ABDURRAHMAN JAVID SHAIKH, PHD.

(HEC Approved Supervisor)

Assistant Professor,
DEPARTMENT OF ELECTRICAL ENGINEERING, NED UNIVERSITY OF ENGINEERING & TECHNOLOGY (NED UET), KARACHI.

Co-Principal Investigator,
HAPTICS, HUMAN ROBOTICS & CONDITION MONITORING LAB,
NATIONAL CENTER OF ROBOTICS AND AUTOMATION, PAKISTAN.

PROFILE

Experienced academic with a demonstrated record of working at national and international universities. Proficient in photonic devices and systems: theory and numerical design. Skilled in computational electromagnetics, device TCAD, 3D modelling, design and optimization of optoelectronic and passive photonic devices for short reach optical interconnects and SoC applications.

CONTACT

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WEB PROFILES
https://www.linkedin.com/in/arjs/
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EDUCATION

2019: **Doctor of Philosophy – PhD (Photonics),**
UNIVERSITI SAINS MALAYSIA
Thesis Title: "Modelling of CMOS Based Interleaved PN Junction Optical Phase Shifters"

2008: **Master of Engineering – M. Engg. (Electrical)**
NED UNIVERSITY OF ENGINEERING & TECHNOLOGY
(Major in Telecommunications)

2006: **Bachelor of Engineering – B. E. (Electrical)**
NED UNIVERSITY OF ENGINEERING & TECHNOLOGY

WORK EXPERIENCE

October, 2008 – To date
Assistant Professor
NED UNIVERSITY OF ENGINEERING & TECHNOLOGY (NED UET)
Courses Taught: Feedback Control Systems, Signals & Systems, Circuit Theory – II, Electromagnetic Fields.

October, 2020 – To date
Co-Principal Investigator
HAPTICS, HUMAN ROBOTICS & CONDITION MONITORING LAB
(An associated lab of National Center of Robotics and Automation at NED University of Engineering & Technology)

December, 2011 – December, 2012
Graduate Research Assistant
COLLABORATIVE MICROELECTRONIC DESIGN EXCELLENCE CENTRE, MALAYSIA.

1) Worked on modelling and performance analysis of waveguide based active and passive devices for photonic integrated circuits applications. Primarily investigated silicon optical modulators based on plasma dispersion effect and modelled interferometric switches, splitters and germanium-based photodetectors on Lumerical Solutions tools.
2) Received Postgraduate Research Grant to further investigate on the topic.
3) Significantly contributed in proposal writing for Fundamental Research Grant 2013, Ministry of Higher Education, Malaysia, worth approximately USD 48,000 (max). The proposal cleared initial four out of five phases of approval.

July, 2006 – October, 2008
Lecturer
NED UNIVERSITY OF ENGINEERING & TECHNOLOGY (NED UET)
Courses Taught: Feedback Control Systems, Signals & Systems, Circuit Theory – II, Electromagnetic Fields.

BOARDS, BODIES & MEMBERSHIPS

- 2017 – To date
  Member
  BOARD OF STUDIES
  Department of Electrical Engineering, NED UET.

- 2018 – To date
  Member
  INDUSTRIAL ADVISORY BOARD
  Department of Electrical Engineering, NED UET.

- 2019 – To date
  Member
  PROGRAM TEAM [PHD PROGRAM]
  Department of Electrical Engineering, NED UET.

- 2019 – To date
  Member
  PROGRAM TEAM [M. ENGG. (ELECTRICAL) PROGRAM]
  Department of Electrical Engineering, NED UET.

- 2019 – To date
  Member
  PROGRAM TEAM [M.E.M. (ENERGY) PROGRAM]
  Department of Electrical Engineering, NED UET.

- 2019 – To date
  Member
  PROGRAM TEAM [B. E. (ELECTRICAL) PROGRAM]
  Department of Electrical Engineering, NED UET.

- July, 2007 – December, 2010
  Area Coordinator ISO
  DEPARTMENT OF ELECTRICAL ENGINEERING, NED UET.
  1 - Ensuring the compliance of ISO 9001:2000 Quality Standards at the department.
  2 - Preparing for and defending at the internal and external (surveillance) audits.
  3 - Ensuring achievement of Yearly Objectives.

- July, 2007 – December, 2010
  Secretary
  BOARD OF STUDIES, DEPARTMENT OF ELECTRICAL ENGINEERING, NED UET.

ACHIEVEMENTS & AWARDS

- 2020
  Reviewer
  NATIONAL RESEARCH PROGRAM FOR UNIVERSITIES (NRPU)
  Higher Education Commission,
  Government of Pakistan.

- 2014
  Postgraduate Research Grant
  DIVISION OF RESEARCH AND INNOVATION, USM.
  Awarded to support PhD research.

- 2013
  SPIE – The International Society of Optics and Photonics Education Award 2013 (International)
  Awarded for prospective contribution to the field of photonics at the SPIE Photonics West 2014, San Francisco, California.

- 2013
  Finalist
  VICE-CHANCELLOR'S AWARD UNIVERSITI SAINS MALAYSIA
  Selected as one of the 7 finalists among several thousand postgraduate students for the prestigious Vice-chancellor award in 2013.

- 2009
  Subject Experts
  CONSTITUTION OF CURRICULUM REVISION COMMITTEE
  For college level polytechnical education,
  Higher Education Commission (HEC),
  Government of Pakistan.

- 2006 - 2008
  Tuition Fee Award
  MASTER OF ENGINEERING (M. ENGG.)
  Granted by NED University of Engineering and Technology.

PUBLICATIONS

Journal Papers

[1] Akhtar, M.N., **Shaikh, A.J.**, Khan, A., Awais, H., Othman, A.R., and Bakar, E.A.,, "Smart Sensing with Edge Computing in Precision Agriculture for Soil Assessment and Heavy Metal Monitoring: A Review", *Agriculture* (under review). **(MDPI – Switzerland) ISI Q2 (IF: 2.072).**

[2] Uddin, R., Saleem, M.H., **Shaikh, A.J.**, Shirazi, M.A., Packeer Mohamed, M.F., and Khan U.S., "Design of simulators for Haptic Telerobotic Architectures", *IEEE Access* (under review).

[3] Uddin, R., **Shaikh, A.J.**, Khan, H.R., Rashid, A., Qazi, S.A., "Renewable energy perspectives of Pakistan and Turkey: Current analysis and policy recommendations", *Sustainability*, Vol. 13(6), 3349 (2021). **(MDPI – Switzerland) ISI Q2 (IF: 2.576).**

[4] **Shaikh, A.J.**, Packeer, F., Baig, M.M.A., Sidek, O., "Rigorous 3D Model of Capacitance of CMOS Compatible Optical Phase Shifters Based on Interleaved Junctions with Submicron Dimensions", *Journal of Nanoelectronics & Optoelectronics*, Vol. 15 (10), 1209-1215 (2020), **(American Scientific Publishers - ASP). ISI Q3 (IF: 1.069).**

[5] **Shaikh, A.J.**, Packeer, F., Baig, M.M.A., Sidek, O., "A full 3D model of the modulation efficiency of a submicron complementary metal–oxide–semiconductor (CMOS)-compatible interleaved-junction optical phase shifter", *Journal of Computational Electronics*, Vol. 18, 1379-1387 (2019). **(Springer-Nature). ISI Q2 (IF: 1.532)**

[6] **Shaikh, A.J.**, Sidek, O. and Packeer, F., "Self phase modulation and cross phase modulation in nonlinear silicon waveguides for on-chip optical networks—A tutorial". *Nano Communication Networks*, Vol. 14, 60-67 (2017). **(Elsevier). ISI Q2 (IF: 2.621)**

[7] **Shaikh, A.J.**, and Sidek, O., "Holistic Analysis and Systematic Design of High Confinement Factor, Single Mode, Nanophotonic Silicon-on-Insulator Rib Waveguides". *Journal of Nanoelectronics and Optoelectronics*, Vol. 12(4), 381-391 (2017). **(American Scientific Publishers). ISI Q4 (IF: 1.069)**

Conference Papers

[8] **Shaikh, A.J.**, O. Sidek, and F. Packeer, "Analysis and Design of High Mode Power, Single Mode, Submicron SOI Rib Waveguides", IEECCC 2017, Expo Centre, Karachi.

[9] **Shaikh, A.J.** and Sidek, O. 2016. "Stimulated Raman Scattering in Nonlinear Silicon Nanophotonic Waveguides: Theory and Applications in Photonic Integrated Circuits", 1st International Electrical Engineering Congress (IEEC 2016), Karachi.

[10] **Shaikh, A.J.** and Sidek, O. 2012. "Making Silicon Emit Light Using Third Harmonic Generation." Procedia Engineering 29(0) 1456-1461. (Elsevier). Scopus (SJR: 0.282)

[11] **Shaikh, A.J.** and Sidek, O., "Four Wave Mixing and Cross-Phase Modulation in Silicon Optical Waveguides" presented at 2nd Annual CEDEC's Postgraduate Research Colloquium on Microelectronic Circuits, Devices and Systems (PostRec 2012), Science & Engineering Research Centre (SERC), USM-Engineering Campus, Nibong Tebal, Malaysia (Dec 2012).

[12] **Shaikh, A.J.** and Sidek, O., " Third Harmonic Generation in Silicon Optical Waveguides" presented at 1st Annual CEDEC's Postgraduate Research Colloquium on Microelectronic Circuits, Devices and Systems (PostRec 2011), Bukit Jawi Golf Resort Jawi, Malaysia (Dec 2011).

RECENT PROJECTS

Project # 1: Confinement Factor of Single Mode Submicron Silicon-On-Insulator Rib Waveguides [COMPLETED]

Abstract: Due to the swift increase in demand of higher transmission bandwidth of interconnects at board/chip scale, the metallic interconnects are losing their attraction. Next generation on-board/on-chip interconnects are to be implemented using semiconductor based integrated optical devices which offer large transmission bandwidth and much lesser interference. Photonic waveguides are the backbone of many of these optical devices. This project developed rigorous and efficient mathematical models for one of the key performance metrics i.e., the confinement factor of single mode submicron silicon rib waveguides by numerically solving the Maxwell's equation using FDFD approaches. State-of-the-art industry standard tool Lumerical® Mode Solutions™ has been used. Confinement factor for both the fundamental TE and TM modes have been calculated for each of the supported mode and separate mathematical models have been proposed for TE and TM cases.

Project # 2: Design and Development of a Prototype Thermoelectric Generator (TEG) [ON GOING]

Abstract: This is an ongoing project where efforts are being made to generate electrical energy through solar heat energy making use of the geographic location of Pakistan where temperature scale regularly crosses 40^{o}C in summers. As opposed to photovoltaic energy generation which relies on photon energy of solar radiation, this approach utilizes Seeback effect which exploits solar heat to generate electrical energy. A prototype thermoelectric generator is being built for domestic applications which requires minimal footprint as opposed to PV panels. As initial results, my team is able to generate 12W of power using an indigenously developed thermoelectric cell of about 2 cubic-inch. Results are promising but requires further investigation before reaching the final design.

Project # 3: Development of Model for the Modulation Efficiency of CMOS Based 3D Photonic Phase Shifters [COMPLETED]

(Partially funded by Universiti Sains Malaysia Research University Short-Term Grant No. 304/PELECT/6315067)

Abstract: A rigorous 3D model for the modulation efficiency of a silicon-on-insulator interleaved-junction optical phase modulator with submicron dimensions has been proposed. Drift–diffusion and Poisson's equations are solved on a 3D finite-element mesh, while Maxwell's equations are solved using the finite-difference time-domain method on 3D Yee cells. The entire modeling process has been investigated in detail, and all the coefficients required by the model have been calculated. The model validation suggests<10% root-mean-square (RMS) error.

Project # 4: Development of a 3D Model for the Junction Capacitance of SOI Based Interleaved Junction Photonic Phase Modulators [COMPLETED]

Abstract: Silicon photonics is the most viable and cost-effective platform for next generation optical interconnects. This project investigated and subsequently proposed a full 3D model for the junction capacitance of one of the three active devices of the optical interconnect i.e., photonic phase modulators. Junction capacitance is instrumental in calculating power consumption per bit, modulation speed and efficiency of optical modulators. Whole of the modeling process has been studied and all the coefficients required in the model have been calculated. Model validation suggests <10% RMS error.

Project # 5: Complete Design Approach to Confinement Specific Single Mode Submicron SOI Rib Waveguides [COMPLETED]

Abstract: For efficient operation of nanoscale optoelectronic components, realization of nanophotonic waveguides confining high mode powers is imperative. In this project, an extensive numerical analysis based on rigorous full-vectorial finite difference method has been carried to identify the single mode operation region of sub-micrometer silicon-on-insulator rib waveguides in terms of the waveguide geometric parameters. Achieving high mode confinements while designing a single mode waveguide and providing a way to engineer the confinement factor is particularly emphasized. This is the first such analysis which covers both, the deeply and the shallowly etched rib waveguides (0.1≤ (slab height/rib height) ≤ 0.8) and reports the single mode condition for entire sub-micrometer range (0.2 μm ≤ rib height, rib width ≤ 1.0 μm) while adhering to design specific mode confinement requirements.

PROFESSIONAL COURSES & TRAININGS

- 2014
  SPIE's Short Course: "Silicon Photonics" taught by MIT's Prof. Jurgen Michel.
  (IACET's CEU Earned = 0.35)

- 2008
  "Space Weather Monitoring"
  SPACE & UPPER ATMOSPHERIC RESEARCH COMMISSION
  Funded by NED University of Engineering & Technology.

- 2006
  "Training to Teach English for Specific Purpose"
  AGHA KHAN UNIVERSITY, KARACHI
  Funded by Higher Education Commission (HEC) Pakistan.

- 2006
  "Telecommunication Technology"
  ELECTRONICA VENETA, ITALY.
  Supported by Department of Electrical Engineering
  NED University of Engineering & Technology.

COMMUNITY SERVICES

- 2018 – 2021
  Program Secretary
  INTERNATIONAL ELECTRICAL ENGINEERING CONFERENCE (3rd, 4th, 5th & 6th Conference)
  Department of Electrical Engineering, NED UET & Institution of Engineers Pakistan (IEP).

- 2021
  Technical Convener
  36TH IEEEP STUDENTS' SEMINAR
  Institute of Electrical & Electronic Engineers Pakistan (IEEEP).

- 2011 – 2012
  Member Technical Committee
  ANNUAL CEDEC POSTGRADUATE RESEARCH COLLOQUIUM (POSTREC)
  Spearheaded and managed the team which successfully organized the first and second event in 2011 & 2012.

- 2012
  President
  IEEE STUDENT BRANCH AT UNIVERSITI SAINS MALAYSIA
  Established the IEEE Student Branch at Universiti Sains Malaysia and served as its first president.

- 2011 – 2012
  President
  POSTGRADUATE STUDENT COMMITTEE AT CEDEC, UNIVERSITI SAINS MALAYSIA

- April 2008 – May 2010
  Branch Counselor
  IEEE STUDENT BRANCH AT NED UNIVERSITY
  Served as reviving Branch Counselor of the Student Branch. Presided the Executive Committee meetings. Have successfully arranged many technical sessions and industrial tours in collaboration with leading industries of Pakistan.

RESEARCH TOOLS

- Lumerical Solutions Complete Suite (MODE, FDTD, DEVICE and INTERCONNECT)
- C-Language Programming
- MATLAB
- CurveExpert Professional

RESEARCH INTERESTS

- Semiconductor Optics
- Active and Passive Photonic Devices
- Photonic Integrated Circuits
- Integrated Optical Systems
- Group III/V Photonics
- Group IV Photonics
- Design and Optimization of Optical Sensors & Actuators
- Integrated Sensors Fabrication Processes
- Haptics / Tele-operations