Islam I. Abdulaal

Postgraduate Student and Researcher in Integrated Photonics

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Professional Summary

Research-focused ECE postgraduate student specializing in integrated photonics, nonlinear optics, and physics-informed design workflows. Work centers on simulation-driven photonic device development, inverse design with machine learning, and research communication through publications, mentoring, and technical programs.

Research Interests

Integrated photonics; nonlinear and quantum photonics; photonic-electronic co-design; physics-informed machine learning for inverse design; optical communications; biomedical photonic sensing.

Education

B.Sc. in Electronics and Communications Engineering Aug 2021 – Aug 2026
Alexandria University, Faculty of Engineering *Alexandria, Egypt*

- **CGPA:** 3.39/4.00 (Distinct with Honors).
- **Thesis:** Intra-DC IEEE 802.3 Ethernet MDM-based 400 Gb/s integrated silicon transceiver.
- **Advisor:** Dr. Eslam Elfiky.
- **Focus:** Ge/Si PIN photodetector modeling, mode-division multiplexing, EO modulation, and optical DSP.

Research Experience

Research Intern Sep 2025 – Present
*NanoPhoto Lab, IMRE, A*STAR* *Remote*

- Continued collaboration with Dr. Omar Abdelraouf after Egypt Scholars Advanced Labs track.
- Contributing to a review on metamaterial bound states in the continuum (BIC).
- Running device-level simulation workflows in Lumerical FDTD with MATLAB post-processing.

Research Intern Jul 2025 – Sep 2025
Advanced Labs Program, Egypt Scholars Inc. *Remote*

- Completed an intensive 10-week program on independent research execution.
- Collaborated on MPM SPDC inverse design using physics-informed neural networks (PINNs).
- Generated and validated approximately 12 million simulation samples for $NbOCl_{2x}$ design studies.

Undergraduate Researcher Jul 2023 – Aug 2025
OPST Group, CSMNP, SmartCI, Alexandria University *Hybrid*

- Completed structured training in photonics fundamentals, simulation, and mathematical modeling.
- Developed FBG-based concepts for multi-parameter respiratory monitoring.
- Co-authored a funded proposal (USD 15k) supported by Alexandria University Technology Park.

Selected Research Projects

Multi-Parameter Respiratory Monitoring via FBG 2025 – Ongoing
Funded Project (AUTP) *12-month cycle*

- Designed a compact sensing workflow for early asthma/COPD exacerbation detection.
- Developed analytical models for mode coupling and FBG spectral response.
- Validated performance using Lumerical FDTD/MODE and INTERCONNECT.

PINN Inverse Design for Photonic Quantum Systems 2025 – Ongoing
Collaborative Research *6-month cycle*

- Designed and benchmarked PINN architectures for inverse design of integrated nonlinear sources.
- Modeled SPDC structures in $NbOCl_{2x}$ waveguides against simulation-driven baselines.

Publications

Preprints

[1] **Abdulaal, I. I.**, Elsayed, A. W. A., Abdelraouf, O. A. M., "Terahertz quasi-bic metasurfaces for ultra-sensitive biosensing and high-speed wireless communications," Preprint submitted to *Journal of Optics* (IOP), 2025. arXiv: 2510.00357 [physics.optics]. [Online]. Available: https://arxiv.org/abs/2510.00357

Manuscripts in Preparation

[2] **Abdulaal, I. I.**, Abdelraouf, O. A. M., "Nbocl$_{2x}$-based spdc inverse design using a physics-informed neural network model," Manuscript in preparation, 2026.

[3] **Abdulaal, I. I.**, Elsayed, A. W. A., Abdelraouf, O. A. M., Sallam, B., Mahmoud, A., Hazem, A., "Physics-informed machine learning multiphysics for forward modelling, inverse design, and equation discovery," Manuscript in preparation, 2026.

Technical Skills

Photonics: Lumerical (FDTD, MODE, INTERCONNECT), COMSOL, Silvaco TCAD
Scientific Computing: MATLAB, Python, Octave, PyTorch, TensorFlow
Analog and Mixed-Signal: Cadence, LTspice, NGspice, Xschem, Verilog-A/AMS
Digital and Hardware: Verilog, VHDL, Vivado, Quartus, QuestaSim, FPGA/CPLD
Engineering Tools: Git, Linux, LaTeX, Jupyter, LabVIEW

Awards, Leadership, and Service

- **Alexandria University Technology Park (AUTP) Research Grant** (2025): USD 15k for photonics-based respiratory monitoring research.
- **Chairman, IEEE SSCS Alexandria University Student Branch Chapter** (2025): Led chapter governance, programs, and technical events.
- **ICMTC AI Contest (AIC-2), 4th Place** (2024): Ranked 4th among 500 teams.
- **General Coordinator, Education Clinic NGO** (2021 – 2023): Coordinated volunteer programs serving students across the MENA region.

Professional Training

- **AMS Simulation and Modeling, Siemens EDA (2025):** 90+ training hours; 8× PLL behavioral model; 92% overall.
- **ADC Design and Verification, Siemens EDA (2025):** 8-bit SAR ADC implementation with FFT-based performance validation.
- **CMOS Analog IC Design, ITI (2024):** 180+ training hours with full OTA design and stability validation workflows.

Memberships and Languages

Memberships: IEEE Student Member (ID: 101099759); IEEE SSCS; IEEE Photonics Society
Languages: Arabic (native), English (professional working proficiency)

References

Available upon request.