

Source details

Telkomnika

Open Access ⓘ

Scopus coverage years: from 2011 to 2018

Publisher: Institute of Advanced Engineering and Science (IAES)

ISSN: 1693-6930 E-ISSN: 2087-278X

Subject area: Engineering: Electrical and Electronic Engineering

[View all documents >](#)

[Set document alert](#)

[Journal Homepage](#)

[Visit Scopus Journal Metrics ↗](#)

CiteScore 2017

0.63



SJR 2017

0.265



SNIP 2017

0.580



CiteScore

CiteScore rank & trend

Scopus content coverage

Year	Documents published	Actions
2019	66 documents	View citation overview >
2018	294 documents	View citation overview >
2017	236 documents	View citation overview >
2016	299 documents	View citation overview >
2015	174 documents	View citation overview >
2014	130 documents	View citation overview >
2013	103 documents	View citation overview >
2012	94 documents	View citation overview >
2011	69 documents	View citation overview >

[About Scopus](#)

[What is Scopus](#)

[Content coverage](#)

[Scopus blog](#)

[Scopus API](#)

[Privacy matters](#)

[Language](#)

[日本語に切り替える](#)

[切换到简体中文](#)

[切换到繁體中文](#)

[Русский язык](#)

[Customer Service](#)

[Help](#)

[Contact us](#)

ELSEVIER

[Terms and conditions](#) ↗ [Privacy policy](#) ↗

Copyright © 2019 Elsevier B.V. ↗. All rights reserved. Scopus® is a registered trademark of Elsevier B.V.

We use cookies to help provide and enhance our service and tailor content. By continuing, you agree to the use of cookies.

 RELX Group™

also developed by scimago:



SCIMAGO INSTITUTIONS RANKINGS

SJR

Scimago Journal & Country Rank

Enter Journal Title, ISSN or Publisher Name

[Home](#)[Journal Rankings](#)[Country Rankings](#)[Viz Tools](#)[Help](#)[About Us](#)

Telkomnika

CountryIndonesia - [SJR Ranking of Indonesia](#)**Subject Area and Category**[Engineering](#)
[Electrical and Electronic Engineering](#)**Publisher**[Institute of Advanced Engineering and Science \(IAES\)](#)**Publication type**

Journals

ISSN

23029293, 16936930

Coverage

2011-ongoing

Scope

TELKOMNIKA (Telecommunication, Computing, Electronics and Control) ISSN: 1693-6930, e-ISSN: 2302-9293 is a peer-reviewed, scientific journal published by Universitas Ahmad Dahlan (UAD) in collaboration with Institute of Advanced Engineering and Science (IAES). The aim of this journal is to publish high-quality articles dedicated to all aspects of the latest outstanding developments in the field of electrical engineering. Its scope encompasses the applications of Telecommunication and Information Technology, Applied Computing and Computer, Instrumentation and Control, Electrical (Power), and Electronics Engineering. It was first published in 2003. Beginning with issue 1 of volume 16 (2018), TELKOMNIKA will be published as a bimonthly journal (6 issues/year). The journal registered in the CrossRef system with Digital Object Identifier (DOI) prefix 10.12928. The Journal has been indexed by SCOPUS, Google Scholar, Scholar Metrics etc; accredited 'A' Grade by DGHE (Ministry of Research, Technology and Higher Education, Republic of Indonesia); registered Directory of Open Access Journals (DOAJ), BASE - Bielefeld Academic Search Engine and CORE KMi, etc. The Journal also have a license agreement with ProQuest LLC and EBSCO Publishing.

[Homepage](#)[How to publish in this journal](#)[Contact](#)[Join the conversation about this journal](#)

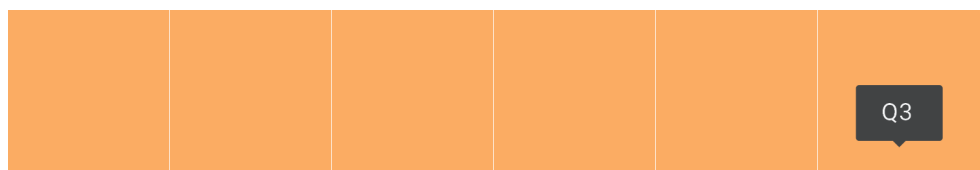
13

H Index

Quartiles



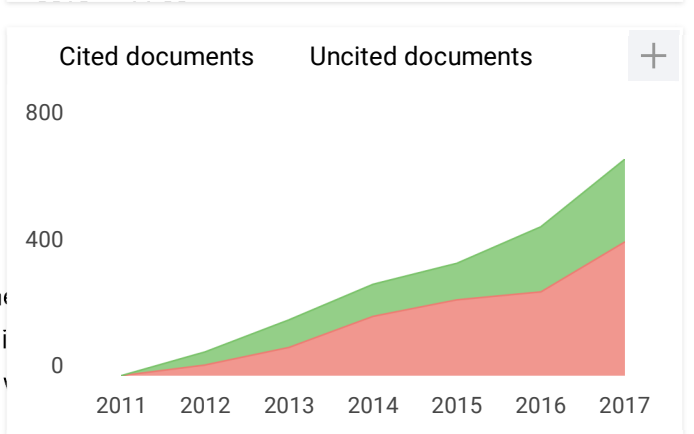
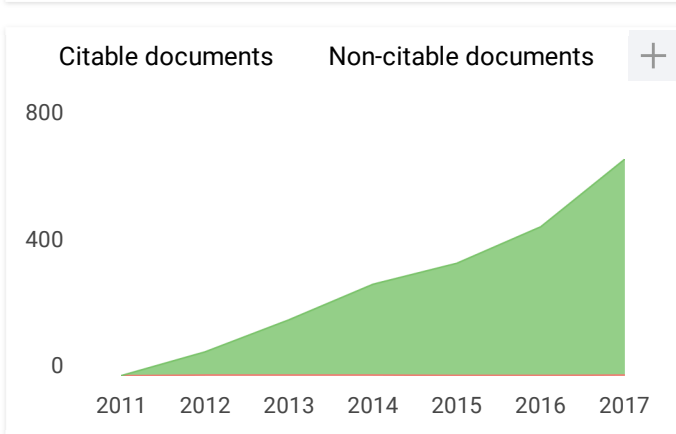
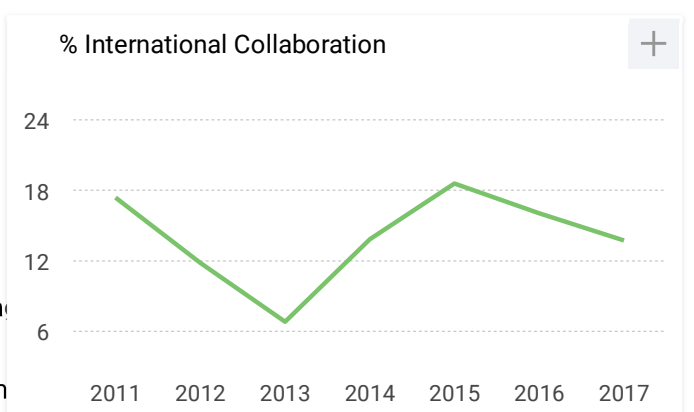
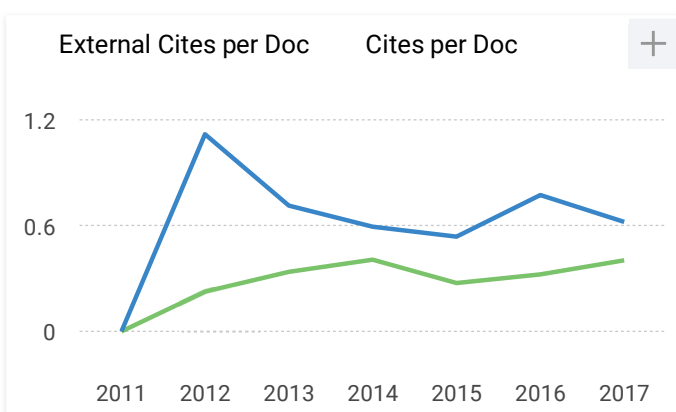
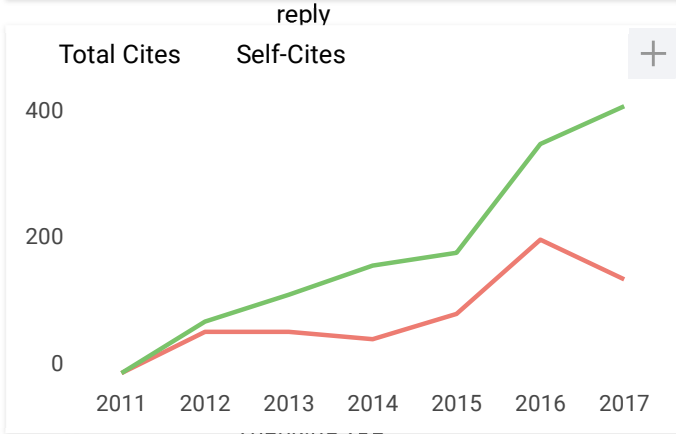
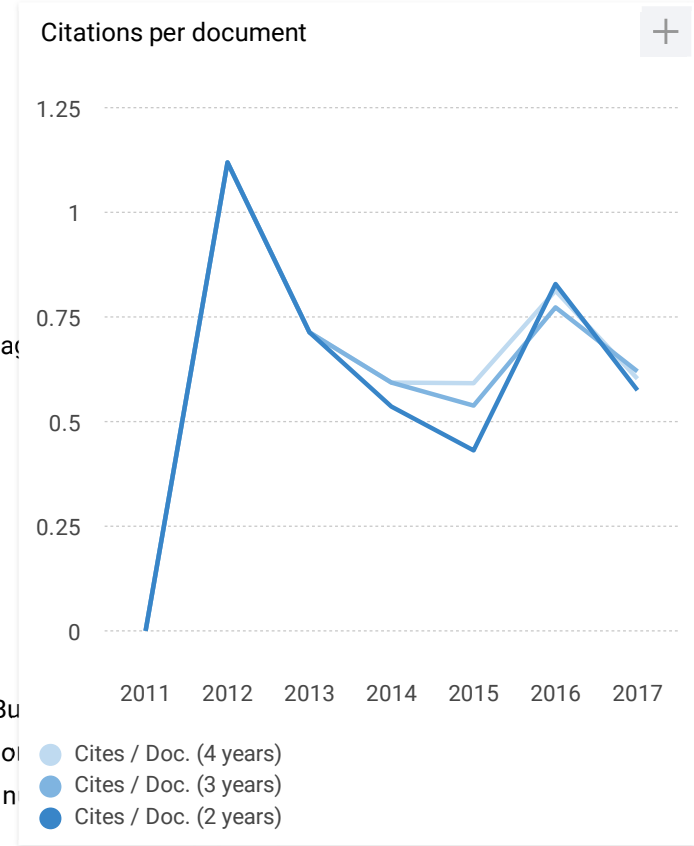
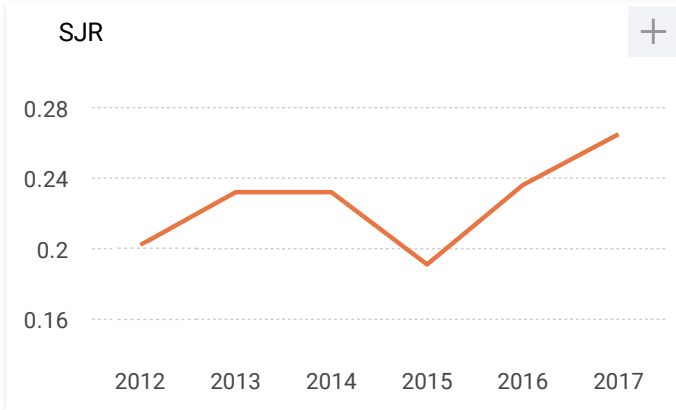
Electrical and Electronic Engineering



Q3

M

I want answer, why journal website appear error? now can check my research status? please



as already published in the journal, maybe could help us



The widget displays the journal name 'Telkomnika' at the top. Below it, a large orange square contains 'Q3', indicating the journal's quartile. To the right, it says 'Electrical and Electronic Engineering' and 'best quartile'. Below this, the SJR 2017 index is shown as '0.26'. A small line graph shows the journal's performance over time. At the bottom, it says 'powered by scimagojr.com' and a large letter 'S' is visible.

← Show this widget in your own website

Just copy the code below and paste within your html code:

```
<a href="https://www.scim
```

I want to Know how I can get the Impact Factor of any Journal

reply



Elena Corera 7 months ago

Dear Ahahd,

thank you very much for your request. You can consult that information in SJR website.

Best Regards,
SCImago Team

Leave a comment

Name

Email

(will not be published)

I'm not a robot

reCAPTCHA
Privacy - Terms

Submit

The users of Scimago Journal & Country Rank have the possibility to dialogue through comments linked to a specific journal. The purpose is to have a forum in which general doubts about the processes of publication in the journal, experiences and other issues derived from the publication of papers are resolved. For topics on particular articles, maintain the dialogue through the usual channels with your editor.

Developed by:



Powered by:



Follow us on @ScimagoJR

Scimago Lab, Copyright 2007-2018. Data Source: Scopus®

EST MODUS IN REBUS
Horatio (Satire 1,1,106)



TELKOMNIKA

HOME ABOUT LOGIN REGISTER SEARCH CURRENT ARCHIVES
ANNOUNCEMENTS

Home > [About the Journal](#)

About the Journal

People

- » [Contact](#)
- » [Editorial Team](#)

Policies

- » [Focus and Scope](#)
- » [Section Policies](#)
- » [Peer Review Process](#)
- » [Open Access Policy](#)
- » [Archiving](#)
- » [Publication Ethics and Publication Malpractice Statement](#)
- » [Checklist for preparing your paper for publication](#)
- » [TELKOMNIKA Profile in Scimago and Google Scholar](#)
- » [Withdrawal of Manuscripts](#)
- » [Retraction and Correction policies](#)

Submissions

- » [Online Submissions](#)
- » [Author Guidelines](#)
- » [Copyright Notice](#)
- » [Privacy Statement](#)
- » [Author Fees](#)

Other

- » [Journal Sponsorship](#)
- » [Site Map](#)
- » [About this Publishing System](#)

TELKOMNIKA Telecommunication, Computing, Electronics and Control

ISSN: 1693-6930, e-ISSN: 2302-9293

Universitas Ahmad Dahlan, 4th Campus, 9th Floor, LPPI Room

Jl. Ringroad Selatan, Kragilan, Tamanan, Banguntapan, Bantul, Yogyakarta, Indonesia 55191

Phone: +62 (274) 563515, 511830, 379418, 371120 ext. 4902, Fax: +62 274 564604



This work is licensed under a [Creative Commons Attribution-NonCommercial 4.0 International License](#).

01616623

[View TELKOMNIKA Stats](#)

USER

Username
 Password
 Remember me

ICW-TELKOMNIKA

2019 ICW-TELKOMNIKA
International Conference

JOURNAL METRICS

SJR 2017 : 0.265
(Q3)
 CiteScore 2017 : 0.63
 SNIP 2017 : 0.580

TELKOMNIKA is the best journal in Indonesia 2017

Telkomnika



QUICK LINKS

- [Author Guideline](#)
- [Editorial Boards](#)
- [Reviewers](#)
- [Online Submissions](#)
- [Abstracting and Indexing](#)
- [Publication Ethics](#)
- [Visitor Statistics](#)
- [Contact Us](#)

JOURNAL HARDCOPY

Order journal prints (hardcopy) <<click in here>>

JOURNAL CONTENT

Search
 Search Scope
 All

Browse

- [By Issue](#)
- [By Author](#)
- [By Title](#)
- [Other Journals](#)


TELKOMNIKA

Telecommunication, Computing, Electronics and Control

ISSN: 1693-6930, e-ISSN: 2302-9293

Accredited First Grade by Ministry of Research, Technology and Higher Education, Republic of Indonesia, Decree No: 21/E/KPT/2018

 Scopus
indexed

[HOME](#) [ABOUT](#) [LOGIN](#) [REGISTER](#) [SEARCH](#) [CURRENT](#) [ARCHIVES](#)
[ANNOUNCEMENTS](#)
[Home](#) > [About the Journal](#) > [Editorial Team](#)

Editorial Team

Editor-in-Chief

[Dr. Tole Sutikno](#), Universitas Ahmad Dahlan, Indonesia

Editor-in-Chief for Power Engineering

[Dr. Ahmet Teke](#), Cukurova University, Turkey

Editor-in-Chief for Electronics Engineering

[Prof. Dr. Faycal Djeflal](#), University of Batna, Batna, Algeria

Editor-in-Chief for Power Electronics and Drives

[Assoc. Prof. Dr. Nik Rumzi Nik Idris](#), Universiti Teknologi Malaysia, Malaysia

Editor-in-Chief for Control Engineering

[Dr. Auzani Jidin](#), Universiti Teknikal Malaysia Melaka (UTeM), Malaysia

Editor-in-Chief for Signal Processing

[Assoc. Prof. Dr. Nidhal Bouaynaya](#), Rowan University, Glassboro, NJ, United States

Editor-in-Chief for Telecommunication Engineering

[Prof. Dr. Leo P. Ligthart](#), Delft University of Technology, Netherlands

Editor-in-Chief for Machine Learning, AI and Soft Computing

[Prof. Dr. Luis Paulo Reis](#), University of Minho, Portugal

Editor-in-Chief for Computer Science, Informatics and Information System

[Assoc. Prof. Dr. Wanquan Liu](#), Curtin University of Technology, Australia

Associate Editors

[Prof. Dr. Ahmad Saudi Samosir](#), Lampung University, Indonesia
[Prof. Dr. Francis C.M. Lau](#), The University of Hong Kong, Hong Kong
[Prof. Franco Frattonillo, Ph.D.](#), University of Sannio, Italy
[Prof. Dr. G. A. Papakostas](#), Eastern Macedonia and Thrace Institute of Technology, Greece
[Prof. Dr. Hussain Al-Ahmad](#), Khalifa University, United Arab Emirates
[Prof. Longquan Yong](#), Shaanxi University of Technology, China
[Prof. Ing. Mario Versaci](#), Mediterranea University of Reggio Calabria, Italy
[Prof. Dr. Mirosław Swiercz](#), Politechnika Białostocka, Poland
[Prof. Dr. Omar Lengerke](#), Universidad Autónoma de Bucaramanga, Colombia
[Prof. Dr. Srinivasan Alavandar](#), CK College of Engineering and Technology, India
[Prof. Dr. Tarek Bouktir](#), Ferhat Abbas University, Setif, Algeria
[Prof. Dr. Zahrihadha Zakaria](#), Universiti Teknikal Malaysia Melaka, Malaysia
[Assoc. Prof. Jumril Yunas](#), Universiti Kebangsaan Malaysia, Malaysia
[Assoc. Prof. Dr. Luchakorn Wuttisittikulkij](#), Chulalongkorn University, Thailand
[Assoc. Prof. Dr. Mochammad Facta](#), Diponegoro University, Indonesia
[Assoc. Prof. Dr. Mohamed Arezki Mellal](#), M'Hamed Bougara University, Algeria
[Asst. Prof. Dr. Supavadee Aramviith](#), Chulalongkorn University, Thailand
[Asst. Prof. Dr. Andrea Francesco Morabito](#), University of Reggio Calabria, Italy
[Dr. Achmad Widodo](#), Universitas Diponegoro, Indonesia
[Dr. Arianna Mencattini](#), University of Rome "Tor Vergata", Italy
[Dr. Deris Stiawan](#), Universitas Sriwijaya, Indonesia
[Dr. Haruna Chiroma](#), Federal College of Education (Technical), Gombe,, Nigeria
[Dr. Huchang Liao](#), Sichuan University, China
[Dr. Jacek Stando](#), Technical University of Lodz, Poland
[D. Jude Hemanth](#), Karunya University, India
[Mark S. Hooper](#), Analog/RF IC Design Engineer (Consultant) at Microsemi, United States
[Dr. Munawar A Riyadi](#), Universitas Diponegoro, Indonesia
[Dr. Shahrin Md Ayob](#), Universiti Teknologi Malaysia, Malaysia
[Dr. Surinder Singh](#), SLIET Longowal, India
[Dr. Tutut Herawan](#), Universiti Malaya, Malaysia
[Dr. Yang Han](#), University of Electronic Science and Technology of China, China
[Dr. Yin Liu](#), Symantec Research Labs' Core Research group, United States
[Dr. Youssef Said](#), Tunisie Telecom Sys'Com Lab, National Engineering School of Tunis (ENIT), Tunisia
[Dr. Yutthapong Tuppadung](#), Provincial Electricity Authority (PEA), Thailand
[Dr. Zhixiong Li](#), China University of Mining and Technology, China

TELKOMNIKA Telecommunication, Computing, Electronics and Control

ISSN: 1693-6930, e-ISSN: 2302-9293

Universitas Ahmad Dahlan, 4th Campus, 9th Floor, LPPI Room

Jl. Ringroad Selatan, Kragilan, Tamanan, Banguntapan, Bantul, Yogyakarta, Indonesia 55191

Phone: +62 (274) 563515, 511830, 379418, 371120 ext. 4902, Fax: +62 274 564604

USER

 Username
 Password
 Remember me

ICW-TELKOMNIKA

2019 ICW-TELKOMNIKA
 International Conference

JOURNAL METRICS

 SJR 2017 : 0.265
 (Q3)
 CiteScore 2017 : 0.63
 SNIP 2017 : 0.580

TELKOMNIKA is the best journal in Indonesia 2017

Telkomnika

 Q3 Electrical and Electronic Engineering
 best quartile
 SJR 2017 0.26
 powered by scimagojr.com

QUICK LINKS

- Author Guideline
- Editorial Boards
- Reviewers
- Online Submissions
- Abstracting and Indexing
- Publication Ethics
- Visitor Statistics
- Contact Us

JOURNAL HARDCOPY

Order journal prints (hardcopy) <<click in here>>

JOURNAL CONTENT

 Search
 Search Scope

Browse

- By Issue
- By Author
- By Title
- Other Journals



This work is licensed under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/).

01659538

[View TELKOMNIKA Stats](#)



Home > Archives > Vol 17, No 3

Vol 17, No 3

June 2019

DOI: <http://dx.doi.org/10.12928/telkomnika.v17i3>

Table of Contents

Wireless sensor network based monitoring system for precision agriculture in Uzbekistan <i>Farruh Muzafarov, Abdimurod Eshmuradov</i>	PDF	1071-1080
Design and optimization of a new compact 2.4 GHz-bandpass filter using DGS technique and U-shaped resonators for WLAN applications <i>A. Belmajdoub, A. Boutejdar, A. El Alami, S. D. Bennani, M. Jorio</i>	PDF	1081-1089
A new configuration of a printed diplexer designed for DCS and ISM bands <i>H. Setti, J. Zbitou, A. El Hamichi, A. Tribak</i>	PDF	1090-1095
Multicast routing protocol for advanced vehicular ad hoc networks <i>Omar Saeed Al Mushayt, Wajeb Gharibi, Nasrullah Armi</i>	PDF	1096-1100
Hybrid multi-independent mmWave MNOs assessment utilising spectrum sharing paradigm for 5G networks <i>Mothana L. Attiah, A. A. Md Isa, Zahrladha Zakaria, M. K. Abdulhameed, Mowafak K. Mohsen, Ahmed M. Dinar</i>	PDF	1101-1109
Rain attenuation statistics for mobile satellite communications estimated from radar measurements in Malaysia <i>Mohammad Ibrahim Abozeed, Manhal Alhilali, Lam Hong Yin, Jafri Din</i>	PDF	1110-1117
Healthcare receivers' acceptance of telecardiology in Malaysia <i>Kee Jiar Yeo, Rania Hussien Ahmed Al-Ashwal, Lina Handayani, Shih Hui Lee</i>	PDF	1128-1135
Outage probability based on telecommunication range for multi-hop HALE UAVs <i>Mohammadreza Tarihi, Mohammad Mahdinejad Noori, Mohammadhossein Madani</i>	PDF	1118-1127
Implementation model architecture software defined network using raspberry Pi: a review paper <i>Okki Marzuqi, Agus Virgono, Ridha Muldina Negara</i>	PDF	1136-1141
Cladding effects on silica directional couplers <i>Ary Syahriar, Ahmad Husin Lubis, Jusman Syafii Jamal, Anwar Mujadin, Ahmad Juang Pratama</i>	PDF	1142-1148
Significant variables extraction of post-stroke EEG signal using wavelet and SOM kohonen <i>Esmeralda C. Djamal, Deka P. Gustiawan, Daswara Djajasasmita</i>	PDF	1149-1158
GNSS interference reduction method for CORS site planning <i>Reza Septiawan, Agung Syetiawan, Arief Rufiyanto, Nasrullah Taufik, Budi Sulistya, Erik Madyo Putro</i>	PDF	1159-1167
Hiding data in images using steganography techniques with compression algorithms <i>Osama F. Abdel Wahab, Aziza I. Hussein, Hesham F. A. Hamed, Hamdy M. Kelash, Ashraf A. M. Khalaf, Hanafy M. Ali</i>	PDF	1168-1175
Design of radar display of Indonesian airspace monitoring application <i>Sulistyaningsih Sulistyaningsih, Yussi Perdana Saputera, Mashury Wahab, Yudi Yulius Maulana</i>	PDF	1176-1184

USER

Username
Password
 Remember me

[Login](#)

ICW-TELKOMNIKA

2019 ICW-TELKOMNIKA
International Conference

JOURNAL METRICS

SJR 2017 : 0.265
(Q3)
CiteScore 2017 : 0.63
SNIP 2017 : 0.580

TELKOMNIKA is the best journal in Indonesia 2017

Telkomnika



QUICK LINKS

- Author Guideline
- Editorial Boards
- Reviewers
- Online Submissions
- Abstracting and Indexing
- Publication Ethics
- Visitor Statistics
- Contact Us

JOURNAL HARDCOPY

Order journal prints (hardcopy) <<click in here>>

JOURNAL CONTENT

Search
Search Scope
All
[Search](#)

Browse

- By Issue
- By Author
- By Title
- Other Journals

Performance analysis of tunnel broker through open virtual private network	PDF
<i>Rendy Munadi, Danu Dwi Sanjoyo, Doan Perdana, Fidar Adjie</i>	1185-1192
Enhance interval width of crime forecasting with ARIMA model-fuzzy alpha cut	PDF
<i>Yaya Sudarya Triana, Astari Retnowardhani</i>	1193-1201
Measuring the quality of e-commerce websites using analytical hierarchy process	PDF
<i>Umar Abdul Aziz, Arif Wibisono, Amna Shifia Nisafani</i>	1202-1208
Transformation to electronic purchasing: an empirical investigation	PDF
<i>Mansour Naser Alraja, Maryam Ali Said Kashoob</i>	1209-1219
Analysis of color image features extraction using texture methods	PDF
<i>Aws AlQaisi, Mokhled AlTarawneh, Ziad A. Alqadi, Ahmad A. Sharadqah</i>	1220-1225
A new agglomerative hierarchical clustering to model student activity in online learning	PDF
<i>Agung Triayudi, Iskandar Fitri</i>	1226-1235
Approximated computing for low power neural networks	PDF
<i>Gian Carlo Cardarilli, Luca Di Nunzio, Rocco Fazzolari, Daniele Giardino, Marco Matta, Mario Patetta, Marco Re, Sergio Spanò</i>	1236-1241
"Magic Boosed" an elementary school geometry textbook with marker-based augmented reality	PDF
<i>Reza Andrea, Siti Lailiyah, Fahrul Agus, Ramadiani Ramadiani</i>	1242-1249
Smart taxi security system design with internet of things (IoT)	PDF
<i>Indrianto Indrianto, Meilia Nur Indah Susanti, Riki Ruli A. Siregar, Purwati Putri J., Yudhi Purwanto</i>	1250-1255
Lung diseases detection caused by smoking using support vector machine	PDF
<i>Sri Widodo, Ratnasari Nur Rohmah, Bana Handaga, Liss Dyah Dewi Arini</i>	1256-1266
Optimal SVC allocation via symbiotic organisms search for voltage security improvement	PDF
<i>Mohamad Khairuzzaman Mohamad Zamani, Ismail Musirin, Sharifah Azma Syed Mustaffa, Saiful Izwan Suliman</i>	1267-1274
A low-cost electro-cardiograph machine equipped with sensitivity and paper speed option	PDF
<i>Bambang Guruh Irianto, Budhiaji Budhiaji, Dwi Herry Andayani</i>	1275-1281
Power analysis attack against encryption devices: a comprehensive analysis of AES, DES, and BC3	PDF
<i>Septafiansyah Dwi Putra, Mario Yudhiprawira, Sarwono Sutikno, Yusuf Kurniawan, Adang Suwandi Ahmad</i>	1282-1289
Suitability analysis of rice varieties using learning vector quantization and remote sensing images	PDF
<i>Annisa Apriliani, Retno Kusumaningrum, Sukmawati Nur Endah, Yudo Prasetyo</i>	1290-1299
27markerless motion capture for 3D human model animation using depth camera	PDF
<i>Maulahikmah Galinium, Jason Yapri, James Purnama</i>	1300-1309
Fuzzy sequential model for strategic planning of small and medium scale industries	PDF
<i>Imam Santoso, Puspa Ayu Indah Prameswari, Aulia Bayu Yushila, Muhammad Arwani</i>	1310-1316
Filter technique of medical image on multiple morphological gradient (MMG) method	PDF
<i>Jufriadif Na'am, Johan Harlan, Rosda Syelly, Agung Ramadhanu</i>	1317-1323
Risk assessment of information production using extended risk matrix approach	PDF
<i>Jaka Sembiring, Fitasari Wiharni</i>	1324-1337
Formal expansion method for solving an electrical circuit model	PDF
<i>Tjendro Tjendro, Sudi Mungkasi</i>	1338-1343
AHP-TOPSIS for analyzing job performance with factor evaluation system and process mining	PDF

<i>Gabriel Sophia, Riyanarto Sarno</i>	1344-1351
Parallel random projection using R high performance computing for planted motif search	PDF
<i>Lala Septem Riza, Tyas Farrah Dhiba, Wawan Setiawan, Topik Hidayat, Mahmoud Fahsi</i>	1352-1359
KANSA: high interoperability e-KTP decentralised database network using distributed hash table	PDF
<i>Rolly Maulana Awangga, Nisa Hanum Harani, Muhammad Yusril Helmi Setyawan</i>	1360-1366
Comparison of exponential smoothing and neural network method to forecast rice production in Indonesia	PDF
<i>Gregorius Airlangga, Agatha Rachmat, Dodisutarma Lapihu</i>	1367-1375
Cluster-based water level patterns detection	PDF
<i>Friska Natalia Ferdinand, Yustinus Soelistio, Ferry Vincenttius Ferdinand, I Made Murwantara</i>	1376-1384
Lightweight IoT middleware for rapid application development	PDF
<i>A. Karim Mohamed Ibrahim, Rozeha A. Rashid, A. Hadi Fikri A. Hamid, M. Adib Sarijari, Muhammad Ariff Baharudin</i>	1385-1392
Vehicle detection using background subtraction and clustering algorithms	PDF
<i>Puguh Budi Prakoso, Yuslena Sari</i>	1393-1398
Architectural design of IoT-cloud computing integration platform	PDF
<i>Adhitya Bhawiyuga, Dany Primanita Kartikasari, Kasyful Amron, Ocki Bagus Pratama, Moch. Wildan Habibi</i>	1399-1408
Clustering analysis of learning style on anggana high school student	PDF
<i>Siti Lailiyah, Ekawati Yulsilviana, Reza Andrea</i>	1409-1416
Optimization of video steganography with additional compression and encryption	PDF
<i>Dwi Arraziqi, Endi Sailul Haq</i>	1417-1424
K-Nearest neighbor algorithm on implicit feedback to determine SOP	PDF
<i>Muhammad Yusril Helmi Setyawan, Rolly Maulana Awangga, Nadia Ayu Lestari</i>	1425-1431
Region of interest and color moment method for freshwater fish identification	PDF
<i>Gibtha Fitri Laxmi, Fitrah Satrya Fajar Kusumah</i>	1432-1438
Bridging IoT infrastructure and cloud application using cellular-based internet gateway device	PDF
<i>Eko Sakti Pramukantoro, Maxi Luckies, Fariz Andri Bakhtiar</i>	1439-1446
Exploration of genetic network programming with two-stage reinforcement learning for mobile robot	PDF
<i>Siti Sendari, Arif Nur Afandi, Ilham Ari Elbaith Zaeni, Yogi Dwi Mahandi, Kotaro Hirasawa, Hsien-I Lin</i>	1447-1454
Effect of kernel size on Wiener and Gaussian image filtering	PDF
<i>Zayed M. Ramadan</i>	1455-1460
An implementation of novel genetic based clustering algorithm for color image segmentation	PDF
<i>Varshali Jaiswal, Varsha Sharma, Sunita Varma</i>	1461-1467
Prototype of multifunctional transmitter with Rejection of disturbances	PDF
<i>Holman Montiel Ariza, Fernando Martínez Santa, Fredy H. Martínez S.</i>	1468-1473
A statistical approach on pulmonary tuberculosis detection system based on X-ray image	PDF
<i>Ratnasari Nur Rohmah, Bana Handaga, Nurokhim Nurokhim, Indah Soesanti</i>	1474-1482
IoT: smart garbage monitoring using android and real time database	PDF
<i>Riyan Hadi Putra, Feri Teja Kusuma, Tri Nopiani Damayanti, Dadan Nur Ramadan</i>	1483-1491
Improving of classification accuracy of cyst and tumor using local polynomial estimator	PDF
<i>Nur Chamidah, Kinanti Hanugera Gusti, Eko Tjahjono, Budi Lestari</i>	1492-1500

Adaptive robust nonsingular terminal sliding mode design controller for quadrotor aerial manipulator	PDF
<i>Samah Riache, Madjid Kidouche, Amar Rezoug</i>	1501-1512
Low cost NodeMcu based development water rocket measurement system applied to STEM education	PDF
<i>Andi Susilo, Yasmiami Yasmiami, Ahmad Apandi</i>	1513-1520
Real-time monitoring and warning system in urban rivers	PDF
<i>Sabam Parjuangan, Rionaldi Ali, Ari Purnama</i>	1521-1525
Dissemination of technology information through YouTube: a case of renewable energy technology	PDF
<i>Muhammad Kunta Biddinika, Mochamad Syamsiro, Srikandi Novianti, Bakhtiyor Nakhshiniev, Muhammad Aziz, Fumitake Takahashi</i>	1526-1538
Stress detection and relief using wearable physiological sensors	PDF
<i>Kriti Sethi, T. Ramya, Hanut Pratap Singh, Rishik Dutta</i>	1139-1146
Benchmarking medium voltage feeders using data envelopment analysis: a case study	PDF
<i>K. T. M. U Hemapala, H. M. J. N Herath, O. V. Gnana Swathika</i>	1547-1558
Bandwidth enhancement of compact microstrip rectangular antennas for UWB applications	PDF
<i>S. Elajoumi, A. Tajmouati, J. Zbitou, A. Errkik, A. M. Sanchez, M. Latrach</i>	1559-1568
Two-port network model of fixed-speed wind turbine generator for distribution system load flow analysis	PDF
<i>Rudy Gianto, Kho Hie Khwee, Hendro Priyatman, Managam Rajagukguk</i>	1569-1575
VRLA battery state of health estimation based on charging time	PDF
<i>Akhmad Zainuri, Unggul Wibawa, Mochammad Rusli, Rini Nur Hasanah, Rosihan Arby Harahap</i>	1577-1583
Authentication techniques in smart grid: a systematic review	PDF
<i>Malik Qasaimeh, Rawan Turab, Raad S. Al-Qassas</i>	1584-1594

TELKOMNIKA Telecommunication, Computing, Electronics and Control

ISSN: 1693-6930, e-ISSN: 2302-9293

Universitas Ahmad Dahlan, 4th Campus, 9th Floor, LPPI Room

Jl. Ringroad Selatan, Kragilan, Tamanan, Banguntapan, Bantul, Yogyakarta, Indonesia 55191

Phone: +62 (274) 563515, 511830, 379418, 371120 ext. 4902, Fax: +62 274 564604



This work is licensed under a [Creative Commons Attribution-NonCommercial 4.0 International License](https://creativecommons.org/licenses/by-nc/4.0/).

01634839

[View TELKOMNIKA Stats](#)

Formal expansion method for solving an electrical circuit model

Tjendro*¹, Sudi Mungkasi²

¹Department of Electrical Engineering, Faculty of Science and Technology, Sanata Dharma University, Mrican, Tromol Pos 29, Yogyakarta 55002, Indonesia

²Department of Mathematics, Faculty of Science and Technology, Sanata Dharma University, Mrican, Tromol Pos 29, Yogyakarta 55002, Indonesia

*Corresponding author, e-mail: tjendro@usd.ac.id¹, sudi@usd.ac.id²

Abstract

We investigate the validity of the formal expansion method for solving a second order ordinary differential equation raised from an electrical circuit problem. The formal expansion method approximates the exact solution using a series of solutions. An approximate formal expansion solution is a truncated version of this series. In this paper, we confirm using simulations that the approximate formal expansion solution is valid for a specific interval of domain of the free variable. The accuracy of the formal expansion approximation is guaranteed on the time-scale 1.

Keywords: damped oscillation, electrical circuit, formal expansion, van der pol equation, vibration model

Copyright © 2019 Universitas Ahmad Dahlan. All rights reserved.

1. Introduction

Mathematics and its programming have played important roles in solving as well as designing experiments of electrical engineering problems, for example, see the work of Sutikno et al. [1-4]. To be specific, in this paper we consider electrical circuit problems. Problems in electrical circuits are often modelled into differential equations. One of the models is called the van der Pol equation. This equation is due to the Dutch physicist Balthasar van der Pol in around 1920 to describe oscillations in a triode-circuit [5]. In a specific situation with small source in oscillations, the van der Pol equation becomes a vibration model with a linear friction term. In this paper we solve the vibration model with a linear friction term, which is a modification of the van der Pol equation, using the formal expansion method.

Previous research has been conducted by a number of authors relating to the van der Pol equation [5-8] in physics [9-10], biology [11], economics [12], etc. [13-15]. Amongst them, Verhulst [5] provided a theorem about the order of accuracy of the formal expansion solution with respect to the perturbation factor in the damping term. Nevertheless, it has not been confirmed computationally when we use this method to solve the vibration model with a linear damping (friction term), especially the validity of the method relating to the interval of the free variable. Therefore, this paper shall fill this gap of research, that is, we shall validate of the formal expansion method computationally. The rest of this paper is written as follows. We provide the mathematical model and method in section 2. After that we present our research results and discussion in section 3. The paper is concluded with some remarks in section 4.

2. Mathematical Model and Method

The van der Pol equation, as the considered mathematical model, is

$$\ddot{x} + x = \mu(1 - x^2)\dot{x}$$

where μ is a positive constant [5]. When the factor $\mu(1 - x^2)$ is replaced by $-\varepsilon$, where ε is a small positive constant, the model becomes

$$\ddot{x} + x = -\varepsilon\dot{x}$$

which is valid for $x > 1$ or $x < -1$. This model is the vibration model with a linear friction term.

The core property in the formal expansion method is given in a theorem as follows due to Verhulst [5]. We consider the initial value problem

$$\dot{x} = f_0(t, x) + \varepsilon f_1(t, x) + \dots + \varepsilon^m f_m(t, x) + \varepsilon^{m+1} R(t, x, \varepsilon)$$

where $x(t_0) = \eta$ and $|t - t_0| \leq h$, $x \in D \subset \mathbb{R}^n$, $0 \leq \varepsilon \leq \varepsilon_0$. Here η is a constant, h is a positive constant, D is a domain in the n dimension, and ε_0 is a positive constant. We assume that in this domain all functions involved in the problem are infinitely many differentiable. Then the formal expansion

$$x_0(t) + \varepsilon x_1(t) + \dots + \varepsilon^m x_m(t)$$

with $x_0(t_0) = \eta$, $x_i(t) = 0, i = 1, \dots, m$ approximates the exact solution $x(t)$ with the property

$$\|x(t) - (x_0(t) + \varepsilon x_1(t) + \dots + \varepsilon^m x_m(t))\| = O(\varepsilon^{m+1})$$

on the time-scale 1. This means that the formal expansion is of the $(m + 1)$ th order of accuracy.

3. Results and Discussion

For the convenience of writing and in order to be consistent with our references (such as Verhulst [5]), we consider the model

$$\ddot{x} + x = -2\varepsilon \dot{x}$$

suppose the initial conditions are $x(0) = a$ and $\dot{x}(0) = 0$. The exact solution to this problem is

$$x(t) = ae^{\varepsilon t} \cos(\sqrt{1 - \varepsilon^2} t) + \varepsilon \frac{a}{\sqrt{1 - \varepsilon^2}} e^{-\varepsilon t} \sin(\sqrt{1 - \varepsilon^2} t)$$

substituting

$$x(t) = x_0(t) + \varepsilon x_1(t) + \varepsilon^2 \dots$$

into the model, we obtain

$$\begin{aligned} \ddot{x}_0 + x_0 &= 0, \\ \ddot{x}_n + x_n &= -2\dot{x}_{n-1}, \quad n = 1, 2, \dots \end{aligned}$$

now we put

$$\begin{aligned} x_0(0) &= a, \quad \dot{x}_0(0) = 0 \\ x_n(0) &= 0, \quad \dot{x}_n(0) = 0, \quad n = 1, 2, \dots \end{aligned}$$

we obtain

$$\begin{aligned} x_0(t) &= a \cos t \\ x_1(t) &= a \sin t - at \cos t \end{aligned}$$

therefore, our solution based on the formal expansion is

$$x(t) = a \cos t + a\varepsilon(\sin t - t \cos t) + \varepsilon^2 \dots$$

that is, the first order formal solution is

$$y_1(t) = a \cos t$$

the second order formal solution is

$$y_2(t) = a \cos t + a\varepsilon(\sin t - t \cos t)$$

Remark: We choose to consider this problem, because this problem has an exact solution. We intentionally use the exact solution to verify the validity of formal expansion solutions. If the

formal expansion solutions are valid for solving problems having exact solutions, then we shall be sure to use the formal expansion method to solve problems with the exact solutions are not known. Note that in practice, exact solutions are generally not known. Now for numerical experiments, we take $a = 1$ and vary the values of ε . To get clear illustrations, we take $\varepsilon = 0.5, 0.05, 0.025$ respectively.

3.1. Simulation for Case $\varepsilon = 0.5$

For the first case, we take $\varepsilon = 0.5$. Figure 1 shows the exact solution, the first order formal expansion solution, and the second order formal expansion solution on the interval $0 \leq t \leq 1$. We observe that the second order solution approximates the exact solution better than the first order does in the domain $0 \leq t \leq 1$. However, if we extend the domain to be $0 \leq t \leq 10$, the second order solution behaves poorly and even worse than the first order solution, as given in Figure 2.

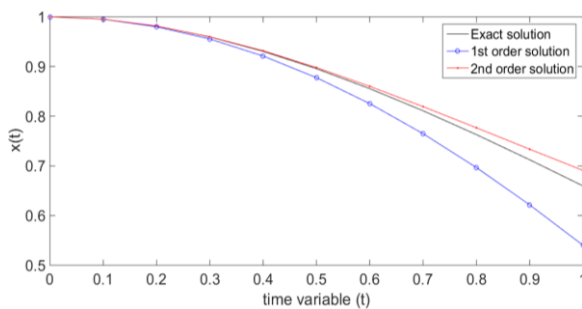


Figure 1. Exact, first order, and second order solutions for $\varepsilon = 0.5$ in domain $0 \leq t \leq 1$

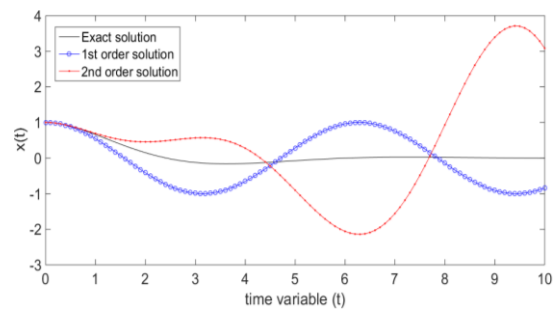


Figure 2. Exact, first order, and second order solutions for $\varepsilon = 0.5$ in domain $0 \leq t \leq 10$

3.2. Simulation for Case $\varepsilon = 0.05$

For the second case, we take $\varepsilon = 0.05$. Figure 3 shows the solutions on the interval $0 \leq t \leq 10$. Similar to the previous case, we observe that the second order solution approximates the exact solution better than the first order does in the domain $0 \leq t \leq 1$ and the extended domain $0 \leq t \leq 10$. However, if we extend the domain further to be $0 \leq t \leq 50$, the second order solution behaves worse than the first order solution, as illustrated in Figure 4.

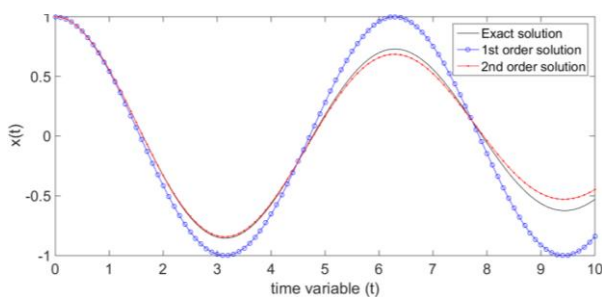


Figure 3. Exact, first order, and second order solutions for $\varepsilon = 0.05$ in domain $0 \leq t \leq 10$

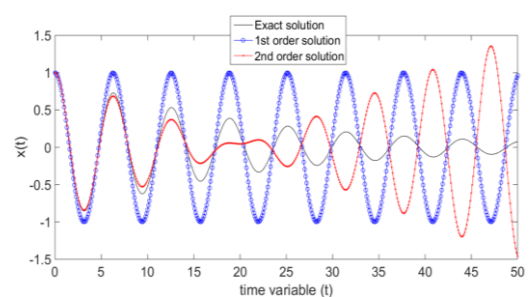


Figure 4. Exact, first order, and second order solutions for $\varepsilon = 0.05$ in domain $0 \leq t \leq 50$

3.3. Simulation for Case $\varepsilon = 0.025$

As the third case, we fix $\varepsilon = 0.025$. We plot the solutions on the interval $0 \leq t \leq 10$ as shown in Figure 5. Once again, we observe that the second order solution approximates the exact solution better than the first order does in the domain $0 \leq t \leq 1$ and the extended domain $0 \leq t \leq 10$. However, once again, if we extend the domain further to be $0 \leq t \leq 100$, the second order solution behaves worse than the first order solution, as illustrated in Figure 6.

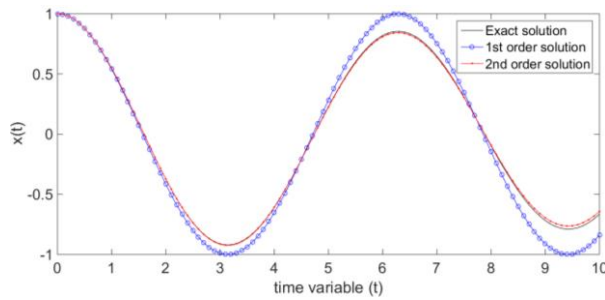


Figure 5. Exact, first order, and second order solutions for $\epsilon = 0.025$ in domain $0 \leq t \leq 10$

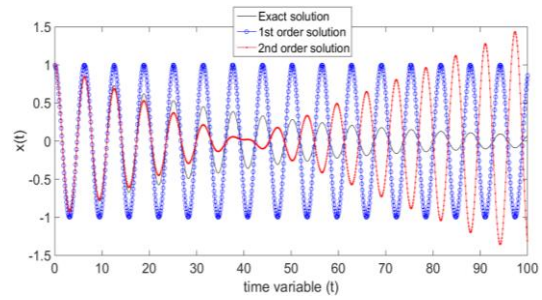


Figure 6. Exact, first order, and second order solutions for $\epsilon = 0.025$ in domain $0 \leq t \leq 100$

3.4. Simulation for the Validity of Order of Accuracy

As we have mentioned in the mathematical method section, the formal expansion is guaranteed to be valid only on the time-scale 1. For any extension of the domain larger than $0 \leq t \leq 1$, the accuracy is not guaranteed. Obviously from the previous subsections (Subsections 3.1-3.3), we obtain that for an extended domain, the errors of the formal expansion solutions are indeed very large. In the present subsection we investigate the validity of the order of accuracy of the formal expansion. We limit our domain only on the interval of the time-scale 1. We take a discrete version of the time domain to be $t = 0, 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7, 0.8, 0.9, 1$. This means that we have discretised the time domain into 11 points. Error of an approximate solution is quantified as

$$Error = \frac{1}{N} \sum_{i=1}^N |x(t_i) - y(t_i)|$$

where N is the number of discrete time points t_i (in this case $i = 1, 2, 3, \dots, N$ with $N = 11$), $x(t)$ is the exact solution, and $y(t)$ is the approximate solution. Furthermore, the order of accuracy is calculated as:

$$Order\ of\ accuracy = \frac{\log\left(\frac{Error_j}{Error_{j+1}}\right)}{\log\left(\frac{\epsilon_j}{\epsilon_{j+1}}\right)}$$

the order of accuracy is calculated based on the j th and the $(j + 1)$ th simulations, respectively, using different values of ϵ . Our results of errors and orders of accuracy are summarised in Tables 1 and 2. Table 1 contains the errors of the first order formal solution with respect to varying ϵ on the time-scale 1. As ϵ tends to zero, the order of accuracy approaches 1. This is consistent with the theoretical background that the solution is of the first order. Table 2 summarises the errors of the second order formal solution with respect to varying ϵ on the time-scale 1. We find that as ϵ tends to zero, the order of accuracy approaches 2. This is consistent with the theory that as it is the second order formal expansion solution, the order of accuracy is 2 in the time-scale 1.

Table 1. Errors of the First Order Formal Solution with Respect to Varying ϵ on the Time-Scale 1

ϵ	Error	Order of accuracy
0.5	0.0351	-
0.25	0.0193	0.86
0.125	0.0101	0.93
0.0625	0.0052	0.96
0.03125	0.00	0.98

Table 2. Errors of the Second Order Formal Solution with Respect to Varying ϵ on the Time-Scale 1

ϵ	Error	Order of accuracy
0.5	0.007527	-
0.25	0.002037	1.89
0.125	0.000531	1.94
0.0625	0.000136	1.97
0.03125	0.000034	1.98

As final remarks, knowing the accuracy of the formal expansion method, we could extend the application of this method to solve other mathematical engineering problems, such as those studied by researchers in [16-26]. Possible other problems to be solved using the formal expansion method could be those in [27-37].

4. Conclusion

We have provided our research results on the formal expansion method for solving an electrical circuit model. The accuracy of the formal expansion is guaranteed on the time-scale 1. We have also confirmed the order of accuracy for the first and second order formal expansion solution using numerical experiments. We obtain that for the first order formal expansion solution, as the perturbation factor is halved, the error is also halved on the time-scale 1. For the second order formal expansion solution, as the perturbation factor is halved, the error is quartered on the time-scale 1. With these results, the formal expansion method could be used to solve other problems in electrical circuits for the time-scale 1. When the time-scale is not equal to 1, we may need to do re-scaling so that the time domain is on the time-scale 1. This could be a future research direction.

Acknowledgements

This work was financially supported by a research grant from *Direktorat Riset dan Pengabdian Masyarakat* of the Ministry of Research, Technology, and Higher Education of the Republic of Indonesia. We are very grateful for the financial support in the form of *Hibah Penelitian Terapan Unggulan Perguruan Tinggi* year 2018 with the contract number 109/SP2H/LT/DRPM/2018.

References

- [1] Sutikno T, Idris NRN, Widodo NS, Jidin A. FPGA Based a PWM Technique for Permanent Magnet AC Motor Drives. *International Journal of Reconfigurable and Embedded Systems*. 2012; 1(2): 43-48.
- [2] Sutikno T, Idris NRN, Jidin A, Jopri MH. FPGA Based Optimized Discontinuous SVPWM Algorithm for Three Phase VSI in AC Drives. *International Journal of Power Electronics and Drive System*. 2013; 3(2): 228-240.
- [3] Sutikno T, Idris NRN, Jidin AZ. Overview on Strategies and Approaches for FPGA Programming. *TELKOMNIKA Telecommunication Computing Electronics and Control*. 2014; 12(2): 273-282.
- [4] Sutikno T, Jidin AZ, Jidin A, Idris NRN. Strategies for FPGA Implementation of Non-Restoring Square Root Algorithm. *International Journal of Electrical and Computer Engineering*. 2014; 4(4): 548-556.
- [5] Verhulst F. *Nonlinear Differential Equations and Dynamical Systems*. Second, Revised and Expanded Edition. Berlin: Springer. 1996.
- [6] Zanette DH. Effects of Noise on the Internal Resonance of a Nonlinear Oscillator. *Scientific Reports*. 2018; 8: 5976.
- [7] Hellevik K, Gudmestad OT. *Limit Cycle Oscillations at Resonances*. IOP Conference Series: Materials Science and Engineering. 2017; 276: 012020.
- [8] Kiss G, Lessard JP. Rapidly and Slowly Oscillating Periodic Solutions of a Delayed van der Pol Oscillator. *Journal of Dynamics and Differential Equations*. 2017; 29(4): 1233-1257.
- [9] Hussin WNW, Harun FN, Mohd MH, Rahman MAA. Analytical Modelling Prediction by Using Wake Oscillator Model for Vortex-induced Vibrations. *Journal of Mechanical Engineering and Sciences*. 2017; 11(4): 3116-3128.
- [10] Herrera L, Montano O, Orlov Y. Hopf Bifurcation of Hybrid van der Pol Oscillators. *Nonlinear Analysis: Hybrid Systems*. 2017; 26: 225-238.
- [11] Cherevko AA, Bord EE, Khe AK, Panarin VA, Orlov KJ. The Analysis of Solutions Behaviour of van der Pol Duffing Equation Describing Local Brain Hemodynamics. *Journal of Physics: Conference Series*. 2017; 894(1): 012012.
- [12] He L, Yi L, Tang P. Numerical Scheme and Dynamic Analysis for Variable-order Fractional van der Pol Model of Nonlinear Economic Cycle. *Advances in Difference Equations*. 2016; 2016(1): 195.
- [13] Rachunkova I, Tomecek J. Antiperiodic Solutions to van der Pol Equations with State-dependent Impulses. *Electronic Journal of Differential Equations*. 2017; 2017: 247.
- [14] Siewe RT, Talla AF, Wofo P. Response of a Resonant Tunneling Diode Optoelectronic Oscillator Coupled to a Non-linear Electrical Circuit. *IET Optoelectronics*. 2016; 10(6): 205-210.
- [15] Hoveijn I. Stability Pockets of a Periodically Forced Oscillator in a Model for Seasonality. *Indagationes Mathematicae*. 2016; 27(5): 1204-1218.
- [16] Mezghani F, Barchiesi D, Cherouat A, Grosgees T, Borouchaki H. Comparison of 3D Adaptive Remeshing Strategies for Finite Element Simulations of Electromagnetic Heating of Gold Nanoparticles. *Advances in Mathematical Physics*. 2015; 2015.

- [17] Dymnikova I, Galaktionov E, Tropp E. Existence of Electrically Charged Structures with Regular Center in Nonlinear Electrodynamics Minimally Coupled to Gravity. *Advances in Mathematical Physics*. 2015; 2015.
- [18] Vafeas P. Dipolar Excitation of a Perfectly Electrically Conducting Spheroid in a Lossless Medium at the Low-Frequency Regime. *Advances in Mathematical Physics*. 2018; 2018.
- [19] Morán-López A, Córcoles J, Ruiz-Cruz JA, Montejo-Garai JR, Rebollar JM. Electromagnetic Scattering at the Waveguide Step between Equilateral Triangular Waveguides. *Advances in Mathematical Physics*. 2016; 2016.
- [20] Mungkasi S. Adaptive Finite Volume Method for the Shallow Water Equations on Triangular Grids. *Advances in Mathematical Physics*. 2016; 2016.
- [21] Gómez-Aguilar JF, Escalante-Martínez JE, Calderón-Ramón C, Morales-Mendoza LJ, Benavidez-Cruz M, Gonzalez-Lee M. Equivalent Circuits Applied in Electrochemical Impedance Spectroscopy and Fractional Derivatives with and without Singular Kernel. *Advances in Mathematical Physics*. 2016; 2016; 1-15.
- [22] Gómez-Aguilar JF, Rosales-García J, Escobar-Jiménez RF, López-López MG, Alvarado-Martínez VM, Olivares-Peregrino VH. On the Possibility of the Jerk Derivative in Electrical Circuits. *Advances in Mathematical Physics*. 2016; 2016; 1-8.
- [23] Dymnikova I, Galaktionov E. Basic Generic Properties of Regular Rotating Black Holes and Solitons. *Advances in Mathematical Physics*. 2017; 2017; 1-10.
- [24] Sun D, Bao W, Li X. Analytic Calculation of Transmission Field in Homogeneously Layered Mediums Excited by EMP. *Advances in Mathematical Physics*. 2017; 2017; 1-8.
- [25] Gao S, Chen S, Ji Z, Tian W, Chen J. DC Glow Discharge in Axial Magnetic Field at Low Pressures. *Advances in Mathematical Physics*. 2017; 2017; 1-8.
- [26] Tao B. Model Equations for Three-Dimensional Nonlinear Water Waves under Tangential Electric Field. *Advances in Mathematical Physics*. 2017; 2017; 1-8.
- [27] Supriyadi B, Mungkasi S. Finite Volume Numerical Solvers for Non-Linear Elasticity in Heterogeneous Media. *International Journal for Multiscale Computational Engineering*. 2016; 14(5): 479-488.
- [28] Suzuki Y, Takahashi M. Multiscale Seamless-Domain Method Based on Dependent Variable and Dependent-Variable Gradients. *International Journal for Multiscale Computational Engineering*. 2016; 14(6): 607-630.
- [29] Krowczynski M, Cecot W. A Fast Three-Level Upscaling for Short Fiber-Reinforced Composites. *International Journal for Multiscale Computational Engineering*. 2017; 15(1): 19-34.
- [30] Panda N, Butler T, Estep D, Graham L, Dawson C. A Stochastic Inverse Problem for Multiscale Models. *International Journal for Multiscale Computational Engineering*. 2017; 15(3): 265-283.
- [31] Rojek J, Nosewicz S, Chmielewski M. Micro-Macro Relationships from Discrete Element Simulations of Sintering. *International Journal for Multiscale Computational Engineering*. 2017; 15(4): 323-342.
- [32] Daniel YS, Aziz ZA, Ismail Z, Salah F. Entropy Analysis of Unsteady Magnetohydrodynamic Nanofluid over Stretching Sheet with Electric Field. *International Journal for Multiscale Computational Engineering*. 2017; 15(6): 545-565.
- [33] Sun W, Fish J, Dhia HB. A Variant of the S-Version of the Finite Element Method for Concurrent Multiscale Coupling. *International Journal for Multiscale Computational Engineering*. 2018; 16(2): 187-207.
- [34] Mungkasi S, Magdalena I, Pudjaprasetya SR, Wiryanto LH, Roberts SG. A Staggered Method for the Shallow Water Equations Involving Varying Channel Width and Topography. *International Journal for Multiscale Computational Engineering*. 2018; 16(3): 231-244.
- [35] Moyeda A, Fish J. Multiscale Analysis of Prestressed Concrete Structures. *International Journal for Multiscale Computational Engineering*. 2018; 16(3): 285-301.
- [36] Puzscharz AK, Krucinska I. Simulations of Air Permeability of Multilayer Textiles by the Computational Fluid Dynamics. *International Journal for Multiscale Computational Engineering*. 2018; 16(6): 509-526.
- [37] Li D, Fish J, Yuan ZF. Two-Scale and Three-Scale Computational Continuum Models of Composite Curved Beams. *International Journal for Multiscale Computational Engineering*. 2018; 16(6): 527-554.