also can propagate in three main medium which are homogeneous, linear and isotropic medium (Daintith, 2005).

The main objective of this project paper is to investigate about the wave propagation in nonlinear and homogeneous media using the special media called Kerr media. In order to fulfil this objective, the nonlinear Schrödinger equation has been derived. This equation lead to the spatial soliton solution and the numerical approach has been used to complete the solution. The medium is nonlinear if its properties depend on the amplitude of the field in the medium. Meanwhile, the medium is called homogeneous if its properties are not function of space.

The Kerr media is caused by Kerr effect, which is known as the quadratic electro-optic effect. It is the change in the refractive index of a material because it response to a practical electric held. According to Weinberger (2008), the Kerr effect is different from the Pockels effect, where the induced index change is directly proportional to the square of the electric field instead of varying linearly with it. Moreover, all materials demonstrate the Kerr effect but certain fluids show it strongly than others. The optical Kerr effect is one of the special cases that we study in this paper.

The optical Kerr effect is the cause in which the electric field is due to the light itself. Then it causes a variation in index of refraction and it is proportional to the local irradiance of light. The refractive index vibration lead to nonlinear optical effect of self focusing, self-