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
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Vol. 2

IIUM Press
Contents

Part I. Quadratic Operators and Their Dynamics

Farrukh Mukhamedov, Abduaziz Abduganiev, Maksut Mukhamedov, On Dynamics of a Class of Quantum Quadratic Operators on \( \mathbb{M}_2(\mathbb{C}) \).

Mansoor Saburov, On Ergodic Principle for Quadratic Volterra Operators.

Mansoor Saburov, Fixed Point of Compositions of Volterra Operators.

Farrukh Mukhamedov, Afifah Hanum Bt Mohd. Jamal, Classification of \( \xi^t \) - Quadratic Stochastic Operators in 2D-Simplex.

Farrukh Mukhamedov, Mansoor Saburov, Afifah Hanum Bt Mohd. Jamal, Dynamics of \( \xi^t \) - Quadratic Stochastic Operators in 2D-Simplex.

Farrukh Mukhamedov, Mansoor Saburov, Some Examples of Lotka-Volterra Type Models.

Nasir Ganikhodjaev, Makhsuma Usmanova, On Linearization of Quadratic Stochastic Operators.

Nasir Ganikhodjaev, Continual Family of Ergodic Non-Homogeneous Markov Chains.

Rasul Ganikhodjaev, Farrukh Mukhamedov, Mansoor Saburov, On G-Decomposition of Matrices.

Farrukh Mukhamedov, On \( L_1 \)-Weak Ergodicity of Nonhomogeneous Discrete Markov Processes


Inomjon Ganiev, Farrukh Mukhamedov, A Weighted Ergodic Theorem for Contractions Defined on Banach-Kantorovich Lattice.
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 $\mathbb{Q}_p$. 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 $K_{1,3}B_{1,7,1}$-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
SINGLE POLYGON COUNTING FOR TWO FIXED NODES
ON A CAYLEY TREE OF ORDER 2

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Abstract

We have found an exact formula for a single polygon counting problem on
Cayley tree of order 2, which the polygon contain 2 fixed vertices with a
constraint. The solution is elementary based on Catalan numbers. Some
identities of the solution have been established which associate with Catalan
numbers.

Keywords: Cayley tree, Catalan numbers, Single polygon counting
Mathematics Subject Classification : 82B20, 11B83.

Introduction

In the study of computer science, tree model appears very often and attracted a
lot of attention of researchers [1,2]. In a Cayley tree of order 2 [3], we denote
V the set of all vertices of the Cayley tree, we fixed 2 vertices, namely \( x^0, x^1 \in V \). There is only a single shortest path connecting the two
vertices as it is in a tree. Let \( I \) denote the number of the vertices along the
shortest path, where \( I \in V \). In this paper, we would like to find the number of
different connected component containing these two fixed vertices as well as the
vertices along the shortest path for a given \( n \) number of vertices. We call
this connected component a "polygon" [4,5]. In network theory, the scenario
stated above is identical to setting up 2 gateway with distance \( I \) nodes
(shortest path), each gateway is allowed to expand in a rooted tree. These
nodes are connected by using fiber optics or simple phone line. In this
problem, each router is maximally connected to 3 network components (not
end user). The problem statement is how many different ways we can arrange
the network with given \( n \) routers (nodes). ation. For example, in figure below:
Recall that a Cayley tree of order 2, denoted as \( \Gamma^2 \), is a graph with no cycles,
each vertex emanates 3 edges. We denote the set of all vertices as \( V \) and
denote the set of all edges as \( L \), i.e., \( \Gamma^2 = (V, L) \). Let \( C_r \) be \( r \)-th
Catalan numbers [6,7,8] which