



The Report of Research Activities of the COMSATS' International Thematic Research Group on Mathematical Modeling (May 2018- April 2019)

Prepared by B. O. OYELAMI, Chairman, ITRG.

A SUBMISSION TO THE 22ND COMSAT COORDINATING COUNCIL MEETING
16-17 APRIL 2019, HOSTED AT
TIANJIN INSTITUTE OF INDUSTRIAL BIOTECHNOLOGY (TIB), TIANJIN, CHINA.

The Report of Research Activities

Effect of pollution on human health

The ITRG considered Mathematical models and Numerical simulation for dynamics evolution of cancer and immune cells

It was found that the benign and malignant cancer cells displayed out of control growth and hence unstable in nature, the immune cells depreciate to the point of immune collapse.

By the use of Energy function, it was established that starving of cancer cells of oxygen, vital enzymes, nutrients, and the use of drugs are strategic ways of combating cancer disease.

Published in (Oyelami B O, Mathematical Models and Numerical Simulation for Dynamic Evolutions of Cancer and Immune cells. Applied Mathematics, 2018, 5, 9,561-585.,<http://www.scirp.org/journal/am>, DOI:10.4236/am.2018.96040).

Evolution toxic gasses from small and medium size electric generator sets and effect of pollution on the environment

Modeling of Carbon dioxide, carbon monoxide and nitric oxides emitted from small and medium size electric generator sets and effect of pollution on the environment are made.

It was found that large quantity of the gases are evolved to the environment.

The agricultural productive of the community will also be affected because of possible acid rain in that environment couple with allergic and respiratory diseases because of emission of the poisonous gases to the remote environment.

Published in (Oyelami B.O., Lugano W., and David L. 'Modeling CO, CO₂ and NO_x Evolution from Small and Medium Size Electric Gensets.' *American Journal of Modeling and Optimization* 6.1 (2018): 1-17.

DOI: 10.12691/ajmo-6-1-1; <http://pubs.sciepub.com/ajmo/6/1/1/index.html>

Behaviors of zooplankton – phytoplankton population in a polluted environment

Model for studying behaviors of zooplankton –phytoplankton populations in a polluted environment have been developed including models for risk assessment metric and the models simulated.

It is worthy to note that Phytoplankton is a major player in biogeochemical cycling of major elements like carbon, nitrogen, phosphorus and minor element such as nitrogen iron, zinc and carbon dioxide in the ocean. The photosynthesis and nitrogen fixation attributes made it a major contribution to global climate change.

The research output has been published (Oyelami B O, Ogidi J.A., Nonlinear Difference Equations and Simulation for Zooplankton-Fish Model with Noise. *IOSR Journal of Mathematics (IOSR-JM)*, Volume 14, Issue 2 Ver. II, 2018, PP 18-37. <http://www.iosrjournals.org/iosr-jm/papers/Vol14-issue2/Version-2/D1402021837.pdf> ;DOI: 10.9790/5728-1402021837).

Research on Water Quality

Sustainable development is the development that meets the needs of the present without compromising the ability of future generations to meet their own needs.

Water is indeed a precious natural resource that exists on our planet and all forms of life need it.

Water pollution occurs when the quality of water in a body of water is negatively affected due to addition of large amount of contaminants to the water body.

In pursuance of sustainable development, pollution control in groundwater systems via the modeling of qualitative parameters of water is one of the primary factors that warranted our research focus.

Application of artificial neural network in the prediction of water pollution for sustainable development

The researchers: Benjamin Oyediran Oyelami¹, Olufuminyi Abiri², Chindo Istifanus Yarkasuwa³, Buba Mamman Wufem⁴, Danladi Amamki⁵, Peter Feldman⁶, Vremudia Lawal⁷

1 & 2. NMC, Abuja, Nigeria.

3. Department of Chemistry, Abubakar Tafawa Balewa University Bauchi, Nigeria

4 & 5. Department of Chemistry, Plateau State University, Boko, Nigeria

5. WaterAid, UK Eagleworks Drive, Walsall, WS3 1BF, United Kingdom

6. WaterAid, Abuja, Nigeria

7. WaterAid, Abuja, Nigeria

Application of artificial neural network in the prediction of water pollution for sustainable development cont...

The researchers developed as a means of predicting water points quality parameters in Nigeria.

The use of Bayesian regularized technique reduces the potential of overfitting and overtraining, thereby improving the prediction quality of the model.

The total dissolved solid, TDS, is the predicted variable in our model. This is to measure the important concern of salinity in the groundwater in Nigeria.

The MFNN model predictions are in good agreement with measurements. To obtain the measurements, water quality data are collected for states in Nigeria in 2016. The results they obtained show that the proposed model has a great potential to simulate and predict the TDS.

The developed model is robust as it can be generalized to water quality conditions below or above the training dataset. This will require more measurement data. (To appear in the **Proceeding of International Conference on Mathematical modeling of Environmental pollution (ICMMEP2019), 2th-6th December 2018, National Mathematical Centre, Abuja, Nigeria**)

Research on Pollution of Water and effect on Biodiversity

ECOSYSTEM AND HYDRODYNAMIC MODELS IN A POLLUTED MARINE ECOSYSTEM

Researchers from National Mathematical Centre and National Defence College Abuja considered an ecosystem and hydrodynamic model in the form of coupled partial differential equations containing pollution function.

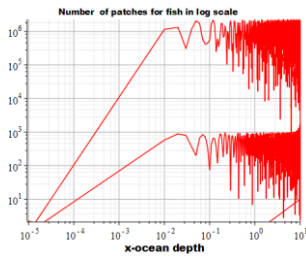
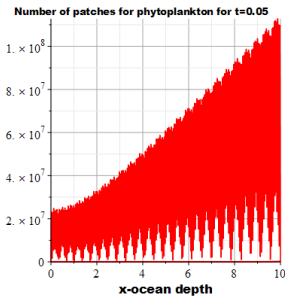
The research interest is to gain insight into temporal-spatial dynamics of phytoplanktons, zooplanktons, fishes and birds in ocean polluted by chemical substances.

The analytic solution and numerical simulation for model under certain conditions obtained.

The population of the species were found to be cyclic and oscillatory and show persistence and coexistence phenomena at some period during simulation period.

The population of the species are global sector stable and the population ratio of the species varies on 10 meters spatial scale from ocean surface down below the ocean.

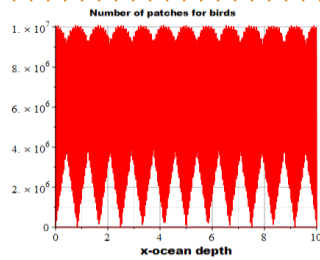
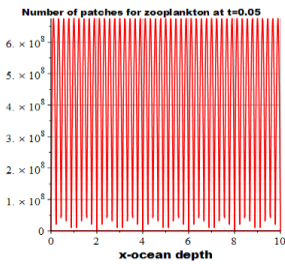
models in a polluted marine ecosystem cont...



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models in a polluted marine ecosystem cont...



The paper was published in the Proceedings of the 6th International Conference on Mathematical Analysis and Optimization: Theory and Applications, (ICAPTA 2019), 25th-29th March 2019, National Mathematical Centre, Abuja (icapta.unilag.edu.ng/proceedings/2019/).

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population in polluted environment

Oyelami Benjamin Oyediran and
Ogidi Ajisafe Jonathan

From the National Mathematical
Centre, Nigeria

considered a habitat and trophic
model consisting of phytoplankton,
zooplankton and fish as a kind of
prey-predation model.

The models considered are tempo -
spatial prey-predator models and
investigation are on populations of
phytoplankton, zooplankton and fish
using some functional responses
and couple partial differential
equations containing pollutant
functions.

Under certain conditions the species
are found to exhibit coexistence and
persistent phenomena.

Simulation for vertical patches for
the models are made in a polluted
and non-polluted environments and
are found to be oscillatory down the
ocean as the depth increases.

REPORT OF THE MEETING OF MATHEMATICAL MODELING STUDY GROUP ON
ENVIRONMENTAL POLLUTION HELD ON 5TH DECEMBER, 2018 AT NMC GUEST HOUSE

Consequent upon the conclusion of the 3- Day international conference
on Mathematical modeling of environmental pollution, the Study
Groups met with the invited/visiting Resource persons and considered
the following that :-

There was need to facilitate joint research projects with the initial
consent with the institutions represented at the conference.

There was need to share facilities/laboratory resource and data of
benefits to the NMC Stakeholders.

There was need to come together to discuss and initiate joint research
projects relevant to the theme of the conference "Militating against
Environmental Pollution through Mathematical Modeling for
Sustainable Development".

Meeting of Study group cont...

Providing avenue to benefit from expertise and resources that may not be available in the country.

Sharing facility/data needed to perform research among group members.

Meeting for posing research problems to be solved by the NMC Group.

After some extensive deliberation on the above, the meeting agreed that:

Nigeria is specifically interested in pollution of air, land and water; data analysis and climate change problems, among others.

On the areas of possible collaboration/joint research proposals, it was agreed that a research project titled “Mathematical Modelling of Effect of climate change on pollution” may be desirable for the consideration by the NMC Management.

Meeting of Study Group cont...

CAS – ESM is an Earth system model (ESM) developed by Chinese Academy of Science to simulate the physical, chemical and biological processes within and between the atmosphere, ocean, land surface etc. It is also suitable to study global climate and environmental change and extreme events/disasters. It can also capture the general characteristics of global climate system.

There is the need to venture into Industrial related research and big data analysis. There are research funds from some organization with big data seeking collaborators to analyze them.

Next project of ITRG

Our next project of ITRG will be on pollution and effect on climate with the following to be considered:

Mathematical models and Simulation on:

Biomass and utilization to produce of energy and its effect on climate change

Ozone depletion and free radicals in Stratosphere

Physiological effects of pollutants e.g. carcinogenic ones on vital organs such as the heart, kidney, liver and eyes.

Effects of carbon, sulphur, nitrogen and phosphor cycles on climate change and converse.

Production cheaper and clean energy using some renewable energy means.

Predict analytics using machine learning and big data analysis for UN sustainability goal related project .

Challenges

- The major challenge is that the Group could not meet since the second thematic group meeting held in National Mathematical Centre Abuja, 2015.
- The Third group meeting was to be hosted by the Cheikh Anta Diop University Dakar Senegal in 2016. The meeting did not hold and for this reason, we are unable to meet to finalize the project and come up with new project to work upon.
- Prayer: The Coordinating Council to facilitate and support the Meeting of ITRG on Mathematical Modeling in order to come up with new project.

Pictures from International conference on mathematical modeling of Environmental pollution held in NMC December 2-6, 2018

PHOTOGRAPH TAKEN AFTER STUDY GROUP MEETING

FROM RIGHT PROF. C. THRON, PROF. XIODUNG AND PROF B. BAJOGA



Group photograph with some participants at the Conference





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Pictures from the Conference

PROF. STEPHEN E. ONAH, THE DIRECTOR & CEO OF
NATIONAL MATHEMATICAL CENTRE ABUJA



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Pictures from the Conference cont...

PROF B. S. JUNaidu, NIGERIA COUNTRY
REPRESENTATIVE AT COMSATS TECHNICAL
ADVISORY COMMITTEE

THE NATIONAL DANCING TROUPES PERFORMING
AT THE OPENING CEREMONY



Thank you for listening
God bless you