NIGERIAN ASSOCIATION OF MEDICAL PHYSICISTS (NAMP)

in collaboration with

NIGERIAN NUCLEAR REGULATORY AUTHORITY (NNRA) & NIGERIA ATOMIC ENERGY COMMISSION (NAEC)

13th Medical Physics Annual Scientific Conference & Workshop Abuja 2024

Theme:

MEDICAL PHYSICS:
Improving Medicine, Shaping the Future of Healthcare

Mon 4th to Fri. 8th Nov. 2024

PRECISION PHYSICS
MIERI Ltd.
TANIT MEDICAL ENGINEERING
JNCI TURNKEY MEDICAL EQUIPMENT SERVICES
MARCELLE RUTH CANCER CENTRE & SPECIALIST HOSPITAL
ASI UKPO HOSPITALS
PTW THE DOSIMETRY COMPANY

ASI UKPO HOSPITALS

ASI UKPO COMPREHENSIVE CANCER CENTRE

in Calabar

Mary Slessor Avenue,
Opposite College of Health Technology,
Calabar, Cross River State.

Services

Radiotherapy . Brachytherapy . Chemotherapy

Super Specialty Surgical Procedures

ABOUT

NIGERIAN ASSOCIATION OF MEDICAL PHYSICISTS

i. To promote and develop to the highest standards, the application of the methods and concepts of physics in medicine, biology and related sciences through clinical services,education and research

ii. To encourage professional interest in training and safety in the application of Physics in medicine.

iii. To prepare and disseminate technical information, scholarships, scientific resources related to Medical Physics and related fields to members.

iv. To promote cooperation in scientific research, development and education within the field of medical physics.

v. To promote scientific exchanges on medical physics and related fields of science.

vi. To recommend standards for education, training and accreditation programmes within the field of medical physics.

vii. To initiate and/or support in approved centres and institutions, research and educational programs in medical physics.

viii. To promote certification of medical physicists.

ix. To develop the field of medicine and healthcare in the country through the application of concepts of physics.

x. To be the voice of Nigerian medical physicists in the international community.

His Excellency,
ASIWAJU BOLA AHMED TINUBU
President, Federal Republic of Nigeria

MUHAMMAD ALI PATE
Coordinating Minister of Health and Social Welfare
Federal Republic of Nigeria

NYESOM WIKE
Minister of the Federal Capital Territory
Federal Republic of Nigeria

Executive Committee 2023-2025

Dr Iyobosa B. Uwadiae
Secretary

Prof Fatai Balogun
President

Obinna C. Asogwa
Vice President

Abdullahi Hassan Abdullahi
Auditor

Clinton Ogese
Asst. Secretary

Maryann Ekpo
Welfare

Dr. Williams Igoniye
PRO

Dr. Lawal Abba
Treasurer

Keynote Speaker

Prof. Wil Ngwa
Professor of Global Health,

Wilfred Ngwa is a global oncology researcher and medical physics expert who is developing technologies that integrate with radiation therapy to reduce cancer treatment times and costs. He is a professor of global health at Rutgers Global Health Institute and a professor in the Department of Radiation Oncology at Rutgers Cancer Institute of New Jersey and Robert Wood Johnson Medical School. He also is a Rutgers Presidential Faculty Scholar.

The broad aim of Ngwa's research and global collaboration is to increase access to cancer treatment and reduce health disparities, particularly in low- and middle-income countries.

He leads a research group that is developing low-cost approaches and technologies that can substantially reduce treatment times and costs and that can be implemented in resource-poor settings. One such technology incorporates artificial intelligence and smart radiotherapy biomaterials, such as nanoparticle drones that can be injected intravenously and will emit missile-like electrons when activated by photon beams during radiation therapy. This process is designed to increase damage to cancerous tumors while minimizing toxic effects on body tissues. This technology also can be programmed to sustainably deliver cancer-fighting immunotherapy drugs in resource-effective and measurable ways. This research is supported by the National Institutes of Health and industry partners and is in clinical translation.

Ngwa's overall research program is designed to address many types of cancer, and he is leading studies related to treating prostate, breast, and cervical cancers in Nigeria, South Africa, Tanzania, and the United States. Since 2019, he has been the chair of The Lancet Oncology commission on cancer in sub-Saharan Africa. He also is an external adviser to the U.S. presidential administration's Cancer Cabinet, convened by President Joe Biden to help establish and make progress on the administration's reignited Cancer Moonshot initiative, and he is a co-chair of the U.S. Cancer Moonshot 2.0 Lancet Oncology commission. He is editor of IOP Publishing's scientific series in global health and radiation oncology and an editorial board member for Journal of Global Oncology, Frontiers in Oncology, and ecancermedicalscience.

He is the founding director of the Global Health Catalyst Summit, designed to catalyze high-impact international collaborations and initiatives to eliminate health-related disparities in the U.S. and globally.

Ngwa is originally from Cameroon, where he studied physics and computer science at the University of Buea, receiving a bachelor of science degree. He earned his master's and doctoral degrees from University of Leipzig in Germany then completed postdoctoral education and training in radiation oncology at MD Anderson Cancer Center at the University of Texas and at Brigham and Women's Hospital, Dana-Farber Cancer Institute, and Harvard Medical School.

Prof. Wil Ngwa is the Keynote Speaker at the 2024 Medical Physics Conference, Nigeria

TABLE OF CONTENTS

	Photon Energy (0.1-15MeV) Radiation Simulation using a Model Nigeria MCNPTM Phantom	Olaseni M. Bello
	Chitosan, Alginate and Polyethylene Glycol Capped Zinc Oxide Nanoparticles for Hyperthermia Applications	Christian Nwabunwanne, Samson O. Aisida, M. Hisham Alnasir, Subelia Botha, Chawki Awada, Adil Alshoaibi, Fabian I. Ezema
	High Energy X-Ray Dosimetry Using (ZnO)0.4(TeO2)0.6 Thin Film- Based Real-Time Gamma Sensor	Idris Mohammed Mustapha, Umaru Ibrahim and Abdulahi A. Mundi
	Anatomical Versus Clinical Diagnostic Reference Levels in Mammography: A Panacea for Dose Optimization	Ihotu Joy Ogar, Abdullahi Mundi, Joseph Dlama Zira
	Gender Disparities in Radiation Exposure: Analyzing Dose Discrepancies in X-Ray Examinations for Male and Female Patients in Sokoto Metropolis	Buhari Maidamma, Mutaka Umar, Anas Shehu, Zainab A. Bashir, Asma'u M. Koko, Usman Abubakar
	Enhancing Patient Safety in Cancer Treatment: Advances in Gafchromic Film In-vivo Dosimetry for Precise Radiation Therapy	Zahra Liman, A. A. Bello, Dlama J. Zira, G. Kamal
	Comparison of Treatment Plans for Hypofractionated Prostate Cancer Radiotherapy Using the Varian Halcyon and the Varian Vital Beam	Hussaini Musa, Nusairat Adedewe, Yusuf Tajuddeen Batsari, Ahmad Ubaidullah, Samuel Adeneye
	Properties of Zinc-Tellurite Glasses for Medical Physics Laser Application: A Systematic Review	G. Kamal, A. A. Bello, Abdulkarim Muhammad Hamza, A. A. Sule, Abubakar Abdulkadir, M. S. Otto, F. U. Muhammad, Zarah Liman, Alhassan Tijani
	Physicomechanical and Radiation Attenuation Factors of Bio-composite Phantoms in the Therapeutic Energy Range for Radiotherapy Applications	D. O. Samson, S. H. Zuber, A. Shukri, M. Z. A. Aziz, A. D. Biodun, M. S. A. Fadzil, G. G. Nyam
ARTIFICIAL INTELLIGENCE, MACHINE LEARNING, DATA SCIENCE, COMPUTATIONAL MODELING AND SIMULATIONS		
	The Impact of Artificial Intelligence on Medical Physics Practice in Nigeria	Nsed Ayip Akonjom
	Early Diagnosis of Breast Cancer in Mammogram Images Using a Combinatorial Algorithm Method	Sadiq Hamzah, Muktar Itopa, Bashiru Kayode Sodipo
	Advancing Quantum Computing in Medical Physics: Gaussian Spherical Quantum Dots Array in Kagome Metals for Enhanced Diagnostic and Therapeutic Applications	B. Yahweh, G. J. Ibeh, G. E. Akpojotor, A. M. Ekanem, N. J. George
	Development and Implementation of Web-based Machine Learning Model for Disease Diagnosis Using Common Health Indicators	Eleojo O. Kezia, Lawal O. Samuel, Aaron B. Aniebiet, Udeme I. Nicholas, Sanni A. Henry, Dada O. Michael and Awojoyogbe O. Bamidele
	Machine Learning-Based Classification of Brain Tumors Using Perceptron Model and Nuclear Magnetic Relaxometry Data	Yusuf A. Abdulmajid, Udeme I. Nicholas, Dada O. Michael, Awojoyogbe O. Bamidele
	Artificial Intelligence-Based Classification of Brain Tumors Using Garson Model and Magnetic Resonance Fingerprinting	Yusuf A. Abdulmajid, Udeme I. Nicholas, Dada O. Michael, Awojoyogbe O. Bamidele
	Machine Learning-Based Classification of Brain Tumor Using Spiking Neural Networks (SNNs) and Nuclear Magnetic Relaxometry Data	Yusuf A. Abdulmajid, Udeme I. Nicholas, Dada O. Michael, Awojoyogbe O. Bamidele
	Development of Machine Learning Approach for Fast Diagnosis of Chronic Kidney Disease	Ndako Muhammed, Sanni A. Henry, Udeme I. Nicholas, Dada

Derivation of Multidimensional Force for Magnetic Tweezer as a Function of T_1 and T_2 Relaxation Times using Magnetic Resonance Diffusion and Langevin Equations

Lazarus A. John[1], Dada O. Michael[1], Awojoyogbe O. Bamidele[1], Simon O. Abolarinwa[2]
[1]Department of Physics, Federal University of Technology, P.M.B. 65, Minna, Niger State Nigeria.
[2]Department of Animal Biology, Federal University of Technology, P.M.B. 65, Minna, Niger State Nigeria.
Corresponding Author: johnalamkahlazarus@gmail.com

Abstract
Magnetic tweezer is an instrument that has the ability to exert force in terms of magnitude and direction on biomolecules, such as deoxyribonucleic acid (DNA). It is a force spectroscopy technique with wide range of applications ranging from determination of elastic properties of DNA, study of DNA-protein interactions, study of topology of DNA, study of cancer cells, among others. Magnetic field is produced when magnetic tweezer applies force on a biomolecule. The force applied is along the axis of the molecule and field direction. Several models of magnetic tweezer have been developed overtime for measurement of force applied on a particle, but each developed model is marred with limitations such as magnetic hysteresis of the core material in the tweezer and low level spatial resolution. Also, there is limited availability of knowledge on the incorporation of nuclear magnetic resonance (NMR) relaxation time constants (T_1 and T_2), with NMR diffusion and Langevin equations to determine force applied on a particle along different axis. Therefore, this study derived a multidimensional force for magnetic tweezer from T_1 and T_2 relaxation times using NMR diffusion and Langevin equations. As this model helps to overcome the limitations encountered by the previous models. The NMR diffusion equation: $\frac{\partial M_y}{\partial t} = D\nabla^2 M_y + \frac{F_0}{T_0}\gamma B_1(r,t)$, and Langevin equation: $M\frac{dV}{dt} = -\zeta V + X(t)$ were utilised in the study to derive a multidimensional force at different boundary conditions. The equations are used to derive power spectrum from T_1 and T_2 relaxation times, given that $T_0 = \frac{1}{T_1} + \frac{1}{T_2}$. The multidimensional force derived in this study is in x, y, and z orientation with each axis having its characteristic variable. The result obtained from this study can be used to simulate T_1 and T_2 relaxation times values of DNA-binding proteins, an essential protein which enhance DNA-protein interactions. The results of the simulation can depict different features of DNA, thereby availing knowledge on DNA classification, genetic abnormality in cancer cells, among others.
Keywords: Magnetic tweezer, DNA, NMR Diffusion Equation, Langevin Equation, Relaxation Times.

Evaluation of Generative Medical Artificial Intelligence based on Fine-tuned Large Language Models (LLM)

Bobai Terry Bitrus, Dada O. Michael, Awojoyogbe O. Bamidele
Department of Physics, Federal University of Technology, Minna, Nigeria
Corresponding Author: shenkez23@gmail.com/ +2347039375697

Abstract
The integration of large language models (LLMs) into medical applications has opened new frontiers in clinical decision support and patient management. Fine-tuned generative models can significantly improve diagnostics and personalized care but require rigorous evaluation for reliability and accuracy. While LLMs excel in natural language generation, their medical applications face challenges, including accuracy, clinical relevance, and ethical use. Ensuring these models align with real-world practices and data privacy is crucial for adoption. This study fine-tunes a GPT-style LLM using a curated medical dataset, comprising publicly available resources (e.g., PubMed articles, clinical guidelines, medical textbooks, electronic health records (EHR). Etc.) and anonymized patient records. The dataset was curated by removing irrelevant data, anonymizing sensitive information, and annotating key medical concepts for improved model learning. The model's performance was evaluated across tasks like generating medical summaries and proposing diagnoses, using accuracy, precision, recall, F1 score, and human evaluations as key metrics. The fine-tuned model achieved an accuracy of 85% in generating patient summaries and 80% for differential diagnostic suggestions. The F1 score was 0.82, reflecting a good balance of precision and recall. However, in complex cases, accuracy dropped to 70%, and factual inaccuracies emerged. Ethical concerns, such as biases in training data, were also noted, emphasizing the need for ongoing improvements and oversight. Generative medical AI based on fine-tuned LLMs holds significant potential for enhancing healthcare delivery. Nonetheless, challenges related to accuracy, transparency, and ethical compliance must be addressed before integration into clinical practice. Future work will focus on improving model robustness and alignment with regulatory standards.
Keywords: Large language models, Generative medical AI, GPT-style LLM, Healthcare delivery.

Machine Learning-based Medical Image Compression Using Principal Component Analysis (PCA) and Autoencoders

Sanni A. Henry, Dada O. Michael and Awojoyogbe O. Bamidele
Department of Physics, Federal University of Technology, Minna, Niger State, Nigeria.
Corresponding Author: hanzyitops@gmail.com/ +234 703 648 3555

Abstract
Medical imaging creates large datasets crucial for diagnosis, posing storage and transmission challenges in digital health systems. Traditional compression methods like JPEG and PNG often lose critical diagnostic details, necessitating more

effective solutions. Principal Component Analysis (PCA) and autoencoders can be employed for efficient, high-quality medical image compression. The goal is to minimize storage and transmission burdens while preserving essential diagnostic information. PCA is used to reduce the dimensionality of input data by capturing the most important features, then autoencoders further compress the data by generating low-dimensional representations through unsupervised learning. The growing size of medical images presents significant challenges for healthcare systems related to storage and transmission, as existing compression methods are often too lossy. Traditional algorithms frequently lose clinically important details, highlighting the need for advanced techniques that preserve diagnostic accuracy while achieving high compression ratios. Principal Component Analysis (PCA) and autoencoders are integrated to form a model that achieve efficient compression of medical images. We used the open-source Adult Diffusion dataset from the MGH Human Connectome Project, specifically the first five subjects (IDs: MGH1002, MGH1001, MGH1003, MGH1004, MGH1005), and split it in a ratio of 80:20 for training and testing. The PCA is applied to reduce the dimensionality of the input data and an autoencoder neural network is trained to further compress the PCA-reduced data, learning a compact latent representation for efficient storage and transmission. The model's performance is evaluated by comparing compression ratios and image reconstruction quality across various medical imaging modalities, ensuring minimal information loss during reconstruction. The hybrid PCA-autoencoder model was tested on MRI images, achieving an average compression ratio of 15:1 while preserving critical diagnostic details. The reconstructed images demonstrated a high Structural Similarity Index Measure (SSIM) of 0.95, Peak Signal-to-Noise Ratio (PSNR) of 35.67 dB and Mean Squared Error (MSE) was evaluated, resulting in a value of **0.0012**, indicating minimal perceptual loss compared to the originals and a high-quality reconstruction. Compared to traditional methods like JPEG, this model showed superior compression efficiency and image fidelity, offering a promising solution for MRI image storage and transmission in healthcare systems. This study developed a compression model that combines Principal Component Analysis (PCA) and autoencoders for MRI images, effectively reducing storage requirements while preserving high image quality.

Keywords: Image compression, Machine learning, Principal component analysis, Autoencoders, Structural similarity index measure

Implementation of Magnetic Resonance Radiomics Platform (MRP) for Machine Learning-based Features Extraction and Convolutional Filter Analyses of Brain Tumor Images

Idowu B. Abdulsemiu, Dada O. Michael, Awojoyogbe O. Bamidele
Department of Physics, Federal University of Technology Minna, Nigeria
Email: tunsmenat@gmail.com

Abstract

This study implemented the magnetic resonance radiomics platform (MRP) for machine learning based features extraction from brain tumor images. Image segmentation is a critical step of the radiomics process that is currently challenging (mostly manual segmentation) because many tumours show unclear borders. Magnetic resonance imaging data publicly available in The Cancer Imaging Archive (TCIA) were downloaded and used to perform image Coregistration, Multi-Modality, Images interpolation, Morphology and Extraction of radiomic features with MRP tools. Radiomics analyses were then applied to the data (containing AX-T1-POST, Diffusion weighted, AX-T2-FSE and AX-T2-FLAIR sequences) using wavelet decomposition principles. The results employing different configurations of low-pass and high-pass filters were exported to Microsoft excel data sheets. The exported data were visualized using MATLAB's classification learner tool. Most of the intensity-based data were based on the reference coordinate system and these data were analysed with contour plots. The contour plots showed that applying low pass filters in three directions of an image produce the best image contrasts. Few of the data were now selected for training of classification algorithms. Linear SVM model returned an accuracy of 91.7% for T1 post-contrast images, Fine/medium tree discriminant model returned an accuracy of 100% for diffusion weighted images, RUSBoosted tree model returned an accuracy of 58.3% for fast spin echo images while linear SVM returned an accuracy of 70.8%. The receiver operating characteristic further confirmed that the classification algorithms performed very well at predicting the intensities of the images. These exported data and the analyses provide a new way of deep assessment of image data as well as easier interpretation of image scans. Findings from this study revealed that Machine learning Radiomics Platform is important in characterising, visualising and gives adequate information on a brain tumor.

Keywords: Magnetic resonance radiomics platform, machine learning, features extraction, brain tumor images, image segmentation, The Cancer Imaging Archive (TCIA), image coregistration, radiomic features.