

PROCEEDINGS

The 1st International Basic Science Conference 2016
TOWARDS THE EXTENDED USE OF BASIC SCIENCE
FOR ENHANCING HEALTH, ENVIRONMENT,
ENERGY, AND BIOTECHNOLOGY

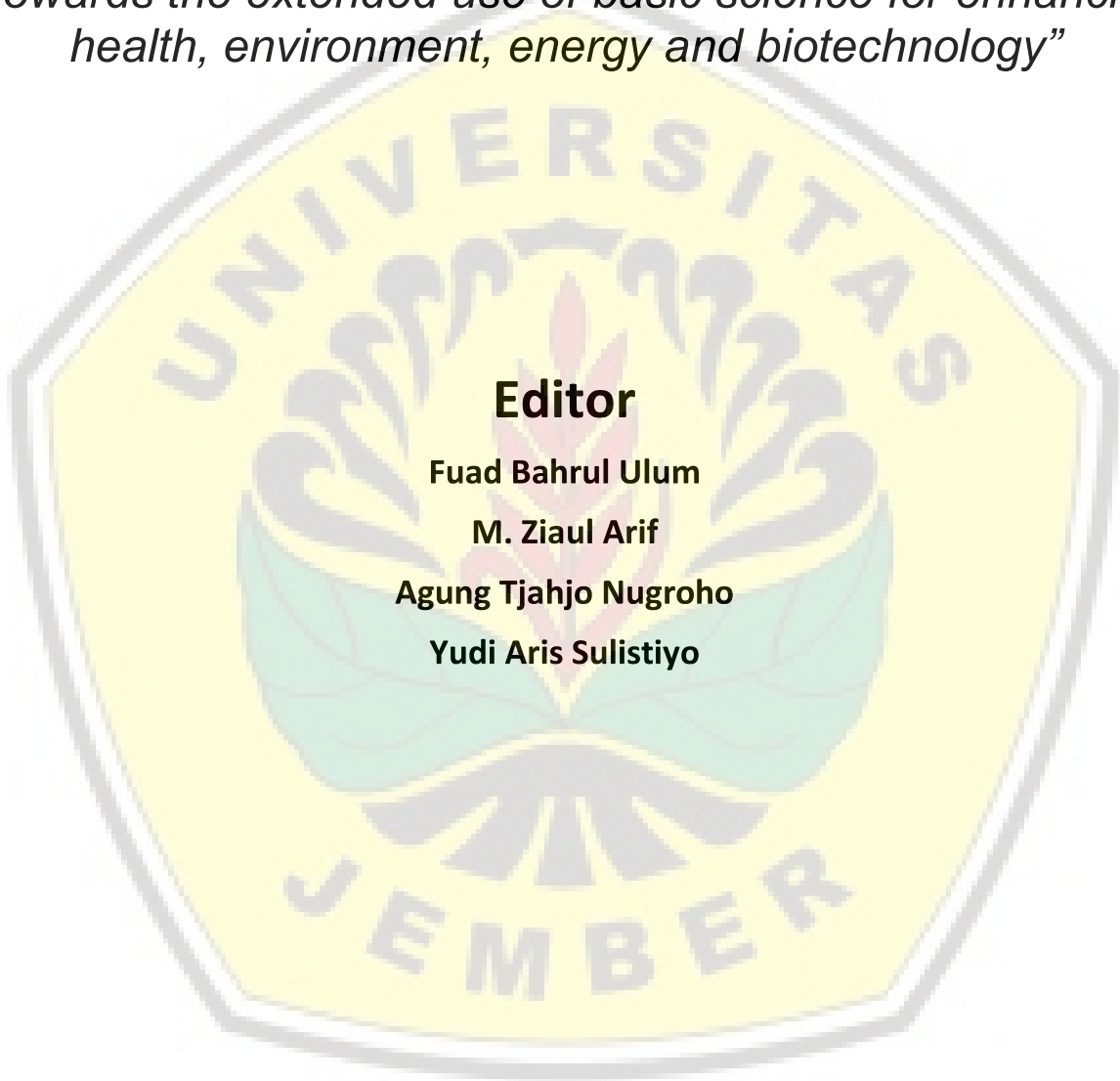
University of Jember, September 26 - 27, 2016



Digital Repository Universitas Jember

(The 1st IBSC 2016)

“Towards the extended use of basic science for enhancing health, environment, energy and biotechnology”



Editor

Fuad Bahrul Ulum

M. Ziaul Arif

Agung Tjahjo Nugroho

Yudi Aris Sulistiyo

**Faculty of Mathematics and Natural Sciences
The University of Jember
Jember
Indonesia**

Email : ibsc.fmipa@unej.ac.id

Website : <http://ibsc.fmipa.unej.ac.id/>

Address : Jl. Kalimantan no 37 Kampus Tegal Boto, Jember 68121

First Published 2017

**TITLE : PROCEEDINGS OF THE 1st INTERNATIONAL BASIC SCIENCE
CONFERENCE 2016**

**EDITORS : Fuad Bahrul Ulum, M. Ziaul Arif, Agung Tjahjo Nugroho, Yudi Aris
Sulistiyo**

ISBN 978-602-60569-5-5



ISBN: 978-602-60569-5-5

Copyright © 2017 IBSC The University of Jember and the authors of the paper

All Rights Reserved. No part of this publication may be reproduced, stored or transmitted in any form or by any means without the permission in writing of the copyright holders.

A Conference on the extended use of Basic Science was hosted by the Faculty of Mathematics and Natural Science (FMIPA), at CDAST building, Universitas Jember in 26-27th day of September 2016. This conference is intended to promote further developments of basic science for their tangible applications, especially health, environment, energy and biotechnology.

The conference posed the question “what biological, chemical, physical, geological, mathematical, statistical, medical, agricultural and other basic science field changes must be made in order to ensure better live quality in term of health, environment, energy and biotechnology. FMIPA was fortunate to welcome researchers, educators and engineers from various backgrounds representing a variety ways to extend the application of basic science in which safety, environmental friendly and energy efficiency were being pursued. More than two hundred contributors from fifty five different institutions presented the theory, methodology and application of the field and thus the 1st IBSC 2016 was very rich as the proceeding in this volume.

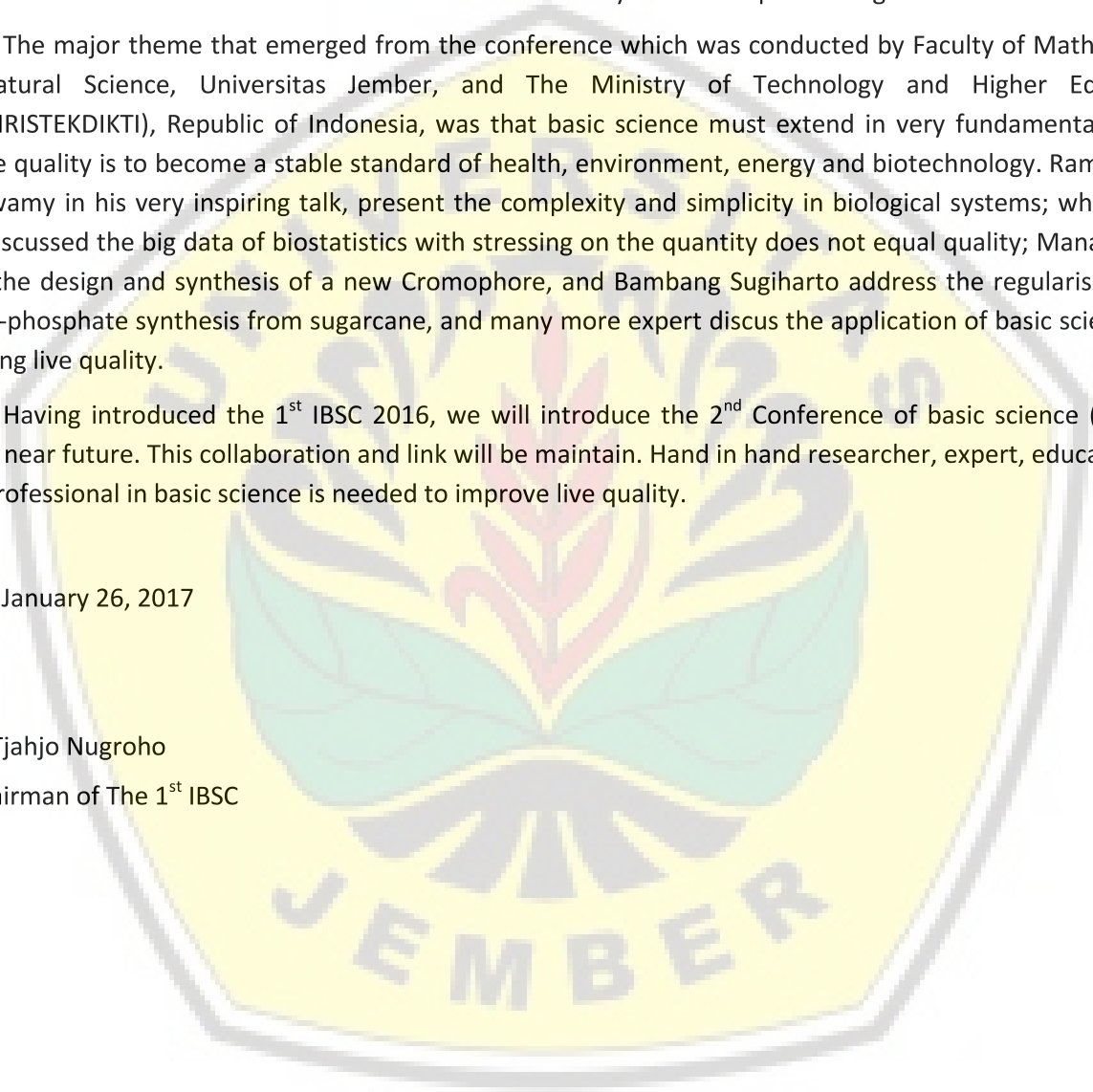
The major theme that emerged from the conference which was conducted by Faculty of Mathematics and Natural Science, Universitas Jember, and The Ministry of Technology and Higher Education (KEMENRISTEKDIKTI), Republic of Indonesia, was that basic science must extend in very fundamental way if high live quality is to become a stable standard of health, environment, energy and biotechnology. Ramkrishna Ramaswamy in his very inspiring talk, present the complexity and simplicity in biological systems; while Agus Salim discussed the big data of biostatistics with stressing on the quantity does not equal quality; Manabu Abe report the design and synthesis of a new Cromophore, and Bambang Sugiharto address the regularisation of sucrose-phosphate synthesis from sugarcane, and many more expert discus the application of basic science for improving live quality.

Having introduced the 1st IBSC 2016, we will introduce the 2nd Conference of basic science (The 2nd IBSC) in near future. This collaboration and link will be maintain. Hand in hand researcher, expert, educator and other professional in basic science is needed to improve live quality.

Jember January 26, 2017

Agung Tjahjo Nugroho

The Chairman of The 1st IBSC



Digital Repository Universitas Jember

Drs. Sujito, Ph.D

Drs. Yuda Cahyoargo Hariadi, M.Sc., Ph.D

Dr. Rike Oktarianti, M.Si.

Purwatiningsih, S.Si, M.Si, Ph.D

Ika Oktavianawati, S.Si, M.Sc

Dwi Indarti, S.Si., M.Si

Yeni Maulidah Muflihah, S.Si, M.Si

Dr. Mohamat Fatekurohman, S.Si., M.Si

Erlia Narulita, S.Pd., M.Si., Ph.D



COMMUNITY STRATEGY FOR MANAGING TROPICAL FOREST RESOURCES IN THE AREA OF CAGAR ALAM PULAU SEMPU (NATURE RESERVE OF SEMPU ISLAND) 2

BIOREDUCTION ADSORBENT (BIOSORBENT): RECOVERY TECHNOLOGY OF HEAVY METAL POLLUTION (CADMIUM/ CD) IN POLLUTED LAPINDO WATER SOURCES USING BACTERIA AND DURIAN LEATHER 7

COMPARATIVE STUDY OF THE MANAGEMENT OF VANAME SHRIMP (*LITOPENAEUS VANNAMEI*) BASED ON DEMOGRAPHIC FACTORS AT MOLANG BEACH TULUNGAGUNG 10

ANALYSIS OF THE INFLUENCE OF PUBLIC PARTICIPATION IN THE MANAGEMENT OF RESOURCES SUSTAINABLE WATER MALANG DISTRICT 13

CONSERVATION *COCCINELLA* SP. AS PREDATOR OF GREEN PEACH APHID *MYZUS PERSICAE* SULZER ON POTATO INTERCROPPING 16

THE EFFECT OF MYCORRHIZAL INOCULANT AND COMPOST OF VOLCANIC ASH ON GROWTH AND YIELD OF CHILLI (*CAPSICUM ANNUM* L.) 19

THE POTENTIAL OF ARTHROPODE DIVERSITY FOR ECOTOURISM DEVELOPMENT IN WONOREJO MANGROVE ECOSYSTEM, SURABAYA 23

THE EFFECTS OF WATER FRACTION OF BITTER MELON (*MOMORDICA CHARANTIA*) LEAF EXTRACT IN MAMMARY GLAND DEVELOPMENT OF BALB/C MICE (*MUS MUSCULUS*) WITH HISTOLOGICAL AND MOLECULAR BIOLOGICAL ANALYSIS OF PROTEIN APPROACHES 27

COMPETITIVENESS AND POTENTIAL OF SHEEP LIVESTOCK AS SOURCE INCREASING INCOME AND PROVIDER OF MEAT ANIMAL IN NORTH SUMATRA 30

MORPHOLOGICAL AND PHYSIOLOGICAL CHARACTERS OF CASSAVA (*MANIHOT ESCULENTA CRANTZ*) WHICH WET TOLERANT 32

THE EFFECT OF SOY TEMPEH FLOUR EXTRACT ON VAGINA HISTOLOGICAL STRUCTURE OF SWISS WEBSTER OVARIECTOMIZED MICE (*MUS MUSCULUS*) 36

THE TOXICITY OF SEEDS EXTRACT OF *ANNONA SQUAMOSA* L., LEAVES EXTRACT OF *TERMINALIA CATAPPA* L. AND LEAVES EXTRACT OF *ACACIA NILOTICA* L. ON THE MORTALITY OF *Aedes aegypti* L. LARVAE 39

ELEPHANTOPUS SCABER AND SAUROPUS ANDROGYNUS REGULATE MACROPHAGES AND B LYMPHOCYTE CELLS DURING SALMONELLA TYPHI INFECTION 42

THE EFFORT TO INCREASE PRODUCTION OF SUPER RED DRAGON FRUIT (*HYLOCEREUS COSTARICENSIS*) BY ARTIFICIAL POLLINATION 45

EVALUATION OF ZONATION OF THE MANGROVE CONSERVATION AREAS IN PAMURBAYA 47

INPUT OF NUTRIENT (NITROGEN AND PHOSPHORUS) FROM THE CATCHMENT AREA INTO RAWAPENING LAKE OF CENTRAL JAVA 50

RELATIONSHIP BETWEEN WATER QUALITY AND ABUNDANCE OF CYANOPHYTA IN PENJALIN RESERVOIR 52

HEMATOLOGICAL CHARACTERISTIC OF THE FEMALE ASIAN VINE SNAKE (*AHAETULLA PRASINA* BOIE, 1827) 57

HIGHLY SPESIFIC *BACILLUS CEREUS*-PHAGES ISOLATED FROM HOSPITAL WASTEWATER IN BANYUMAS REGENCY 60

BIOSYNTHESIS SILVER NANOPARTICLE USING FRESH WATER ALGAE 65

EFFECT OF SAPONIN-PODS EXTRACT ACACIA (*ACACIA MANGIUM*) TO HEMATOCRIT, HEMOGLOBIN AT TILAPIA (*OREOCHROMIS NILOTICUS*) 67

EFFECT OF DISSOLVED NUTRIENT CONCENTRATION (NITRATE AND ORTHOPHOSPHATE) ON ABUNDANCE OF CHLOROPHYTA IN PENJALIN RESERVOIR BREBES REGENCY 70

THE ANATOMY OF CAROTENE BIOSYNTHESIS IN *BETA VULGARIS* L., VAR. *RUBRA* USING SCAN ELECTRON MICROSCOPE 74

OPTIMIZATION OF YOGURT FERMENTED MILK PRODUCTS WITH THE ADDITION OF NATURAL STABILIZER BASED ON LOCAL POTENTIAL OF TARO STARCH (*COLOCASIA ESCULENTA*) 77

PTERIDOPHYTES OF ALAS PURWO NATIONAL PARK AND THEIR MEDICINAL POTENCY 80

GENETIC VARIATION OF *Aedes aegypti* (DIPTERA : CULICIDAE) BASED ON DNA POLYMORPHISM 83

THE EFFECT OF SOY TEMPEH FLOUR EXTRACT TO UTERINE HISTOLOGY OF OVARIECTOMIZED MICE 85

MATING BEHAVIOUR OF *CROCIDOLOMIA PAVONANA* F. 88

THE DEVELOPMENT OF SUSTAINABLE RESERVE FOOD GARDEN PROGRAM'S VIDEO IN MALANG CITY 92

EFFECT OF MEDIUM COMPOSITIONS ON THE GROWTH OF RICE (*ORYZA SATIVA* L. CV. CIHERANG) CALLUS 97

BLOOD FIGURE OF RAMBON CATTLE FED FORMULATED CONCENTRATE CONTAINING SOYBEAN CAKE, POLLARD AND CORN OIL COMBINE WITH UREA XYLANASE MOLASSES CANDY 101

STRATEGIES FOR DEVELOPMENT OF BEEF CATTLE FARMING BASED ON INNOVATION TECHNOLOGY AND FEEDING PROGRAM TO MEET SELF SUFFICIENCY IN MEAT 103

COLLAGEN FROM SEA CUCUMBER (STICHOPUS VARIEGATUS) AS AN ALTERNATIVE SOURCE OF HALAL COLLAGEN	111
DEVELOPMENT OF NEW PRODUCT "COCOA SPIRULINA AS FUNCTIONAL FOOD"	114
THE PROTEIN AND WATER CONTENT OF TEN VARIATIONS OF THE FEED - CASSAPO OF YEAST TAPE	120

MEDICAL, DENDTISTRY, AND PUBLIC HEALTH..... 123

EFFECT OF POMELO (CITRUS GRANDIS) ETHANOLIC EXTRACT ON ATHEROSCLEROTIC PLAQUE FORMATION.....	124
CLINICAL MANIFESTATION OF ORAL TUBERCULOSIS.....	127
IDENTIFICATION OF DERMATOPHYTES BY MULTIPLEX-POLYMERASE CHAIN REACTION, POLYMERASE CHAIN REACTION-RESTRICTION FRAGMENT LENGTH POLYMORPHISM ITS1-ITS4 PRIMERS AND MVAI, AND POLYMERASE CHAIN REACTION (GACA) ₄ PRIMER.....	132
IMPACT PSYCHOLOGICAL AND PSYCHO-PHYSICAL WORK DISTRESS ON TOOTH MOBILITY IN RAT MODEL	136
ROLE OF REACTIVE OXYGEN SPECIES ON DEVELOPMENTS OF OSTEOCLASTOGENESIS IN AGING	140
DETERMINANT FACTOR THAT INFLUENCED ANXIETY LEVEL AND ENERGY INTAKE AMONG ELDERLY.....	144
P-CARE BPJS ACCEPTANCE MODEL IN PRIMARY HEALTH CENTERS	147
THE EFFORT OF TB CADRE IN THE IMPROVING OF THE SUCCESS OF TB THERAPY AND REDUCING SIDE EFFECTS OF ANTI TUBERCULOSIS DRUGS	151
RISK FACTOR OF GREEN TOBACCO SICKNESS (GTS) AT THE CHILDREN ON TOBACCO PLANTATION	153

PHYSICS 157

DIRECT SCATTERING PROBLEM FOR MICROWAVE TOMOGRAPHY	158
MICROSTRUCTURE AND MECHANICAL PROPERTIES OF DISSIMILAR JOINT OF COLD ROLLED STEEL SHEETS 1.8 SPCC-SD AND NUT WELD M6 BY SPOT WELDING.....	162
FEATURE EXTRACTION OF HEART SIGNALS USING FAST FOURIER TRANSFORM.....	165
ANALYSIS OF EL NIÑO EVENT IN 2015 AND THE IMPACT TO THE INCREASE OF HOTSPOTS IN SUMATERA AND KALIMANTAN REGION OF INDONESIA.....	168
(B) 170	
SYNTHESIS OF ZINC OXIDE (ZNO) NANOPARTICLE BY MECHANO-CHEMICAL METHOD	174
MODELLING DYNAMICS OF ZNO PARTICLES IN THE SPRAY PYROLYSIS REACTOR TUBE	177
THE INFLUENCE OF EXTREMELY LOW FREQUENCY (ELF) MAGNETIC FIELD EXPOSURE ON THE PROCESS OF MAKING CREAM CHEESE.....	181
AU GRADE OF EPITHERMAL GOLD ORE AT PANINGKABAN ASGM, BANYUMAS DISTRICT, CENTRAL JAVA PROVINCE, INDONESIA.....	184
RENEWABLE ENERGY CONVERSION WITH HYBRID SOLAR CELL AND FUEL CELL	188
RADAR ABSORBING MATERIALS DOUBLE LAYER FROM LATERITE IRON ROCKS AND ACTIVATED CARBON OF CASSAVA PEEL IN X-BAND FREQUENCY RANGE	192
INSTANTANEOUS ANALYSIS ATTRIBUTE FOR RESERVOIR CHARACTERIZATION AT BASIN NOVA-SCOTIA, CANADA	195
DEPLOYMENT POROSITY ESTIMATION OF SANDSTONE RESERVOIR IN THE FIELD OF HIDROCARBON EXPLORATION PENOBSCOT CANADA.....	197
SEISMIC RESOLUTION ENHACEMENT WITH SPECTRAL DECOMPOSITION ATTRIBUTE AT EXPLORATION FIELD IN CANADA ...	199
SIMULATION OF I-V CHARACTERISTICS OF SI DIODE AT DIFFERENCE OPERATING TEMPERATURE:EFFECT OF IONIZED IMPURITY SCATTERING.....	204
SIMULATION OF SELF DIFFUSION OF IRON (FE) AND CHROMIUM (CR) IN LIQUID LEAD BY MOLECULAR DYNAMIC	207
THE STUDY OF ELECTRICAL CONDUCTANCE SPECTROSCOPY OF THE INNER MEMBRANE OF SALAK.....	209
THE ACCURACY COMPARISON OF OSCILLOSCOPE AND VOLTMETER UTILIZATED IN GETTING DIELECTRIC CONSTANT VALUES.....	211
WINDOW FILTER (WINTER) TO CAPTURE POLLUTION OF LEAD (PB) FOR HOUSES NEAR THE HIGHWAY TO PREVENT HEALTH PROBLEMS	214
SIMULATION OF SOLAR CELL DIODE I-V CHARACTERISTICS USING FINITE ELEMENT METHODE: INFLUENCE OF P-LAYER THICKNESS.....	216

GEOLOGY 218

GIS-BASED OPTIMIZATION METHOD FOR UTILIZING COAL REMAINING RESOURCES AND POST-MINING LAND USE PLANNING: A CASE STUDY OF PT ADARO COAL MINE IN SOUTH KALIMANTAN	219
QUANTIFICATION MODEL OF QUALITATIVE GEOLOGICAL DATA VARIABLES FOR EXPLORATION RISK ASSESSMENT IN PROSPECT CU-AU PORPHYRY DEPOSIT RANDU KUNING, WONOGIRI, CENTRAL JAVA.....	226
A SENSOR-BASED OF DETECTION TOOLS TO MITIGATE PEOPLE LIVE IN AREAS PRONE TO LANDSLIDE	232
RELOCATION OF HYPOCENTER USING JACOBIAN'S MATRIX AND JEFFREYS-BULLEN'S VELOCITY MODEL	237

CHEMISTRY..... 239

SYNTHESIS AND CHARACTERIZATION MAGNETIC FE-O ₂ NANOPARTICLE BY USING OLEIC ACID AS STABILIZING AGENT	240
---	-----

HYDROPHOBIC AEROGEL-BASED FILM COATING ON GLASS BY USING MICROWAVE	256
PREPARATION AND CHARACTERIZATION OF CACAO WASTE AS CACAO VINEGAR AND CHARCOAL	259
THE EFFECT OF PHYSICO-CHEMICAL PROPERTIES OF AQUATIC SEDIMENT TO THE DISTRIBUTION OF GEOCHEMICAL FRACTIONS OF HEAVY METALS IN THE SEDIMENT	262
INCREASED CONCENTRATION OF BIOETHANOL BY RECTIFICATION DISTILLATION SIEVE TRAY TYPE	266
DETERMINATION OF LEAD IN COSMETIC SAMPELS USING COATED WIRE LEAD (II) ION SELECTIVE ELECTRODE BASED ON PHYROPILLITE.....	270
PYROLYSIS TEMPERATURE EFFECT ON VOLUME AND CHEMICAL COMPOSITION OF LIQUID VOLATILE MATTER OF DURIAN SHELL	273
HIGH PERFORMANCE LIQUID CHROMATOGRAPHY OF AMINO ACIDS USING POTENTIOMETRIC DETECTOR WITH A TUNGSTEN OXIDE ELECTRODE	276
RAINWATER TREATMENT USING TREATED NATURAL ZEOLITE AND ACTIVATED CARBON FILTER.....	279
FILTRATION OF PROTEIN IN TEMPE WASTEWATER USING CELLULOSE ACETATE MEMBRANE.....	282

MATHEMATICS..... 285

IMAGE ENCRYPTION TECHNIQUE BASED ON PIXEL EXCHANGE AND XOR OPERATION	286
FUZZY ANP METHOD AND INTERNAL BUSINESS PERSPECTIVE FOR PERFORMANCE MEASUREMENT IN DETERMINING STRATEGY SMES	289
APPLICATION OF FUZZY TOPSIS METHOD IN SCHOLARSHIP INTERVIEW	295
THE EFFECT OF INFLATION, INTEREST RATE, AND INDONESIA COMPOSITE INDEX (ICI) TO THE PERFORMANCES OF MUTUAL FUND RETURN AND UNIT LINK WITH PANEL DATA REGRESSION MODELLING	299
USING LOGISTIC REGRESSION TO ESTIMATE THE INFLUENCE OF ADOLESCENT SEXUAL BEHAVIOR FACTORS ON STUDENTS OF SENIOR HIGH SCHOOL 1 SANGATTA, EAST KUTAI-EAST KALIMANTAN	303
APPLICATION CLUSTER ANALYSIS ON TIME SERIES MODELLING WITH SPATIAL CORRELATIONS FOR RAINFALL DATA IN JEMBER REGENCY	307
A ZERO CROSSING-VIRUS EVOLUTIONARY GENETIC ALGORITHM (VEGA) TO SOLVE NONLINEAR EQUATIONS.....	311
ANALYSIS OF SIMULTANEOUS EQUATION MODEL (SEM) ON NON NORMALLY RESPONSE USED THE METHOD OF REDUCE RANK VECTOR GENERALIZED LINEAR MODELS (RR-VGLM).....	316
THE RAINBOW (1,2)-CONNECTION NUMBER OF EXPONENTIAL GRAPH AND IT'S LOWER BOUND	319
CONSTRUCTION OF SUPER H-ANTIMAGICNESS OF GRAPH BY USES A PARTITION TECHNIQUE WITH CANCELATION NUMBER ON THE TOTAL R-DYNAMIC COLORING OF EDGE COMB PRODUCT GRAPH G D H.....	325
ON THE METRIC DIMENSION WITH NON-ISOLATED RESOLVING NUMBER OF SOME EXPONENTIAL GRAPH.....	328
ON TOTAL R-DYNAMIC COLORING OF SEVERAL CLASSES OF GRAPHS AND THEIR RELATED OPERATIONS	331
ON THE RAINBOW VERTEX CONNECTION NUMBER OF EDGE COMB OF SOME GRAPH.....	340
HANDLING OUTLIER IN THE TWO WAYS TABLE BY USING ROBUST AMMI AND ROBUST FACTOR.....	347
AN EPIDEMIC MODEL OF <i>VARICELLA</i> WITH VACCINATION	351

BASIC SCIENCE..... 356

THE CORRELATION BETWEEN PERCEPTION AND BEHAVIOR OF RIVER POLLUTION BY COMMUNITIES AROUND BRANTAS RIVERBANK IN MALANG.....	357
ISOLATION AND SCREENING OF SPECIFIC METHICILLIN RESISTANT- <i>STAPHYLOCOCCUS AUREUS</i> BACTERIOPHAGE FROM HOSIPTAL WASTE AT BANYUMAS.....	360
CO (III) AS MEDIATOR IN PHENOL DESTRUCTION USING ELECTROCHEMICAL OXIDATION	365
DESIGN OF SYSTEM BATCH INJECTION ANALYSIS (BIA) FOR MONITORING THE PRODUCTION OF ALCOHOL (II)	370
PRELIMINARY STUDY GOLD MINERALIZATION HOSTED BY METAMORPHIC ROCKS IN THE SOUTHEASTERN ARM OF SULAWESI, INDONESIA.....	375
EFFECTS OF PACKAGING TYPES ON MOISTURE CONTENT, MICROBE TOTAL AND PEROXIDE VALUE OF INSTANT GANYONG (<i>CANNA EDULIS</i> KERR) YELLOW RICE	379

AUTHOR INDEX..... 384

A Zero Crossing-Virus Evolutionary Genetic Algorithm (VEGA) to Solve Nonlinear Equations

M. Ziaul Arif, Zainul Anwar, Ahmad Kamsyakawuni

Mathematics Department, Mathematic and Natural Science Faculty, University of Jember, Jember, Indonesia

e-mail: ziaul.fmipa@unej.ac.id

Abstract—Nonlinear equation is a mathematical problem that is quite difficult to solve. Its analytic solution is not easily discovered. There are several methods used to solve nonlinear equations and the obtained results is in the form of approximation to the analytical solution. Most of the numerical method need appropriate initial value to perform the accuracy of the method. However, it will diverge if the initial value is inappropriate. Therefore, we propose discovering the solutions of nonlinear equations by applying metaheuristic methods. In this paper, we present the virus Evolutionary Genetic Algorithm (VEGA) combined with Zero Crossing Method at an early stage to solve nonlinear equations. This study was conducted to test the performance and accuracy of the combined both of the method by providing some examples.

Keyword : Nonlinear equation, VEGA, Zero crossing

INTRODUCTION

A nonlinear equation is one of the problem in mathematics. Searching solution of nonlinear equation is determining the value of x that fulfills the equation of $f(x) = 0$, which is the value of $x = s$, so $f(x) = 0$.

Analytic solution of the nonlinear equation is the best solution of the problem. However, the analytic solution of the nonlinear equation is not easy to be found, but in some cases. So, numeric method becomes the main choice to finish it. Some methods that are generally used to look for the solution of the equation, namely Bisection Method, Newton-Raphson, Regula Falsi, and Secant. Newton-Raphson Method is the most used method to solve the equation because, the count is faster than the others. In the other hand, Newton-Raphson Method can't be used when the first approach point is on the extreme point or top point because, in this point, the value of $f(x)=0$ so, the value of denominator $\frac{f(x)}{f'(x)}$ equals to zero.

Beside of numeric method [1-9], nowadays, the solution of nonlinear equation by using metaheuristic method is developed as well. Function optimization becomes the basic development of that method. Some examples of metaheuristic method are Cat Swarm Optimization (CSO) and Genetic Algorithm [10]. Furthermore, there is also Virus Evolutionary Genetic Algorithm (VEGA) which is one of the examples of metaheuristic optimization [10-11]. VEGA is produced by incorporation of genetic algorithm and virus infection. The advantage of using VEGA is being able to get a global optima result¹. Whereas, genetic algorithm is stuck on local optima search. Yusuf and Soesanto state that if one population is too small so that, a certain chromosome with some gens that set in the solution will be spread to the other chromosomes. In other words, the first population that is resurrected on the beginning interval may not set in the solution.

One of the methods that be able to cover the disadvantages is zero crossing method. Zero crossing method ensures that in that interval there is a solution by using the change of sign that is located in the end of the closed interval [12].

A problem that will be solved in this research is the application of Zero crossing method and Virus Evolutionary Genetic Algorithm (VEGA) on the solution of nonlinear equation and compare it with some methods that had been observed in the same problem. The purpose of the thing is to know how accurate Zero Crossing-VEGA in solving the equation. The application of Zero Crossing-VEGA is expected to have a better accuracy level in solving the equation. So that, it can give an insight about the application of metaheuristic method in numeric problem from optimization problem perspective.

BACKGROUND

a. Nonlinear Equations

Nonlinear equation is all equations which are not linear equation with changer that has the smallest degree that is equal to one or transcendent and if it is imagined, it may not be straight line. Roots of nonlinear equation can be got analytically and numerically.

In some simple cases, analytic method becomes the main choice, for example, in quadratic polynomial, this formula is used $\frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$. But, the formula cannot be used to look for high degree polynomial solution or transcendent function, so that, numeric method is chosen to search the solution of nonlinear equation.

Numeric solution is done by guessing in sequence, so that, every result is getting more accurate. By doing some procedures, enough iteration, finally, the researcher got estimating result that approach the exact result (the real result) with a false tolerance allowed [1].

b. Zero Crossing

Zero crossing is a condition of one function that has zero value or has a movement from positive to negative value. This method is often used for a requirement of closed method because zero crossing method will evaluate the positive or negative sign from the value of $f(x)$ in the end of interval ($sign(f(a)) \neq sign(f(b))$). If the value of $f(x)$ in the end of interval have a different sign, so that, the interval indicates that there is the value of $f(x)$ continuous on the interval [12].

c. Virus Evolutionary Genetic Algorithm (VEGA)

Virus Evolutionary Genetic Algorithm (VEGA) is an incorporation between genetic algorithm and virus infection [4]. VEGA is arranged from two populations namely host population and virus population. Host population is equal to the population in the genetic algorithm namely solution candidate. Whereas, virus population is a substring from host population that will infect host population.

According to Fukuda, some elements located in VEGA:

1. Inter infection time: one iteration interval time from virus infection;
2. $host_j$: host individual for - j before experiencing reverse transcription;
3. $host'_j$: host individual for - j after experiencing reverse transcription;
4. fit_{host_j} : the value of host individual fitness before experiencing reverse transcription;
5. $fit_{host'_j}$: the value of host individual fitness after experiencing reverse transcription;
6. $fit_{virus_{i,j}}$: difference between $fit_{host'_j}$ and fit_{host_j}

$$fit_{virus_{i,j}} = fit_{host'_j} - fit_{host_j} \quad (1)$$

7. fitvirusi: virus infection strength

$$fitvirus_i = \sum_{j \in S} fitvirus_{j,i} \quad (2)$$
 8. S: set of host individuals that are infected by virus for I;
 9. Lifei: Virus life strength

$$Life_i = r \times Lif_{i,t-1} + fitvirus_i \quad (3)$$
 10. r: virus life power reduction level. (the value [0,1]);
 11. t: virus generation
- d. Zero Crossing-VEGA

The procedure of this method:

1. Parameter initialization
 Determining the values of parameter that were needed in the form of host pop size, virus pop size, inter infection time, Pc, Pm, and Pv, function and interval as well.
2. First population generation
 Generating the first population randomly on the interval which was the result of zero crossing as much as host pop size which was a solution candidate. Generating the virus population as many as virus pop size as well.
3. Binary coding
 Converting each host population and virus in the binary form with requirement that the length of virus population bit was shorter than the length of host population bit.
4. Fitness value evaluation $f(x)$
 Evaluating the value of host population fitness by substituting every host to the absolute function value or nonlinear equation. The best solution was determined from the most minimum fitness value.
5. Selection
 Doing tournament selection by grouping some hosts into one tournament. Each tournament would produce a winner from host which had the smallest fitness value. The result of selection was in the form of prospective parent crossover host.
6. Crossover
 The crossover process was done to get the varies host. Whereas, the determination of gens position crossover was done randomly so that, the output offspring could have a good quality, worse, or similar to the parent. The result of prospective parents' selection was chosen randomly based on random numbers that were resurrected. If the random numbers were located in the bottom of PC so that, the prospective parent would be chosen being process parents crossover host. Crossover method used was flat crossover. The result of crossover was determined based on equation of (2.4).

$$x^1_i = r_i x_i + (1-r_i) x_{2,i} \quad i=1..n \quad (4) [3]$$
7. Mutation
 This process was done to replace some lost hosts during selection process so that it could be examined on the new condition. The count of mutation parent was determined from the result of multiplication between Pm and host pop size and than taken randomly.
8. Interinfection time
 Updating the host population and the fitness value. The number of population had to be equal to host pop size, so that, there were random choices as many as host pop size. Than, checking the condition of interinfection time, if it had been fulfilled so that, continue the virus infection process. If it was not fulfilled yet, repeat the steps (e to g)
9. Virus infection
 Virus infection process was done by changing the infected substring host with virus

bit. The infected host number determination was determined from the result of multiplication between Pv and host pop size. Than, choosing randomly as many as the infected host number. Furthermore, the virus infection process was done to get a new virus for the next iteration, the process name is transduction.

The steps of zero crossing-VEGA can be illustrated in a flowchart below:

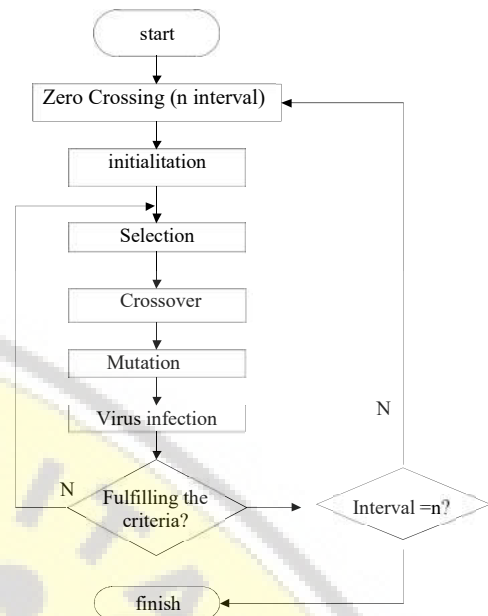


Fig 1. Flowchart Zero Crossing-VEGA

DISCUSION

On this research, there were 11 single root nonlinear equation and 5 double root nonlinear equations that were got from some references referenced. To solve nonlinear equation by using zero crossing-VEGA, the researcher used host pop size parameter = 20, interinfection time = 3, virus pop size = 9, Pc = 0,8, Pm = 0,1, Pv = 0,4 interval = [-10,10] and iteration = 200.

Example 1:

$$\sin^2 x - x^2 + 1 = 0$$

The solution of single root PNL (example 1) is $x = \pm 1,40449164821534$. table 1 shows that the result of solution comparison that is got in this research with the solution that is got in the referent journal. Table 1. the comparison of example 1 solution.

Table 1. Comparison of solution ex.1

Method	Solution
Newton Method	1,4044916482153412260350868178
Zero Crossing-VEGA	1,404491648216208 -1,404491648215341

Zero crossing-VEGA gets 2 solutions with the value of fitness is $|f(x)| = 2,1516e - 012$ in the first solution and $|f(x)| = 3,3307e - 016$ for the second solution. The result is better than newton Method that is got 1 solution only. Figure 2 shows that convergent curve fitness value example 1.

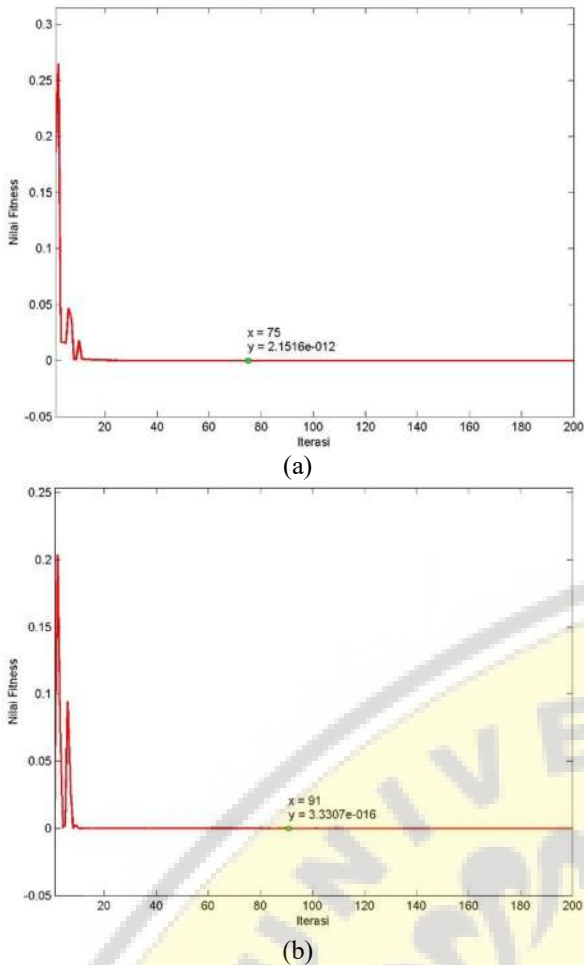


Fig 2. (a) & (b) Convergent curve of fitness value (ex. 1)

Example 2 :

$$\cos x - x = 0$$

Solution of single root PNL (example 2) is $x = 0,73908513321516064165531208767$. Table 2 shows that the result of solution comparison that is got in this research with solution that is got in the referent journal.

Table 2. Comparison of solution ex.2

Method	Solution
Noor Method	0,73908513321516064165537208767
Zero Crossing-VEGA	0,739085133215161

Solution that is got by using zero crossing-VEGA is equal to the solution that is got Noor Method. The fitness value that is got is good $|f(x)| = 0$. Figure 3 shows that convergent curve of fitness value example 2.

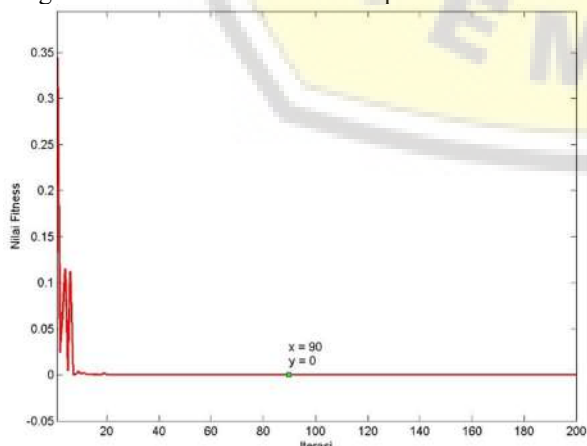


Fig 3. Convergent curve of fitness value (ex. 2)

Example 3 :

$$x^3 - 10 = 0$$

Solution of single root PNL example 3 is $x = 2,1544346900318837217592935665$. Table 3 shows that the result of solution comparison that is got in this research with solution that is got in the referent journal.

Table 3. Comparison of solution ex.3

Method	Solution
Chun Method	2,1544346900318837217592935665
Zero Crossing-VEGA	2,154434690031884

Solution that is got by using zero crossing-VEGA is equal to the solution that is got Chun Method. The fitness value that is got is good enough namely $|f(x)| = 1,7764e - 015$. Figure 4 shows that convergent curve of fitness value example 3.

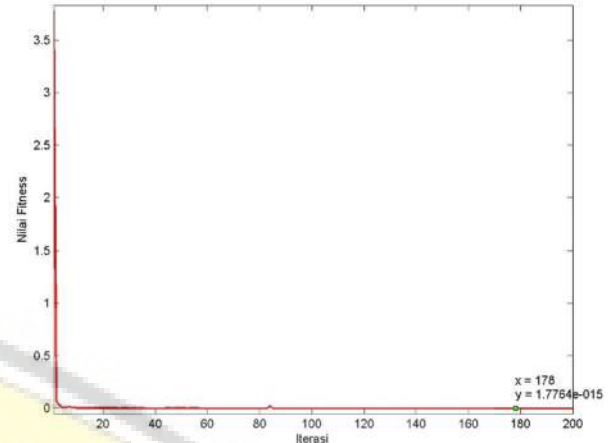


Fig 4. Convergent curve of fitness value (ex. 3)

Example 4 :

$$e^x - 3x^2 = 0$$

Table 4 shows that the result of solution comparison that is got in this research with solution that is got from referent journal.

Table 4. Comparison of solution ex. 4

Method	Solution
Golbabai Javidi Method	-0,45899296202335 0,91001094056187 -0,458962267536945
Zero Crossing-VEGA	0,910007573664188 3,733079028632809

Zero crossing-VEGA gets 3 solutions with the value of fitness is $|f(x)| = 1,8677e - 015$ for the first solution, $|f(x)| = 1,839e - 011$ for the second solution and $|f(x)| = 7,1054e - 015$ for the third solution. The result is better than Golbabai Javidi Method that get 2 solutions only. Figure 5 shows that convergent curve of fitness value from the third solution.

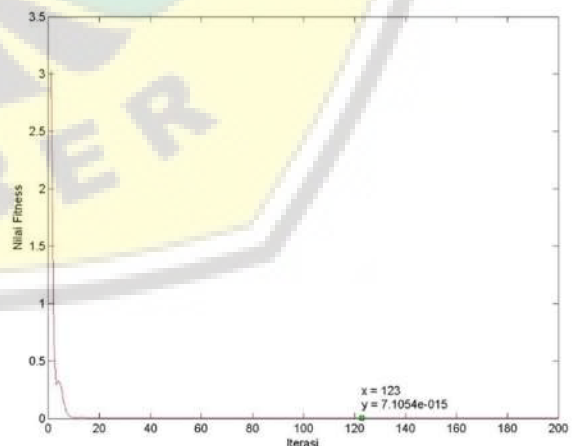


Fig 5. Convergent curve of fitness value (ex. 4)

Example 5 :

$$(\ln(x^2 + 3x + 5) - 2x + 7)^8 = 0$$

In the double root nonlinear equation, input in the form of function will be transformed by using the equation.

$$F(x) = \frac{f^2(x)}{f(x) - f(x-f(x))} \quad [25] \quad (5)$$

Then, the result of transformation will be processed in the zero crossing level to get interval that is contained solution. Whereas, VEGA level use the input in the form of $f(x)$. Table 5 shows that the result of solution

comparison that is got in this research with solution that is got from referent journal.

Table 5. Comparison of solution ex.5

Method	Solution
Newton Method	1,4044916482153412260350868178
Zero Crossing-VEGA	1,404491648223484 -1,404491648216208

The result that is got is only the value of nonlinear equation root without multiplicity or the count of solutions from the equation, but the value of fitness that is got is better namely $|f(x)| = 3,2883e - 071$. Figure 6 shows that convergent curve of double root fitness PNL value of example 5.

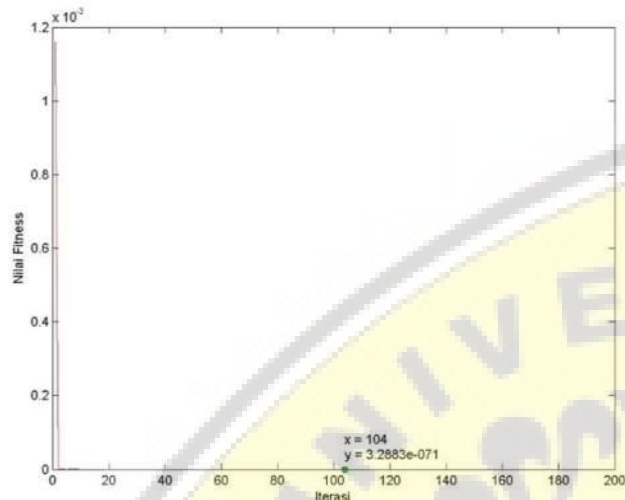


Fig 6. Convergent curve of fitness value (ex. 5)

$$(e^{-x^2+x+3} - x + 2)^9 = 0$$

Similar to example 5, the result that is got in the example 6 only in the form of value from equation root without multiplicity. However, the result is equal to the result that is got from the referent journal. Table 6 and figure 7 shows that the result of solution comparison that are got in this research with solution that is got from the referent journal and the convergent curve of double root PNL fitness example 6.

Table 6. Comparison of solution ex.6

Method	Solution
Newton Method	1,4044916482153412260350868178
Zero Crossing-VEGA	1,404491648223484 -1,404491648216208

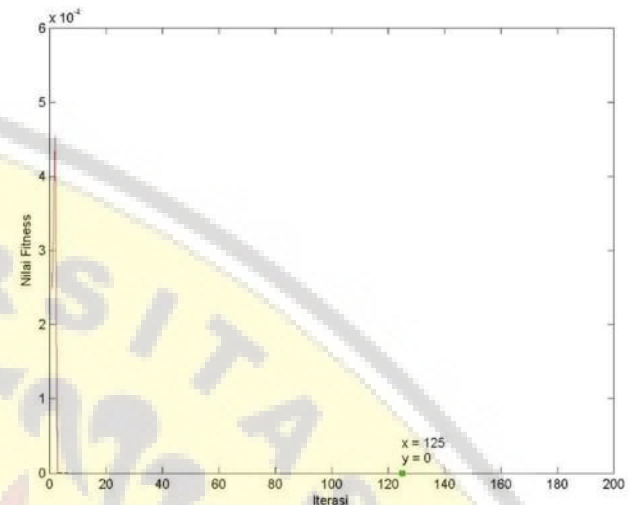


Fig 7. Convergent curve of fitness value (ex. 6)

Example 6 :

No.	PNL	Numerical methods		Zero Crossing VEGA	
		Initial Value	Numerical solution	VEGA Solution	fitness value
1	$\sin^2 x - x^2 + 1 = 0$ [6]	$x_0 = 1$	1,4044916482153412260350868178	1,404491648223484 -1,404491648216208	2,0214e - 011 2,1516e - 012
2	$x^2 - e^x - 3x + 2 = 0$ [7]	$x_0 = 2$	0,25753028543986076045536730494	0,257530285496045	2,12303e - 010
3	$\cos x - x = 0$ [8]	$x_0 = 1,7$	0,73908513321516064165537208767	0,739085133215161	4,409e - 016
4	$(x - 1)^3 - 1$ [8]	$x_0 = 3,5$	2	2	Zero Crossing
5	$x^3 - 10 = 0$ [7]	$x_0 = 1,5$	2,1544346900318837217592935665	2,154434690031884	1,7764e - 015
6	$xe^{x^2} - \sin^2 x + 3 \cos x + 5 = 0$ [6]	$x_0 = -2$	-1,2076478271309189270094167584	-1,207647827131041	2,4722e - 012
7	$e^{x^2+7x-20} - 1 = 0$ [7]	$x_0 = 3,5$	3	3 dan -10	Zero Crossing
8	$x - 2 - e^{-x} = 0$ [9]	$x_0 = 2$	2,12002823898764	2,120028238990926	3,6792e - 012
9	$x^2 - (1 - x)^5 = 0$ [9]	$x_0 = 0,2$	0,34595481584824	0,345954815848245	4,5242e - 015
10	$e^x - 3x^2 = 0$ [9]	$x_0 = 0$	-0,45899296202335	-0,458962267536945	1,8677e - 015
		$x_0 = 0,5$	0,91001094056187	0,910007573664188 3,733079028632809	1,839e - 011 7,1054e - 015
11	$x^3 + 4x^2 - 10 = 0$ [7]	$x_0 = -0,3$	1,3652300134140968457608068290	1,365230013414090	1,066e - 013

(a)

No.	PNL	Numerical methods		Zero Crossing VEGA	
		Initial Value	Numerical solution	VEGA Solution	fitness value
1	$(x^2 + 4x^2 - 10)^2 = 0$ [10]	$x_0 = -0,3$	1,3652300134140968457608068290	1,365230013414097	4,4842e - 044
2	$\frac{(x-\sqrt{5})^4}{(x-2)^2+1} = 0$ [11]	$x_0 = 1,9$	2,236067977499790	2,236067980527878	3,326e - 035
3	$(\ln(x^2 + 3x + 5) - 2x + 7)^2 = 0$ [11]	$x_0 = 34; 5; 5,8$	5,4690123359101421	5,469012336805463	3,2883e - 071
4	$(e^{-x^2+x+3} - x + 2)^9 = 0$ [11]	$x_0 = 2,5; 18;$	2,4905398276083051	2,490539827608305	0
5	$(e^{-x} + 2 \sin x)^4 = 0$ [11]	$x_0 = 4; 2,5$	3,1627488709263654	3,162748870926407	5,2803e - 053

(b)

Fig 8. The comparison of the nonlinear equation result (a) single root (b) even roots from zero crossing-VEGA and numeric method that had been observed.

Based on table 7 (a) and (b), zero crossing-VEGA can be able to give the value of fitness that is near to zero and there is also a value that is similar to exact solution. This thing indicates that roots of nonlinear equation both single root and double root have been found nicely. Furthermore, proposed methods in this research is more effective than Newton-Raphson method that need the first correct value because, the first value error can cause no convergent result. Another advantage is nonlinear equation derivative is not needed so that, it is able to search from liner equation that is the derivative is hard to be found. Besides, the proposed method has a disadvantage like the time process is longer than Newton-Raphson because it depends on some random numbers in the process.

The researcher not only applies zero crossing-VEGA, but also observes the influence of some parameters on the got solution and running time. Some parameters value gives an effect on the count time of using the program, however, there is also influence that gives effect on the solution whether there is a value change. The length of the count process(time) has each parameter so that, the count process will need a long time. Whereas in the P_c parameter value, the kind of thing is not available, the count time cannot be determined from the big or small parameter value. But, P_c parameter value gives the best solution for this research problem in the value of 0,8. Inter infection time parameter value, pop size virus, P_m , and P_v in sequence give the best solution with the value of 3, 9, 0,1, 0,4.

CONCLUSION

Based on the explanation above, it can be concluded that the zero crossing-VEGA can solve nonlinear equation with a good accuracy although it needs a time to find nonlinear equation solution. The parameter value that is very optimal for this research problem are interinfection time = 3, pop size = 20, pop size virus = 9, $P_c = 0,8$, $P_m = 0,1$ and $P_v = 0,4$.

REFERENCES

- [1] B. Triatmodjo, "Metode Numerik", Yogyakarta: Peta Offset, 1996.
- [2] T. Fukuda, K. Shimojima and N. Kubota, "Virus Evolutionary Genetic Algorithm and Its Applications to Traveling Salesman Problem", Editor: Xin Yao, Singapura: World Scientific, 1999.
- [3] J. M. Mendes, "A Comparative Study of Crossover Operators for Genetic Algorithms to Solve the Job Shop Scheduling Problem", Portugal: School of Engineering – Polytechnic of Porto, 2013.
- [4] P. Wang, "A Third-Order Family of Newton Like-Iteration Methods for Solving Nonlinear Equations", Journal of Mathematics and Stochastics, vol. 3, issue 1, pp. 13-19, 2011.
- [5] C. Chun, "Iterative Methods Improving Newton's Method by Decomposition Method", Computer and Mathematics with Application, vol. 50, pp. 1559-1568, 2005.
- [6] M. A. Noor, "New Iterative Schemes for Nonlinear Equations", Applied Mathematics and Computation, vol. 187, pp. 937-943, 2007.
- [7] M. Javidi and A. Golbabai, "A Third-Order Newton Type Method for Nonlinear Equations Based on Modified Homotopy Perturbation Method", Applied Mathematics and Computation, vol. 191, pp. 199-205, 2007.
- [8] L. Shengguo, L. Xiangke and C. Lizhi, "A New-Fourth Order Iterative Method for Finding Multiple Roots of Nonlinear Equations", Applied Mathematics and Computation, vol. 215, pp. 1288-1292, 2009.
- [9] J. Liang, et al., "Fifth-Order Iterative Method for Solving Multiple Roots of the Highest Multiplicity of Nonlinear Equation", Algorithms, vol. 8, pp. 656-668, 2015.
- [10] A. Yusuf and O. Soesanto, "Algoritma Genetika Pada Penyelesaian Akar Persamaan Sebuah Fungsi", Jurnal Matematika Murni dan Terapan, vol. 6, issue 2, pp. 047-056, 2012.
- [11] N. A. Fountas and N. M. Vaxevandis, "A Modified Virus Evolutionary Genetic Algorithm for Rough Machining Optimization of Sculptured Surfaces", International Journal of Engineering Tome XI, vol. 3, pp. 283 – 288, 2013.
- [12] F. Zhang, M. Yeddanapudi and P. J. Mosterman, "Zero Crossing Location and Detection Algorithm for Hybrid Simulation", USA: The Mathworks, Inc, 2008.