

Nasir Ganikhodjaev  
Farrukh Mukhamedov  
Pah Chin Hee

VOLUME 1

$$x' = 2xy$$

$$y' = 2xz$$

# INVESTIGATIONS ON PURE MATHEMATICS, FINANCE MATHEMATICS AND OPTICS

Proceedings of the Department of Computational  
and Theoretical Sciences Kulliyah of Science, IIUM

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

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

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

$$\pi_1 \nu_1 \pi_1 = \nu_{17}$$



الجامعة الإسلامية العالمية ماليزيا  
INTERNATIONAL ISLAMIC UNIVERSITY MALAYSIA  
يُونَيْتِي سَلَامًا اِنْتَارَا اِنْعَسَابًا مَلَيْسِيَا

# **Investigations on Pure Mathematics, Finance Mathematics and Optics**

Nasir Ganikhodjaev  
Farrukh Mukhamedov  
Pah Chin Hee



IIUM Press

Published by.  
IIUM Press  
International Islamic University Malaysia

First Edition, 2011  
©IIUM Press, IIUM

All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording, or otherwise, without any prior written permission of the publisher.

Perpustakaan Negara Malaysia

Cataloguing-in-Publication Data

Nasir Ganikhodjaev, Farrukh Mukhamedov & Pah Chin Hee. Investigations on Pure Mathematics, Finance Mathematics and Optics

ISBN: 978-967-418-198-7

Member of Majlis Penerbitan Ilmiah Malaysia – MAPIM  
(Malaysian Scholarly Publishing Council)

Printed by  
**IIUM PRINTING SDN.BHD.**  
No 1, Jalan Industri Batu Caves 1/3  
Taman Perindustrian Batu Caves  
Batu Caves Centre Point  
68100 Batu Caves  
Selangor Darul Ehsan

# Contents

Preface

## Part I Pure Mathematics Concentration

Chapter 1	THE BEHAVIOR OF TRAJECTORY OF $\xi^s$ 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 $\xi^a$ -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

# INTERACTING PARTICLE SYSTEM

Huda Salmi Ahmad  
Prof. Dr. Nasir Ganikhodjaev

**Abstract.** *Probability measures are used in physical and biological models as a tool to study the behaviour of the models. The purposes of this paper are to study two probability measures which describes the distribution of configurations or elements when the model is in some state of dynamic equilibrium, namely Gibbs state and nearest neighbour state and to study one of dynamic models that has the probability measures mentioned earlier as its equilibrium state. This model is called as birth-death process. We will use graph structure properties to describe the model. We will first show that the Gibbs state and the nearest neighbour state are the same. Then the result is used to prove the relation that every nearest neighbour state is the equilibrium state of some time-reversible nearest neighbour birth-death semi-group.*

## 1 Introduction

A particle system is composed of one or more individual particles. Interacting particle systems are models in which the individual particles or elements, are changed in time according to some microscopic rules, from which collective macroscopic behaviour may emerge. These particles may represent molecules, biological entities, or social agents, depending on the application of the model.

The topic of interacting particle systems was originated from statistical mechanics of physics and became a branch of probability theory after being introduced by R. L. Dobrushin of the Soviet Union and F. Spitzer of Cornell University in the late 1960s. Today, interacting particle systems are used in many areas such physics, chemistry, biology and social science. The birth-death process is one of the interacting particle system models which has been applied in a wide range of disciplines. For instance, it is used in biomedicine to model an epidemic and spread of infection, and in cellular communication systems, to model the interactions among cells.

We are interested to know the probability distribution of nearest neighbour birth-death process models satisfying time-reversibility conditions when they reach their equilibrium state. According to Preston(1994), this distribution is called the nearest neighbour state or, equivalently the Gibbs state with nearest neighbour potential  $V$  where  $V$  is a potential value. We will apply the induction method using eighteen graphs, each consists of four vertices to prove this statement.

## 2 Preliminaries

In this section, we introduce basic notations and terminologies that will be used throughout the text.

Let  $\Lambda$  be a finite set and let  $\mathcal{p}(\Lambda)$  denote the set of subsets of  $\Lambda$ . The points of  $\Lambda$  can be interpreted as sites. Each site can be either empty or occupied by a particle. The subset  $A \in \mathcal{p}(\Lambda)$  describes the state of the model when the points of  $\Lambda$  are occupied and the points  $\Lambda \setminus A$  are empty. The elements of  $\mathcal{p}(\Lambda)$  are called configurations. For example, in a demographic study, a point may refer to a single individual, and a state may refer to level of