601 112 408
Journal of Physics Cenference Series The 11th Biennial Conference on Classical and Quantum Relativistic Dynamics of Particles and Fields
1000
1239
V+LINE 1231- 2019
Wilde, Tucolda, Madoo
SDTON Morin Lard
The open access journal for conference proceedings
lopsolance.org/lpcs
IOP Publishing

Editorial board

The Editor-in-Chief of *Materials Research Express* provides leadership and management of the Editorial Boards and influences the strategy of the Journal, in co-operation with the Publisher.

The Editorial Boards consist of an Executive Editorial Board, focusing on advocacy and commissioning, and a non-executive Editorial Board, focusing on advocacy and peer review, with membership of both Editorial Boards comprising groups of prominent scientists in the Journal's field. The role of the Editorial Boards is to act as ambassadors for the Journal and IOPP; to foster strong and loyal relationships between the Journal and the scientific community and to channel community feedback to IOPP.

Materials Research Express also has an advisory panel.

Editors-in-Chief



Yi Cao, Nanjing University, China

Dr Yi Cao received his bachelor's degree in 2001 and Master's degree (Supervisor: Prof. Xiqun Jiang) in 2004 from Nanjing University. He then obtained his PhD in 2009 from the University of British Columbia (Supervisor: Prof. Hongbin Li). After a one-year postdoc at the same place, he started his independent career at the Department of Physics, Nanjing University as a full professor in 2010. His work was recognized by several awards including the 2014 IUPAP Young Scientist Prize in Biological Physics, the 2018 Young Innovator Award in Nanobiotechnology by Nano Research, and the 2019 Young Scientist Award from the Biomedical Polymer Materials Division of the Chinese Society for Biomaterials.



Judy Wu, University of Kansas, USA

Dr Judy Wu is a Distinguished Professor of Physics at the University of Kansas. She received her PhD from the University of Houston. She is an experimental condensed matter physicist and is specialized in fabrication, characterization and device applications of thin films and nanostructures. Her current research focuses on understanding the interfaces in ultrathin metal-insulator-metal tunnel junctions including Josephson tunnel junctions, magnetic tunnel junctions, memristors for quantum and neuromorphic computing, and in graphene-based heterostructures nanohybrids quantum sensors including photodetectors, strain/bio/gas/chemical sensors.

Executive Editorial Board

Sarbajit Banerjee, Texas A&M University, College Station, TX, USA Israel Felner, The Hebrew University of Jerusalem, Jerusalem, Israel Mariana Fraga, Federal University of São Paulo, UNIFESP, São José dos Campos, Brazil D D Sarma, Indian Institute of Science, Bangalore, India

Editorial Board

Liming Dai, Case Western Reserve University, Cleveland, OH, USA Francesco Fuso, Università di Pisa, Italy Irving P. Herman, Columbia University, USA Su-Mi Hur, Chonnam National University, South Korea Lingxiang Jiang, South China University of Technology, China K. Khairurrijal, Institut Teknologi Bandung, Indonesia Jian-Min Li, Zhejiang University, China Piraviperumal Malar, SRM Institute of Science and Technology, India Dimitrios Maroudas, University of Massachusetts, Amherst, MA, USA Moinuddin Mohammed Quazi, Universiti Malaysia Pahang, Malaysia **Zhiyong Tang**, National Center for Nanoscience and Technology, China **Oiang Wei**, Sichuan University, China Luisa Whittaker-Brooks, University of Utah, USA Jeong Min Park, Korea Institute of Materials Science (KIMs), South Korea Marta Marmiroli, University of Parma, Italy Alejandro D. Rey, McGill University, Canada Rajinder Pal, University of Waterloo, Canada Wei Huang, University of Electronic Science and Technology of China (UESTC), China Maria Vesna Nikolić, University of Belgrade – Institute for Multidisciplinary Research, Serbia Grzegorz Ludwik Golewski, Lublin University of Technology, Poland Yogendra Kumar Mishra, University of Southern Denmark, Denmark Ali Zolfagharian, Deakin University, Australia J. Paulo Davim, Universidade de Aveiro, Portugal Marco Alfano, University of Waterloo, Canada Fei Sun, Hong Kong University of Science and Technology, China Maria Chatzinikolaidou, University of Crete, Greece Hamdi Torun, Northumbria University, UK Sheng Guo, Chalmers University of Technology, Sweden Chuantong Chen, Osaka University, Japan Way Foong Lim, Universiti Sains Malaysia, Malaysia Marie-Christine Record, Aix Marseille University, France Ajeet K. Kaushik, Florida Polytechnic University, USA

TABLE OF CONTENT

012001

The utilization of Safe Parking Application (SPR) for motorcycle security using Global Positioning System (GPS) in Indonesia A T Henuk, R Mandala, N Hadisukmana, D A Henuk, W Mesinario, N Zendrato and Y L Henuk

012002

Riau Forest Fire Prediction using Supervised Machine Learning B S Negara, R Kurniawan, M Z A Nazri, S N H S Abdullah, R W Saputra and A Ismanto

012003

Received signal consideration for the through the earth radio-based underground object detection S Suherman, A H Rambe, E Wijayanto and N Mubarakah

012004

Byteless CTS for passive load balancing in 802.11 networks S Suherman, R Jasman, M Pinem and Gunawan

012005

Detach CTS for active load balancing in 802.11 networks S Suherman, R Jasman, M Pinem and Gunawan PDF, Detach CTS for active load balancing in 802.11 networks

012006

Data transmission period consideration on the internet of thing node S Suherman, U Hasnita, A H Rambe, N Mubarakah and R Sembiring

012007

Answering Islamic Questions with a Chatbot using Fuzzy String-Matching Algorithm M T Sihotang, I Jaya, A Hizriadi and S M Hardi

012008

K-Means method for analysis of accident-prone areas in Palangka Raya H Sitohang, Rosmiati and S Merni

012009

An Approach for Measuring Research Strength Map of an Institution H T Y Achsan, H Suhartanto, W C Wibowo and W T H Putri

012010

Impetus and influences of Online Learning Interaction based on Non-English Lecturers' Perspectives in global class program J Y Luke and S T Sela

012011

Automated Midline Setting for Brain Image Analysis to Detect Intracerebral Hemorrhage F Fahmi, I K Nasution and Sawaluddin

Comparative Analysis of Eigenface and Learning Vector Quantization (LVQ) to Face Recognition

R Chandra, S An-Nissa and E M Zamzami

012013

Numerical simulation of a rectangular microstrip patch antenna for 3.35 GHz applications Ali Hanafiah Rambe, Muhammad Lutfi, Suherman, Muhammad Zulfin and Maksum Pinem PDF, Numerical simulation of a rectangular microstrip patch antenna for 3.35 GHz applications

012014

Traffic Light Controlling for Emergency Vehicle Line Based on GPS Tracking and Position Using GPRS Network

Seniman, Niskarto Zendrato, Dedy Arisandi and Fahrurrozi Lubis

012015

Implementation of Linear Congruential Generator (LCG) Algorithm, Most Significant Bit (MSB) and Fibonacci Code in Compression and Security Messages Using Images M Elveny, R Syah, I Jaya and I Affandi

012016

Preliminary Study for identifying Rice Plant Disease Based on Thermal Images Maya Silvi Lydia, Indra Aulia, Ivan Jaya, Diana Sofiah Hanafiah and Rizky Hakim Lubis

012017

Preliminary Research Design on Sensor Data Gathering for Air Quality Text Generation Indra Aulia, Ainul Hizriadi, Seniman and Muhibuddin PDF, Preliminary Research Design on Sensor Data Gathering for Air Quality Text Generation

012018

Augmented Reality Virtual House Model Using ARCore Technology Based on Android M F Syahputra, F Hardywantara and U Andayani PDF, Augmented Reality Virtual House Model Using ARCore Technology Based on Android

012019

Prediction for Dengue Fever in Indonesia Using Neural Network and Regression Method T H F Harumy, H Y Chan and G C Sodhy

012020

Bambang Sugiantoro, Muhammad Anshari and Danang Sudrajat

012021

Comparison of Crossover and Mutation Operators to Solve Teachers Placement Problem by Using Genetic Algorithm

P H P Rosa, H Sriwindono, R A Nugroho, A M Polina and K Pinaryanto

Optimization Neural Network of Election of Investment Sector and Mapping of The Best Investment Are in The Terrible Area T H F Harumy

012023

Visual aid presentation as a learning method: a case study in learning English of management students in Binus University M N Willyarto, D Werhoru, S Januarta and Rivaldo

012024

Simulation Analysis of Polymer Electrolyte Membrane Fuel Cell Using Aspen Plus F K Sinurat, T B Sitorus, Taufik Bin Nur and H Susilo

012025

Performance Gasoline Generator Engine Fueled Liquid Petroleum Gas Zulfan, Tulus Burhanuddin Sitorus and Taufiq Bin Nur

012026

Motor Vehicle Security using Microcontroller, GPS and Android as Innovation to Prevent Motor Thieves P Sihombing, I S Daulay, S Efendy and I Syarif

012027

The Development of Heart Rate Detection Using Arduino Microcontroller and Android Poltak Sihombing, Yose E Barus, Sajadin Sembiring and Elviwati M Zamzami

012028 Additively weighted Hamming index of graphs Mardiningsih and Saib Suwilo

012029 Social network extraction based on Web: 4. A framework Mahyuddin K M Nasution and Shahrul Azman Mohd Noah

012030 Mathematic Mahyuddin K M Nasution, Opim Salim Sitompul, Sawaluddin Nasution, Indra Aulia and Marischa Elveny

012031 Methodology Mahyuddin K M Nasution

012032

Architectural Models for Predicting the Amount of Natural Disasters and their Effects Using Batch Training

N L S R Ginantra, S Kesuma, G S Achmad Daengs, G W Bhawika, N Mulyani, I Hasian and Y Siagian

012033

Interaction Mixed Reality Rare Animal Indonesia with Voice Input Using Microsoft Hololens M F Syahputra, D S Kurniawan and B Siregar

012034

Data Science

Mahyuddin K M Nasution, Opim Salim Sitompul and Erna Budhiarti Nababan

012035

Feature Selection Approach for Solving Imbalanced Data Problem in Single Nucleotide Polymorphism Discovery R Nurhasanah, L S Hasibuan and W A Kusuma

012036

Waspmote-Based Landslide Early Disaster Detection System with GSM Communication F Fachrizal, M Zarlis and S Efendi

012037

A Classification: using Back Propagation Neural Network Algorithm to Identify Cataract Disease W S Simamora, R S Lubis and E M Zamzami

012038

An Implementation of Backtracking Algorithm for Solving A Sudoku-Puzzle Based on Android Herimanto, P Sitorus and E M Zamzami

012039 Spatial Modelling to Optimize the Positioning of Air Defense Surveillance Radars with Minimal Shadow Zone S D R Wijaya, R O Bura and Y Prihanto

012040 SSAM: A Haskell Parallel Programming STM Based Simple Actor Model Y Kim, J Cheon, T Hur, S Byun and G Woo

012041 Outcome Prediction Using Naïve Bayes Algorithm in The Selection of Role Hero Mobile Legend A S Chan, F Fachrizal and A R Lubis

012042

Evaluation of working fluids for organic Rankine cycle power plant with Aspen plus H. Ambarita and H V Sihombing

Nikkei Stock Market Price Index Prediction Using Machine Learning Lukman A Harahap, Rajalida Lipikorn and Asanobu Kitamoto

012044

Application of Blended Learning Supporting Digital Education 4.0

Maradoni Jaya Saragih, Raden Mas Rizky Yohannes Cristanto, Yusri Effendi and Elviawaty M. Zamzami

012045

Ant Colony Optimization (ACO) Algorithm for Determining The Nearest Route Search in Distribution of Light Food Production

H Fahmi, M Zarlis, E B Nababan and P Sihombing

012046

Prediction of Vocational Students Behaviour using The k-Nearest Neighbor Algorithm Fadliansyah Nasution and Elviawaty Muiza Zamzami

012047

Analysis of Decision Support Systems on Recommended Sales of the Best Ornamental Plants by Type

R. Rusdiyanto, Joni Karman, Asep Toyib Hidayat, Adat Muli Peranginangin, Frinto Tambunan and Jeperson Hutahaean

012048

The Content Analysis of Electoral Act in Indonesia: The Comparison of Percent Agreement and Cohen Kappa

Muharman Lubis, Arif Ridho Lubis and Elly Rosmaini

012049

Feature engineering strategies based on a One-point Crossover for fraud detection on Big Data Analytics

M Soleh, E R Djuwitaningrum, M Ramli and M Indriasari

012050

Application of Scrum Maturity Model: A Case Study in a Telecommunication Company J Setiyawan, F Gunawan, T Raharjo and B Hardian

012051

An Indonesian Adaptation of the E-Learning Usability Scale D P Hasibuan, H B Santoso, A Yunita and A Rahmah

012052

Deep Learning approach for predicting the therapeutic usage of Jamu S H Wijaya, M Saumnuari, A K Nasution, D A Ramadhan and L S Hasibuan

012053

An Evaluation of the Udacity MOOC based on Instructional and Interface Design Principles F N Anyatasia, H B Santoso and K Junus

A comparison of SARIMA and LSTM in forecasting dengue hemorrhagic fever incidence in Jambi, Indonesia

U Khaira, P E P Utomo, R Aryani and I Weni

012055

Lecturer and employees presence system based on GPS using a fingerprint on mobile devices K Tanjung, W Gumelar and F Fahmi

012056

The Development of Self-Service Application at Martabak Air Mancur Restaurant N T M Sagala, Andreas and E Putro

012057

Collaborative Recommendation System in Users of Anime Films A S Girsang, B Al Faruq, H R Herlianto and S Simbolon

012058

Analysis of Euclidean Distance and Manhattan Distance in the K-Means Algorithm for Variations Number of Centroid K R Suwanda, Z Syahputra and E M Zamzami

012059

Implementing DSDM and OO Method to Develop Billing in Mental Hospital S Rohajawati, P Rahayu, H Akbar, S Indria and D I Sensuse

012060

Analysis of Attribute Reduction Effectiveness on The Naive Bayes Classifier Method D Syafira, S Suwilo and P Sihombing

012061

Analysis of Dijkstra's Algorithm and A* Algorithm in Shortest Path Problem Dian Rachmawati and Lysander Gustin

012062

Analysis of Accuracy Improvement in K-Nearest Neighbor using Principal Component Analysis (PCA) A H Lubis, P Sihombing and E B Nababan

012063

On using Euler's Factorization Algorithm to Factor RSA Modulus M A Budiman, M Zarlis, O S Sitompul and H Mawengkang

012064

Utilization of Augmented Reality to Showcase Historical Buildings in Medan City M F Syahputra, A Umaya and R F Rahmat

012065

Land Suitability Analysis of Over the Horizon Surface Radar for Sea Defense using Geographic Information System F Kurniawan, R O Bura and A A Lestari

012066

Text Classification on Islamic Jurisprudence using Machine Learning Techniques K Jamal, R Kurniawan, A S Batubara, M Z A Nazri, F Lestari and P Papilo

012067

Optimization of Municipal Solid Waste Transporter in Batam City using Genetic Algorithm A R Purnajaya and F D Hanggara

012068

Modeling And Simulating The Design of Air Defense Missile Aerodynamic Systems A I Harahap, R O Bura and Y Ruyat

012069

Literature Review : Implementation of Facial Recognition in Society M I Zarkasyi, M R Hidayatullah and E M Zamzami

012070

An Analysis of Haskell Parallel Programming Model in the HaLVM Junseok Cheon, Yeoneo Kim, Taekwang Hur, Sugwoo Byun and Gyun Woo

012071

A Crypto Compression System Using ElGamal Public Key Encryption Algorithm and Even-Rodeh Codes M A Budiman, E M Zamzami and C L Ginting

012072

Relational database reconstruction from SQL to Entity Relational Diagrams Juanda Hakim Lubis and Elviawaty Muisa Zamzami

012073

Performance Analysis of Start-Step-Stop Codes and Gopala-Hemachandra Codes2 (GH₋₂(n)) Ascompression Algorithms on Text Files M A Budiman, Herriyance and Khairunnada

012074 Arduino UNO and Android Based Digital Lock Using Combination of Vigenere Cipher and XOR Cipher MA Budiman, JT Tarigan and AS Winata

Developing PC-Based Driving Simulator System for Driver Behavior Analysis Research Mohammad Iqbal, Karmila Sari, Kemal Ade Sekarwati and Dian Kemala Putri

012076

Implementation of Modified Cheapest Insertion Heuristic on Generating Medan City Tourism Route

Dian Rachmawati and Wilyanto

012077

Chatbot Implementation with Semantic Technology for Drugs Information Searching System A Amalia, P Y C Sipahutar, E Elviwani and F Purnamasari

012078

Information visualization of metacognitive skills during the software development process based on an adapted engineering design metacognitive questionnaire R R Adisurya, H B Santoso, S Fadhilah and O Lawanto

012079

Analysis of Drug Abuse Users in North Sumatera With K-Means Algorithm Amer Sharif, Selina Amelia Savittri and Syarifah Kemala Putri

012080

Network Fault Effectiveness and Implementation at Service Industry in Indonesia Fahrurrozi Lubis and Muharman Lubis

012081

Internet Provider Service Value Delivery Index Problem: Case Study of the NetHost Fahrurrozi Lubis and Muharman Lubis

012082

Personal Data Protection Paradox towards the Electronic Platform Engagement Fahrurrozi Lubis and Muharman Lubis

012083

Comparison of Text Data Compression Using Yamamoto Recursive Codes and Punctured Elias Codes

S M Hardi, M R Putra, J T Tarigan and I Jaya

012084

Hiding and Data Safety Techniques in Bmp Image with LSB and RPrime RSA Algorithm S M Hardi, M Masitha, M A Budiman and I Jaya

012085

Identification of Tuberculosis (TB) Disease Based on Lung X-Rays using Extreme Learning Machine M K M Nasution, M Elveny, S M Hardi, I Jaya and M A Siregar

Designing Mobile-apps for context-aware notification: case study Merapi Volcano Irving V Paputungan, Teduh Dirgahayu, Hendrik and Hari Setiaji

012087

Analysis of Deep Learning Cyclical order for Prediction of Fresh Milk Production in Sumatera Asep Saefullah, Muhammad Hendri, Sri Lindawati, Muliati Badaruddin and Jeperson Hutahaean

Virtual Pet Simulator Game Using Augmented Reality on Android Platform

Joanna Chahyana and Violitta Yesmaya

012089

An Online Collaborative Mind Mapping Feature on Student-Centered E-Learning Environment H Hakim, H B Santoso and K Junus

012090

Improving The Performance of K-Nearest Neighbor Algorithm by Reducing The Attributes of Dataset Using Gain Ratio N Hasdyna, B Sianipar and E M Zamzami

012091

Nonlinear evolution of bichromatic waves based on the fifth order solution of benjamin bona mahony equation

Haves Qausar, Yulia Zahara, Marwan Ramli, Said Munzir and Vera Halfiani

012092

Analysis and Comparison of Hough Transform Algorithms and Feature Detection to Find Available Parking Spaces S Rahman, M Ramli, F Arnia, R Muharar, M Luthfi and S Sundari

012093

User Experience in Excavator Simulator using Leap Motion Controller in Virtual Reality Environment F Nainggolan, B Siregar and F Fahmi

012094

An Improved Precise Positioning Method for Intelligent Mine Construction Kang Chen, Zhigang Du, Lin Guo and Qiqi Kou

012095

Improving Data Quality in Crowdsourced Data for Indonesian Election Monitor: A Case Study in KawalPilpres F Gunawan and Y Ruldeviyani

012096

User Experience in using VIVE Controller as a Controller in Anatomy Learning System in Virtual Reality Environment

F Nainggolan, B Siregar and F Fahmi

End-to-end indonesian speech recognition with convolutional and gated recurrent units Rifqi Adiwidjaja and M Ivan Fanany

012098

Decision Support System to Determine *Uang Kuliah Tunggal* (UKT) by Combining Naïve Bayes Classifier and Fuzzy-TOPSIS Mauladi, P E P Utomo, B F Hutabarat and R A Putra

012099

A Meta-Review of the Smartphone as the Measurement Device B S Hantono, L E Nugroho, P I Santosa and R Musaddiq

012100

IndoAcro: An Indonesian Acronym and Expansion Repository with Data Auto-Update Implementation T F Abidin, R Ferdhiana, M Iqbal, D Syaputra, T W A Putera and M Z Aksana

012101

RETRACTED: Performance of news clustering using ant colony optimization T Jenson and A S Girsang

012102

Web Based Application for Controlling Data Quality in Phenotype Prediction of Indonesian Rice Genomes

E B Nababan, R Nurhasanah and A S Huzaifah

012103

Bigdata Clustering using X-means method with Euclidean Distance N Zendrato, H W Dhany, N A Siagian and F Izhari

012104

Mapping of Traffic Accidents in Labuhanbatu Regency using GIS Support Ronal Watrianthos, Muhammad Bobbi Kurniawan, Kusmanto, Syahrul Budiman and Basyarul Ulya

012105

Embedded System for Detecting Cigarette Smoke Indoors using STM32 Microcontroller T H Nasution and M Zarlis

012106

Analysis of The Application of Fuzzy Logic and Levenberg-Marquardt in The Calculation of Used Car Prices I Syahputra, M Zarlis and Sutarman

012107

Plant Classification Based on Extraction Feature Gray Level Co-Occurrence Matrix Using knearest Neighbour Fuzy Yustika Manik, S Kana Saputra and Dewi Sartika Br Ginting 012108

Security of Image File with Tiny Encryption Algorithm And Modified Significant Bit Pseudo Random Number Generator

S M Hardi, R Syah Ramadhani, E. Muisa Zamzami, JT Tarigan and I Jaya

012109

Exploring the Pattern of Voters' Characteristics: Partial Least Square Analysis Muharman Lubis, Arif Ridho Lubis and Ahmad Almaarif

012110

Chaos-based Cryptography: A Brief Look Into An Alternate Approach to Data Security Amer Sharif, Nur Intan Raihana and Azman Samsudin

012111

Relationship of Personal Data Protection towards the Electoral Measures: Partial Least Square Analysis

Muharman Lubis, Arif Ridho Lubis, Ahmad Almaarif and Asti Amalia Nur Fajrillah

012112

Comparative Analysis of Inter-Centroid K-Means Performance using Euclidean Distance, Canberra Distance and Manhattan Distance M Faisal, E M Zamzami and Sutarman

012113

Exercising the Students Computational Thinking Ability using Bebras Challenge E M Zamzami, J T Tarigan, N Zendrato, A Muis, A P Yoga and M Faisal

012114

Evaluating Sensors in Modern Smartphone to Damaged Road Features Jos Timanta Tarigan, Elviwani and Ardi Sahputra

012115

Real-Time Routing Protocol for Music Application With Multiple Outputs Jos Timanta Tarigan, Herriyance and Kris Pradana Washitha Nala

012116

Multi Patch 3D Terrain Representation for Collaborative Terrain Editor J T Tarigan, O S Sitompul, M Zarlis and E B Nababan

012117

Integrated Virtual Communities into User Group Management System (UGMS) for Smart Cities Yuli Adam Prasetyo, Muharman Lubis, Muhammad Azani Hasibuan and Rahmat Fauzi

012118

End-to-end indonesian speech recognition with convolutional and gated recurrent units Rifqi Adiwidjaja and M Ivan Fanany

A Latent Semantic Analysis Method for Automatic Scoring System at Essay Test L Handayani, W O Alika, B S Negara and Febiyanto 012120 Genetic Algorithm in Image Inserting with Modified Least Significant Bit Method to Find The Best MSE Value S F Ramadhan, P Sihombing and Sutarman

S F Ramadian, P Smonoling and Suta

012121

The Accuracies of ANFIS and Genetic Algorithm with Tournament Selection on Classifying Hepatitis Data

W FA Siahaan, O S Sitompul and Z Situmorang

012122

Classification of Zingiber Plants Based on Stomate Microscopic Images Using Probabilistic Neural Network (PNN) Algorithm

U Andayani, I B Sumantri and B Arisandy

012123

Optimization DataTransfer Using the Neural Network method Based on Signal Level Niskarto Zendrato, M. Zarlis, Opim Salim Sitompul and Elviawaty Muisa Zamzami

012124

Optimization Metrics Model: The Mobile Wallet for Merchant Ecosystem R Syah, M K M Nasution, E B Nababan and S Efendi

012125

Hydrogen Gas Production Simulation Utilizing Empty Fruit Bunch of Oil Palm Pyrolysis Unit by Steam Methane Reforming Process F T H Sinaga, F H Napitupulu and T B Nur

012126

Performance Improvement of Clustering Affinity Propagation Method using Principal Component Analysis Jasael Simanullang, Muhammad Zarlis and Elviawaty Muisa Zamzami

012127

Application of Food Marketing Optimization using Analytical Hierarchy Process (AHP) T Setiadi, Wasilah, A Tarmuji, A Fadlil and F Noviyanto

012128

Counter-propagation Neural Network for Brain Tumor Classification R F Rahmat, Y T A Harahap and D Rachmawati

012129

Probabilistic Neural Network to Classify Image of Children's Face with Down Syndrome R F Rahmat, S Budiarti, S Faza, I Fawwaz and U Andayani

012130 Classification of Infection Type Based on Leukocytes Examination Results Using K-Nearest Neighbor S A N Suyanto, B Siregar, E B Nababan and H A Fikri

012131

Analysis Effect of Tournament Selection on Genetic Algorithm Performance in Traveling Salesman Problem (TSP) S Prayudani, A Hizriadi, E B Nababan and S Suwilo

012132

MAFODKM: Mobile Application Framework for the management of Omics Data and Knowledge Mining

O Oluwagbemi, Adewumi, S Misra and Marcelo Leon

012133

Retraction: Performance of news clustering using ant colony optimization (*J. Phys.: Conf. Ser.***1566** 012101)

PAPER • OPEN ACCESS

Comparison of Crossover and Mutation Operators to Solve Teachers Placement Problem by Using Genetic Algorithm

To cite this article: P H P Rosa et al 2020 J. Phys.: Conf. Ser. 1566 012021

View the article online for updates and enhancements.

You may also like

- Lineage dynamics and mutation-selection balance in non-adapting asexual populations Sophie Pénisson, Paul D Sniegowski, Alexandre Colato et al.
- <u>Visualization Technique for Mutation</u> <u>Functional Analysis</u> S Pacheco and H Al-Mubaid
- <u>Reply to `Comments on Hereditary Effects</u> of <u>Radiation'</u> K Sankaranarayanan and N E Gentner

Comparison of Crossover and Mutation Operators to Solve Teachers Placement Problem by Using Genetic Algorithm

P H P Rosa^{1*}, H Sriwindono^{1*}, R A Nugroho¹, A M Polina¹ and K Pinaryanto¹

¹Informatics Department, Sanata Dharma University

*Email: rosa@usd.ac.id, 3 haris@usd.ac.id

Abstract. The placement of elementary school teachers is an NP-complex problem. Teacher placement can be optimized by considering several factors that influence their performance, including the distance of teacher's residence to school, age, and gender of the teacher. This paper discusses the solution model of the problem based on genetic algorithms by finding a chromosome formation that represents the possibility of teachers placement solution, composing a population, and finding the recommended combination of two selected mutations operators and two selected crossover operators to achieve optimal results. The selected mutation operators were Reverse Sequence Mutation (RSM) and Partial Shuffle Mutation (PSM), while the selected crossover-operators were Single Point Crossover (SPX) and Ordered Crossover (OX). The combined performance of these operators is measured based on the fitness value and running time of the program. Based on experiments, it can be concluded that the combination of OX-PSM with mutation probability 1:20 gives the lowest minimum fitness value compared to other combinations of crossover and mutation operators. The running time of the combination of OX-PSM is stable in any mutation probability, ranging from 39,5-41minutes.

1. Introduction

One effort to improve the quality of education is through the optimal placement of teachers to support the performance of teachers in schools. The issue of structuring and equitable distribution of teachers has been discussed in several studies as written by Sujati [1], Widyaningrum [2], Wahyuni [3], and Prawiasad [4]. There are several factors that affect teacher performance, including the distance between a teacher's residence to school, age, and gender. From the data of the teacher placement in Magelang Regency, it was found that some teachers live very far from schools so that it affects the physical condition of the teacher because they travel long distances to schools. Increasing age and gender factors are also very likely to have impacts on teacher performance if the domicile is too far from the school. Therefore the success of teacher placement can be determined by the total minimum distance between the teacher to the school so that the teacher's performance could be maintained.

This problem is not easy to solve because of the large number of possible combinations of schools and teachers. In computer science, this problem includes NP-complete problems that are difficult to solve and require a very long time to achieve optimal results when done conventionally. A potential way to solve this kind of problem is by using genetic algorithms. The performance of the genetic algorithm is determined, among others, by the representation of the encoding solution, the crossover, and the mutation operator. There are many crossover and mutation operators known in genetic algorithms.

Content from this work may be used under the terms of the Creative Commons Attribution 3.0 licence. Any further distribution of this work must maintain attribution to the author(s) and the title of the work, journal citation and DOI. Published under licence by IOP Publishing Ltd 1

This paper discusses a model solution using genetic algorithms to solve teacher placement problems, by finding a combination of mutation and crossover operators to get good results. Previously, Abdoun et.al. [5] have concluded that two mutation operators that perform well are Reverse Sequence Mutation (RSM) and Partial Shuffle Mutation (PSM). Picek et.al. [6] have examined the performance comparisons of several crossover operators and concluded that the operator with the best performance is Single Point Crossover (SPX). However, Picek et.al. [6] have never compared SPX with the Ordered Crossover (OX) operator. In the previous study [7] the authors had tried to implement SPX crossover operators and combined them with exchange mutation operators, but the results were not optimal because the program execution time was still quite long and the resulting fitness value was not satisfactory. To improve the optimization of the teacher placement model using genetic algorithms, this study examines the performance of the RSM and PSM mutation operators and combines them with SPX and OX crossover operators. To evaluate the result, the performance of these combined operators is measured based on the fitness value and running time of the program.

2. Genetic Algorithm

Genetic algorithms are heuristic optimizations inspired by natural and genetic selection. This algorithm was developed by Holland [8] and Goldberg [9]. In genetic algorithms, the population of a potential solution is called a chromosome, which is expressed as a series of alphabets or numbers (usually binary numbers). Each chromosome represents a solution to a problem. Each chromosome also has a fitness value that shows how good a chromosome is as a solution to a particular problem.

The process of finding solutions with genetic algorithms begins with the random selection of a group of chromosomes. The initial chromosome is carried out a process to evaluate how good the chromosome is if chosen to be the solution to the problem being discussed. If the results of the evaluation are not satisfactory, then the process is repeatedly carried out to produce new chromosomes by using genetic operators, namely crossover and mutation. At each new set of chromosomes that are formed, an evaluation is done by recalculating the fitness value.

In general, the steps for genetic algorithms are as follows [8][9][10]:

- 1. Randomly generate n chromosomes as the initial population
- 2. For each chromosome in the population, calculate fitness value f(x)
- 3. Generate a new population by repeating the following steps until the new population is complete:
 - a. Choose two chromosomes c1 and c2 as parents based on their fitness values. The higher the fitness values, the higher possibility of the chromosome being selected as parents.
 - b. Using a particular crossover rate, apply crossover on c1 and c2 to produce child chromosome c.
 - c. Using a particular mutation rate, apply mutation on chromosome c to produce a new offspring.
 - d. Place the new offspring in the population
- 4. Replace the previous population with the new population
- 5. If stopping criteria have not been met, return to Step 2.

Genetic algorithms are commonly used to generate high-quality solutions to optimization and search problems by relying on bio-inspired operators such as mutation, crossover, and selection. Genetic algorithms have often been applied to optimization problems such as scheduling, assignments, route search, and others. The application in the scheduling problem can be found in [11 - 14], while the application in the assignment problem can be seen also in [15] and [16]. The use of genetic algorithms in the field of route search such as Traveling Salesman Problem can be found in [17 - 19].

Dewi et.al. [20] described the use of genetic algorithms to optimize teacher placement. Several variables that were considered in the model namely teacher qualifications, education, age, teaching experience, and work placement status. The fitness value is determined by counting the number of rule violations. The smaller the number of violations, the better the solution was. In [7] the authors proposed different variables to be considered in teacher placement problem, namely the distance of

ICCAI 2019 Journal of Physics: Conference Series

teacher's residence to school, age, and gender of the teacher. The fitness function is determined based on these variables. However, the result has not been satisfied. In this study, the authors did some experiments by combining RSM and PSM mutation operators with SPX and OX crossover operators to find a better solution.

3. Model Development

Currently, there are no specific factors that are considered for the placement of teachers in the Magelang Regency. The distance between teacher's residence to school can be so far that it causes teacher fatigue, and ultimately reduces teacher performance. It is assumed here that teacher performance will be better when they are assigned to schools closer to where they live. The problem to be solved in this research is how to assign teachers in schools so that the total distance between teachers and schools is minimal. Thus, it is an optimization problem. As the continuation of the previous research in [7], the authors use the same model as described in [7]. In addition to the distance between the teacher's residence to the school, several other factors to consider in this optimization problem are gender and age. Female teachers get priority over men since female teachers take shorter distances than male teachers. Older teachers (those over or equal to 46 years) get closer priority mileage too. This age categorization is taken according to the Indonesian Ministry of Health where adulthood ends at 45, while old age starts at 46 years. In this study, a simplification is made by assuming that each school has 6 teachers. One teacher for each level from grade 1 to grade 6. The distance of a teacher's residence to a school is measured using Google API feature based on the coordinates of the location on Google Maps.

Each chromosome represents a candidate solution. A solution describes the formation of teacher placement in all study groups. A study group is a class consists of several students. Each school is assumed to have 6 study groups. Each teacher will be assigned to one study group. A one-dimensional array is used to express this structure. The array element represents the teacher's identity assigned in a certain study group as seen in Figure 1. The chromosome length is 6 times the number of schools, where 6 states the number of study groups in one school.

School 1						School 2					
1	2	3	4	5	6	1	2	3	4	5	6
t_1	t_2	t ₃	t4	t ₅	t ₆	t ₇	t ₈	t9	t ₁₀	t ₁₁	t ₁₂

Figure 1.	The representation	of chromosome
-----------	--------------------	---------------

Initially, 6 chromosomes will be generated randomly or, in other words, 6 random solutions will be generated. Each solution meets the requirement that there is only 1 teacher in each study group. The goodness of each solution (fitness function) is considered based on the total distance of all teachers in the solution to the school. The distance between the teacher and the school is given a certain weight, where the weight is influenced by the age and the gender of the teacher. If the teacher's age is lower than 46 years then the distance weight is 1, but if it is greater than or equal to 46 years then the weight is 0.6 if the teacher is female and 0.8 if the teacher is male as seen on the table 1.

Gender	Age < 46	Age ≥ 46
Female	1	0.6
Male	1	0.8

The fitness function which is the total distance (D) will be as follows:

1566 (2020) 012021 doi:10.1088/1742-6596/1566/1/012021

$$D = \sum_{i=1}^{n} w(s_i)$$

The purpose of this optimization is to find a minimum value D, where

$$W = \begin{cases} 1; if age < 46\\ 0.8; if age \ge 46 and male\\ 0.6; if age \ge 46 and female \end{cases}$$

n = number of study groups = number of teachers $s_i = distance of teacher residence to school$

In this study, the roulette wheel selection method is used to select the chromosomes to be mated (cross-overed), where the value of fitness is directly proportional to the probability of chromosomes' electability. The crossover operators being evaluated are Single Point Crossover (SPX) and Ordered Crossover (OX). SPX uses a reference point as a boundary to cross genes on the parent chromosome. This reference point is chosen randomly. After this point is selected, the genes on parent chromosome up this point will be copied to the child chromosome, then the genes on the second parent chromosome will be examined sequentially one by one. If the gene is not in the child chromosome, it will be inserted. In the OX operator, two cut points are randomly selected from the parents' chromosomes. To produce new offspring O1 the genes between the cut points are replaced by the genes in the second parent. The mutation operators being evaluated are Reverse Sequence Mutation (RSM) and Partial Shuffle Mutation (PSM). In RSM, two boundaries of a chromosome are determined. Then the genes between the two boundaries are reversed, while in PSM, some genes from a parent chromosome will be regenerated to produce a new chromosome [5]. The model was implemented using Java language.

4. Result and Discussion

To measure the performance of RSM and PSM combined with selected crossover techniques SPX and OX, several experiments were conducted with various parameters as follows: number of population = 6 chromosomes, number of generation = 5000, number of study groups which is equal to the number of teachers = 636, whereas the probability of a mutation to the crossover varies from 1:20, 1:40, 1:60, 1:80, 1:100, 1:200, 1:300, 1:400. The experiments were carried out on 636 teacher data in Magelang Regency with distribution as described in table 2.

Gender	Age < 46	Age ≥ 46	Total number
Female	51	394	445
Male	20	171	191

Table 2. Distribution of Teach	er.
--------------------------------	-----

The performance of the combined operators was measured based on the minimum fitness value and the running time of the program. Table 3 describes the minimum fitness value and running time of each experiment, while figure 2 and figure 3 describes the graphical view of the table. There are four combinations of mutation operators and crossover techniques, namely OX-PSM, OX-RSM, SPX-PSM, and SPX-RSM. The notation of OX-PSM means Ordered Crossover techniques combined with Partial Shuffle Mutation operator. Other notations have corresponding meanings.

Mutation Probability		Minimum f	ïtness value			Runnin	g time	
	OX- PSM	OX- RSM	SPX- PSM	SPX- RSM	OX- PSM	OX- RSM	SPX- PSM	SPX- RSM
20	11162,31	11675,85	11856,38	11842,49	41,017	52,233	54,17	34,90
40	11431,48	12076,68	12029,99	12131,82	40,233	52,017	34,80	35,97
60	11415,08	12014,34	12159,14	12082,07	39,217	49,267	53,18	31,68
80	11663,90	11835,79	12208,96	12290,99	40,167	49,083	44,25	33,82
100	11558,53	12310,93	12196,76	12321,79	38,950	51,700	42,10	36,08
200	12232,04	12172,18	12396,71	12301,75	39,500	48,450	34,30	35,10
300	12093,54	12330,10	12322,98	12377,53	39,517	49,083	63,05	35,10
400	12401,35	12538,51	12494,64	12378,91	40,733	52,650	79,08	29,03

Table 3. Minimum Fitness Values & Running Time of the Experiment.



Figure 2. Mutation Probability vs Minimum Fitness Values of the Experiment.



Figure 3. Mutation Probability vs Running Time of the Experiment.

From table 3 and figure 2, it can be seen that in the four combinations of crossover and mutation operators, smaller mutation probability tends to result in smaller minimum fitness values as well. Also, for all mutation probabilities, the combination of OX-PSM always result in smaller fitness values compare to other combination of crossover techniques and mutation operators. The smallest minimum fitness value is achieved by the combination of OX and PSM with mutation probability 1:20, while the combination of OX-RSM with mutation probability 1:400 results on the highest minimum fitness value.

From table 3 and figure 3, it can be seen that for all mutation probabilities, the running time of SPX-RSM combination is always shorter than other combinations of mutation and crossover technique. The running time of the SPX-PSM combination tends to be unstable compared to other combinations of mutation operators and crossover techniques which are quite stable. The shortest running time is found on the combination of SPX cross-over operator and RSM mutation operator with a mutation probability of 1: 400. On the other hand, the longest-running time is found on the combination of SPX mutation operator with a 1: 400 mutation probability.

5. Conclusion

From the above discussion, it can be concluded that the combination of Order Crossover-Partial Shuffle Mutation operator with mutation probability 1:20 gives the lowest minimum fitness value compared to other combinations of crossover technique and mutation operator. Besides, the running time of the combination of OX-PSM is quite stable in any mutation probability. Therefore, the combination of OX-PSM can be recommended as the model of decision making in teacher placement problem that considers the following factors: the distance of teacher's residence to school, and gender as well as teachers' age.

Further research to embed the model in a decision support system is encouraged. Another possible research development involves other determinant factors in the case of teacher placement.

6. Acknowledgments

Authors wishing to acknowledge Lembaga Penelitian dan Pengabdian Universitas Sanata Dharma that sponsored this research through research grant number 026/Penel./LPPM-USD/IV/2018.

References

- [1] Sujati, H. 2011. Analisis Kebijakan Penataan Guru Pegawai Negeri Sipil. Prosiding Seminar Nasional PGSD 2015. Universitas PGRI Semarang. http://prosiding.upgrismg.ac.id/index.php/pgsd2015/pgsd2015/paper/view/569/524. Accessed 5 June 2016, 13:20.
- [2] Widyaningrum, P.Z.. 2013. Implementasi Peraturan Bersama 5 Menteri Tentang Penataan dan Pemerataan Guru Pegawai Negeri Sipil Terkait Pemenuhan Jam Mengajar Guru Bersertifikasi (Studi Dinas Pendidikan, Kebudayaan, Pemuda, Dan Olahraga Kota Madiun). Undergraduate thesis. Universitas Brawijaya Malang. http://hukum.studentjournal.ub.ac.id/index.php/hukum/article/view/245/237. Accessed 8 June 2016.
- [3] Wahyuni. 2014. Implementasi Peraturan Bersama Lima Menteri Tentang Penataan dan Pemerataan Guru Pegawai Negeri Sipil di Kabupaten Blitar. journal.unair.ac.id/downloadfullpapers-kmp77847fadcefull.pdf. Accessed 8 June 2016, 03:25.
- [4] Prawiasad, H. 2015. Implementasi Kebijakan Penataan dan Pemerataan Guru Pegawai Negeri Sipil pada Jenjang SMA Negeri di Kabupaten Kulon Progo. *Skripsi*. Universitas Negeri Yogyakarta. http://eprints.uny.ac.id/27852/. Accessed 8 Juni 2016, 01:28.
- [5] Abdoun, O. J. Abouchabaka, dan C. Tajani. 2011. "Analyzing the Performance of Mutation Operators to Solve the Travelling Salesman Problem", in *Wotic*.
- [6] Picek, Stjepan, M. Golub, D. Jakobovic. 2012. Evaluation of Crossover Operator Performance in Genetic Algorithms with Binary Representation. In: Huang DS., Gan Y., Premaratne P., Han K. (eds) Bio-Inspired Computing and Applications. ICIC 2011. Lecture Notes in Computer Science, vol 6840. Springer, Berlin, Heidelberg.
- [7] Sriwindono, H., P.H.P Rosa, A.M. Polina, R.A. Nugroho. 2017. The Model of Elementary Teacher School Placement in Magelang District by Using Genetic Algorithm. *Proceeding of Computer System and Artificial Intelligence (CSAI) International Conference*. Asociation for Computing Machinery.
- [8] Holland, JH. 1992. Adaptation in Natural and Artificial Systems. MIT Press
- [9] Goldberg, D. 1989. Genetic Algorithms: in Search, Optimization, and Machine Learning. *Addison Wesley*.
- [10] McCall, J. 2005. Genetic algorithms for modelling and optimization. *Journal of Computational and Applied Mathematics*. Vol. 184. pages 205–222.
- [11] Gen, M., Cheng, R and Wang, D. 1997. Genetic algorithms for solving shortest path problems. *IEEE Transactions on Evolutionary Computation*, 401-406.
- [12] Sriwindono., H. 2007. Penerapan Algoritma Genetika dalam Job Shop Scheduling Problem. *Media Teknika* (7)1, 38 – 44.
- [13] Pezzella, F., Morganti, G., and Ciaschetti,G. 2008. A genetic algorithm for the Flexible Jobshop Scheduling Problem, *Journal of Computers & Operations Research*, Volume 35, Issue 10, Pages 3202-3212.
- [14] Gonçalves, J.F., Mendes, J.J.M., andResende, M.G.C.. 2005. A Hybrid Genetic Algorithm for the Job Shop Scheduling Problem. *European Journal of Operational Research*, Volume 167, Issue 1, 16 November 2005, Pages 77-95
- [15] Harman, S. 1998. A competitive genetic algorithm for resource-constrained project scheduling. *Naval Research Logistics Journal*, Volume 45, Issue 7October 1998 Pages 733–750
- [16] Ahuja, R. K., Orlin, J.B., Tiwari, A. 2000. A Greedy Genetic Algorithm for the Quadratic Assignment Problem. *Journal of Computers & Operations Research*, Volume 27, Issue 10, September 2000, Pages 917-934
- [17] Chu, P.C. and ^{*}Beasley, J.E. 1997. A genetic algorithm for the generalised assignment problem. *Journal of Computers & Operations Research*, Volume 24, Issue 1, January 1997, Pages 17-23

1566 (2020) 012021 doi:10.1088/1742-6596/1566/1/012021

- [18] Grefenstette, J.J, et.al. 2014. Genetic Algorithm for Travelling Salesman Problem.In Proceedings of the First International Conference on Genetic Algorithms and their Applications., Psychology Press, Jan 2, 2014
- [19] Carte, A.E., Ragsdal, C.T. 2006. A new approach to solving the multiple traveling salesperson problem using genetic algorithms. *European Journal of Operational Research* Volume 175, Issue 1, 16 November 2006, Pages 246-257
- [20] Moon, C., Kim, J., Choi, G., and Seo, Y. 2002. An efficient genetic algorithm for the traveling salesmanproblem with precedence constraints. *European Journal of Operational Research* 140 (2002) 606–617
- [21] Dewi, S., Djamal, E.C., Yuniarti, R., 2017. Optimalisasi Penempatan Guru Sekolah Dasar di Kecamatan Cikajang Kabupaten Garut Menggunakan Algoritma Genetika. In *Prosiding Seminar Nasional Komputer dan Informatika (SENASKI) 2017*(Bandung, Indonesia, July 20-21.