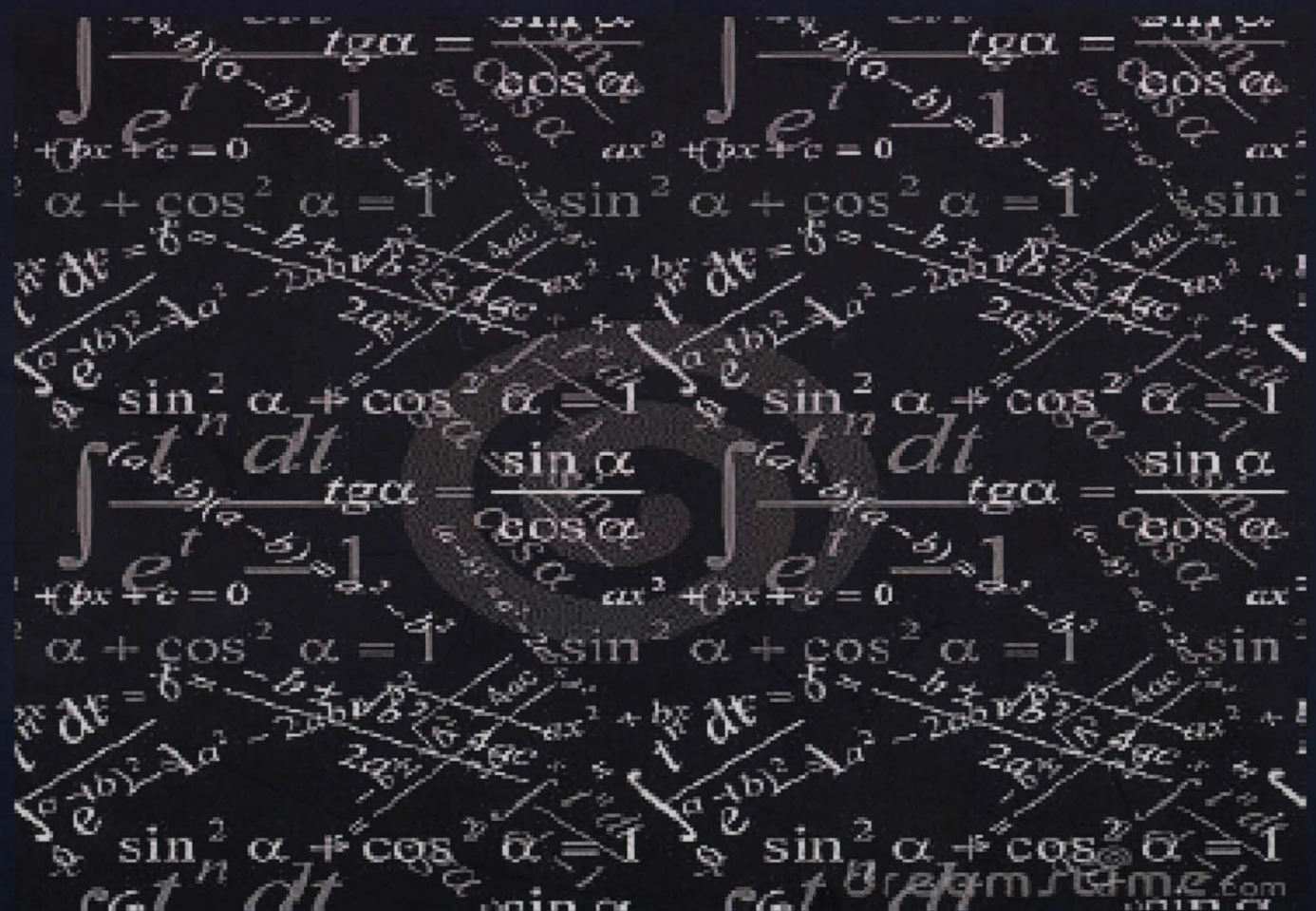




RECENT ACHIEVEMENTS IN DYNAMICAL SYSTEMS

Proceedings of Department of
Computational and Theoretical
Sciences, Faculty of Science, IIUM



Chief Editor : Farrukh Mukhamedov

Editors : Nasir Ganikhodjaev

: Mansoor Saburov

Proceedings of Department of
Computational and Theoretical Sciences,
Faculty of Science, IIUM

Recent Achievements in Dynamical Systems

Chief Editor: Farrukh Mukhamedov

Editors:
Nasir Ganikhodjaev
Mansoor Saburov

Vol. 2



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

Farrukh Mukhamedov, Nasir Ganikhodjaev & Mansoor Saburov
Recent Achievements in Dynamical Systems
Farrukh Mukhamedov, Nasir Ganikhodjaev & Mansoor Saburov

ISBN: 978-967-418-201-4

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

Part I. Quadratic Operators and Their Dynamics

Farrukh Mukhamedov, Abduaziz Abduganiev, Maksut Mukhamedov, On Dynamics of a Class of Quantum Quadratic Operators on $M_2(\mathbb{C})$.	2
Mansoor Saburov, On Ergodic Principle for Quadratic Volterra Operators.	9
Mansoor Saburov, Fixed Point of Compositions of Volterra Operators.	15
Farrukh Mukhamedov, Afifah Hanum Bt Mohd. Jamal, Classification of ξ^s - Quadratic Stochastic Operators in 2D-Simplex.	21
Farrukh Mukhamedov, Mansoor Saburov, Afifah Hanum Bt Mohd. Jamal, Dynamics of ξ^s - Quadratic Stochastic Operators in 2D-Simplex.	29
Farrukh Mukhamedov, Mansoor Saburov, Some Examples of Lotka-Volterra Type Models.	34
Nasir Ganikhodjaev, Makhsuma Usmanova, On Linearization of Quadratic Stochastic Operators.	40
Nasir Ganikhodjaev, Continual Family of Ergodic Non-Homogeneous Markov Chains.	47
Rasul Ganikhodjaev, Farrukh Mukhamedov, Mansoor Saburov, On G-Decomposition of Matrices.	53
Farrukh Mukhamedov, On L_1 -Weak Ergodicity of Nonhomogeneous Discrete Markov Processes	59
Inomjon Ganiev, Farrukh Mukhamedov, On Measurable Bundles of C^* -Dynamical Systems.	65
Inomjon Ganiev, Farrukh Mukhamedov, A Weighted Ergodic Theorem for Contractions Defined on Banach-Kantorovich Lattice.	71

Part II. Dynamical Systems Arising From Physical Models

Farrukh Mukhamedov, Mansoor Saburov, Dynamical Systems of XY-Models On A Cayley Tree Of Order Two.	78
Farrukh Mukhamedov, Mansoor Saburov, Dynamical Systems of XY-Models On A Cayley Tree Of Order Three.	85
Farrukh Mukhamedov, Mansoor Saburov, Dynamical Systems of Ising Model on a Cayley Tree.	91
Nasir Ganikhodjaev, Siti Fatimah Zakaria, Phase Diagram of The Ising Model with Nearest-Neighbor Interactions.	98
Nasir Ganikhodjaev, Siti Fatimah Zakaria, Ising Model on a General Cayley Tree with Competing Next-Nearest-Neighbour Interactions.	107
Pah Chin Hee, Rukiah Ali, Ising Model with Competing Interactions on Cayley Tree of Order Four	118
Massimo Ostilli, Langevin Dynamics for a New Class of Mean-Field Ising Models.	125
Farrukh Mukhamedov, Utkir Rozikov, Free Energy of The Ising Model with Competing Interactions on a Cayley Tree.	133
A. Benseghir, B.A. Umarov, A. Messikh, Modulational Instability In Salerno Model.	141
Nasir Ganikhodjaev, Seyit Temir, On Potts Model with Triple Interactions.	146
Nasir Ganikhodjaev, Ashraf Mohamed Nawi, Mohd Hirzie Mohd Rodzhan, Phase Diagram Of The Potts Model with External Magnetic Field.	152
Nasir Ganikhodjaev, Fatimah Abdul Razak, A Correlation Inequality for Potts Model.	160
Nasir Ganikhodjaev, Ashraf Mohamed Nawi, A Nonlinear Dynamic System Arising in Potts Model.	167

Farrukh Mukhamedov, On Existence of Phase Transition for One Dimensional P-Adic Countable State Potts Model.	177
B.A. Umarov, A. Bouketir, Strongly Localized Models In Two-Component Discrete Media With Cubic-Quintic Nonlinearity.	184
Part III. Nonlinear Dynamical Systems	
Farrukh Mukhamedov , Wan Nur Fairuz Alwani Wan Rozali, On P-Adic Generalized Logistic Dynamical System.	196
Farrukh Mukhamedov, Mansoor Saburov, On Equation $x^q = a$ over \mathcal{Q}_p .	201
Farrukh Mukhamedov, Mansoor Saburov, On Unification of The Strong Convergence Theorems for a Finite Family Of TAN Mappings in Banach Spaces.	207
Part IV. Graphs And Networks	
Pah Chin Hee, Single Polygon Counting for Two Fixed Nodes on a Cayley Tree of Order 2.	214
Khikmat Saburov, Mansoor Saburov, Every 3-Connected $K_{1,3}Z_6$ -Free Graph is Hamiltonian.	219
Khikmat Saburov, Mansoor Saburov, Relation Between $K_{1,3}P_7$ -Free and $K_{1,3}N_{1,1,1}$ -Free Graphs.	224
Khikmat Saburov, Mansoor Saburov, Hamiltonicity Of $K_{1,3}B_{i,7-i}$ -Free Graphs.	232
Saadi Bin Ahmad Kamtuddin , Nor Azura Md Ghani, Choong-Yeun Liong And Abdul Aziz Jemain, Artificial Neural Network Implementation on Firearm Recognition System via Ring Firing Pin Impression Image.	242
Pah Chin Hee, Dirichlet's Theorem And Prime Gap Statistics.	256

ISING MODEL WITH COMPETING INTERACTIONS ON CAYLEY TREE OF ORDER FOUR

Pah Chin Hee¹, Rukiah Bt Ali²

^{1,2}*Department of Computational and Theoretical Sciences,
Faculty of Science, IIUM, Kuantan, Malaysia
E-mail: ¹pahchinhee@gmail.com*

Abstract

Using techniques in dynamical system, we study the phenomenon of phase transition on Ising model with Competing Interactions on Cayley tree of order 3 and order 4. Nearest neighbor interactions and one level neighbor interactions were considered in this model. Recurrent equation for the two cases with respect to ratio of partition function with positive boundary and negative boundary are derived. Result of order 2 is also reproduced for comparison and it is in strong agreement. Result for order 3 disagrees with analytic result. A phase diagram for Cayley tree of order 2,3, and 4 is then constructed numerically. From the formula of order 2 and order 3, one can conjecture the formula for order k , the general case.

Keywords: *component: Ising model, Cayley tree, Phase transition, Competing interactions*

Introduction

The Ising model is a mathematical model of ferromagnetism in statistical mechanics. It was suggested by the physicist, Wilhelm Lenz who then gave the problem to his student, Ernst Ising [1]. Ising model, is a highly simplified model, has greatest application not only in physics but in a very wide range of fields such as sociology, economics, genetics, network and etc. It still make agreeable to mathematical behavior at least in one and two dimensions of Ising model. Phase transition is the transformation of a thermodynamic system from one phase or state of matter to another. It is commonly used to describe the transition between solid, liquid, and gaseous states of matter. For the case of ferromagnetism in the absence of magnetic field $h=0$, the magnetization is either positive or negative which subject to is the initial condition, when ever it is below the Curie temperature $T < T_c$. When $T > T_c$ in the absence of magnetic field $h=0$, the magnetization is zero, which characterize absence of phase transition.

In one dimension, Ising claimed that the solution admits no phase transition. On the basis of this result, he incorrectly concluded that this kind of model does not exhibit phase behavior in any dimension. Physicists like Lars Onsager [2], Yang, Kramers and Wannier brought the development on Ising model and important results were obtained especially in the study of phase