

# DR. IHTESHAM KHAN

Ph.D. in Electrical, Electronics, and Communication Engineering

Passionate about technology and the fastly changing world of the Internet. My view is to keep a simple approach to problems to offer more accessible access to communications for a connected world.



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[scholar.google.com/citations?user=HHxNTYgAAAAJ&hl=en](https://scholar.google.com/citations?user=HHxNTYgAAAAJ&hl=en)

## RESEARCH ACTIVITY

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### Postdoctoral Research Fellow

**Politecnico di Torino**

May. 2022 – Ongoing

Turin, IT

Research Group: [Planet Group](#)

- Network performance analysis of novel wide-band switching architectures.
- Machine learning-based model for Vertical Cavity Surface Emitting Laser circuit-level parameters characterization.

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### Data-Driven Science for Control and Management of Photonic Integrated Systems

**Politecnico di Torino - Synopsys, Inc**

Jan. 2020 – May. 2022

Turin, IT

In collaboration with Synopsys, Inc, this Worked aims to carry out simulative and design analysis of Photonic integrated circuits. This work aims to obtain an augmented knowledge of integrated circuits and build a softwarized system for its management in topological and technologically agnostic manners.

- A data-driven two-step approach based on machine learning is developed to predict the control/routing strategy and the Quality of transmission (QoT) impairments of the photonic switching system. The proposed model is trained and tested completely topologically and technologically agnostic way. Overall datasets for machine learning training are obtained by leveraging the Synopsys Photonic Design Suite's integrated software environment.

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### Machine learning for Software-defined Optical Networks

**Politecnico di Torino**

Jan. 2020 – May. 2022

Turin, IT

Within the Telecom Infra Project framework, a GNPY library is exploited to model different optical networks and generate a dataset against each network. The generated datasets are used to train and test other machine learning models used as an open application program interface in the control plane to assist the QoT estimator engine of the networks.

- This work aims to decrease the uncertainty in the QoT computation of the lightpath. Consequently, the network operator could reliably compute the path to deploying the candidate lightpath at the minimum margin. The simulation considered an open disaggregated network scenario where the network controller may rely on QoT-estimation application program interfaces.

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### Activities on Open and Disaggregated Optical Networks

**Politecnico di Torino- Cisco**

Apr. 2019 – Dec. 2019

Turin, IT

With the collaboration of the Cisco optical networks team and Link foundation, I developed machine learning models for network QoT. The machine learning models were developed using the open-source library TensorFlow.

- A synthetic dataset has been generated using python based emulator for an optical line system and application of machine learning model is observed for predicting the QoT of lightpath.

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### Multi-layer Orchestration of Optical Networks

**Politecnico di Torino - Cisco**

Nov. 2018 – Mar. 2019

Turin, IT

Within the multi-layer orchestration of optical networks (MOON) project, I developed the Python-based emulator, which mimics the Optical line system's behavior. This activity was carried in synergy with Cisco.

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# EDUCATION

Ph.D. in Electrical, Electronic & Communication Engineering

**Politecnico di Torino**

Nov. 2018 – May 2022 Turin, IT

*Specialized in Optical Communication and Photonics Networks.*  
Supervisor: Prof. Vittorio Curri  
Thesis: Machine Learning for Multi-Layer Open and Disaggregated Optical Networks

Research Fellow with Pre-Doc. Scholarship

**Politecnico di Torino - Cisco**

Mar. 2018 – Oct. 2018 Turin, IT

Supervisor: Prof. Vittorio Curri  
Topic: Development of Python base emulator for optical line system for QoT-estimation under the Cisco optical network team's supervision.

M.Sc. in Electrical Engineering

**National University of Science & Technology (NUST)**

Sep. 2014 – Oct. 2017 Islamabad, PK

CGPA : 3.45/4.00  
*Specialized in Communication & Computer networks.*  
Thesis: *Energy Aware IP Over WDM Networks With Data Centers*  
Supervisors: Prof. Arsalan Ahmad

In this thesis, I proposed a heuristics and meta-heuristic for optimal placement of data-centers over the flexible-grid optical network to reduce the overall network's power consumption.

B.Sc. in Electrical Engineering

**University of Engineering & Technology (U.E.T)**

Sept 2009 – Oct 2013 Peshawar, PK

CGPA : 3.30/4.00  
*Specialized in Communication & Computer networks.*  
Thesis: *Wearable Gesture Recognition & Projection System (WGRPS)*  
Supervisors: Prof. Sahib Khan

In this thesis, in a team, we develop WGRPS, which recognizes the objects around it and displays the information related to those objects in real-time. The WGRPS allows the user to interact with the information through hand gestures.

# LIFE PHILOSOPHY

*"Keep it simple!"*

# SKILLS

Hard skills: Optical Networks

- Optical Systems Design and Modeling
- Network Capacity Optimization
- Machine Learning models
- Neural Networks
- Photonic integrated circuits

Hard skills: Coding

- Python
- MATLAB
- TensorFlow
- Git
- Bash

Soft skills

- Problem Solving
- Social Networking
- Teamwork
- Decision Making
- Positive Attitude

# LANGUAGES

- Urdu
- Pashto
- English
- Italian

# INTERESTS

- Photography
- Traveling

# REFEREES

**Prof. Vittorio Curri**

- @ Politecnico di Torino
- ✉ vittorio.curri@polito.it

**Prof. Andrea Carena**

- @ Politecnico di Torino
- ✉ andrea.carena@polito.it

**Prof. Paolo Bardella**

- @ Politecnico di Torino
- ✉ paolo.bardella@polito.it

**Enrico Ghillino**

- @ Synopsys, Inc.
- ✉ enrico.ghillino@synopsys.com

**Prof. Arsalan Ahmad**

- @ NUST, Pakistan
- ✉ arsalan.ahmad@seecs.edu.pk

# PUBLICATIONS

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## Journal Articles

- Khan, Ihtesham, Lorenzo Tunesi, Muhammad Umar Masood, Enrico Ghillino, Paolo Bardella, Andrea Carena, and Vittorio Curri (Jan. 2022b). "Optimized management of ultra-wideband photonics switching systems assisted by machine learning". In: *Opt. Express* 30.3, pp. 3989–4004. DOI: 10.1364/OE.442194. URL: <http://opg.optica.org/oe/abstract.cfm?URI=oe-30-3-3989>.
- Khan, Ihtesham, Lorenzo Tunesi, Muhammad Umar Masood, Enrico Ghillino, Paolo Bardella, Andrea Carena, and Vittorio Curri (Jan. 2022). "Performance evaluation of data-driven techniques for the softwarized and agnostic management of an N×N photonic switch". In: *Opt. Continuum* 1.1, pp. 1–15. DOI: 10.1364/OPTCON.428567. URL: <http://opg.optica.org/optcon/abstract.cfm?URI=optcon-1-1-1>.
- Khan, Ihtesham, Muhammad Bilal, Muhammad Masood, et al. (Jan. 2021). "Lightpath QoT Computation in Optical Networks Assisted by Transfer Learning". In: *Journal of Optical Communications and Networking*. DOI: 10.1364/jocn.409538. URL: <https://doi.org/10.1364/jocn.409538>.
- Khan, Ihtesham, Lorenzo Tunesi, Muhammad Umar Masood, Enrico Ghillino, Paolo Bardella, Andrea Carena, and Vittorio Curri (2021a). "Automatic Management of N × N Photonic Switch Powered by Machine Learning in Software-Defined Optical Transport". In: *IEEE Open Journal of the Communications Society* 2, pp. 1358–1365. DOI: 10.1109/OJCOMS.2021.3085678.
- Usmani, Fehmida, Ihtesham Khan, Muhammad Umar Masood, Arsalan Ahmad, et al. (2021). "Convolutional neural network for quality of transmission prediction of unestablished lightpaths". In: *Microwave and Optical Technology Letters* 63.10, pp. 2461–2469. DOI: <https://doi.org/10.1002/mop.32996>. eprint: <https://onlinelibrary.wiley.com/doi/pdf/10.1002/mop.32996>. URL: <https://onlinelibrary.wiley.com/doi/abs/10.1002/mop.32996>.
- Usmani, Fehmida, Ihtesham Khan, Mehek Siddiqui, Mahnoor Khan, Muhammad Bilal, et al. (2021). "Cross-feature trained machine learning models for QoT-estimation in optical networks". In: *Optical Engineering* 60.12, pp. 1–17. DOI: 10.1117/1.OE.60.12.125106. URL: <https://doi.org/10.1117/1.OE.60.12.125106>.
- D'Amico, Andrea, Stefano Straullu, Antonino Nespola, Ihtesham Khan, Elliot London, et al. (June 2020). "Using machine learning in an open optical line system controller". In: *J. Opt. Commun. Netw.* 12.6, pp. C1–C11.
- Khan, Ihtesham, Arsalan Ahmad, et al. (2020). "Impact of data center placement on the power consumption of flexible-grid optical networks". In: *Optical Engineering* 59.1, p. 016115.
- Khan, Ihtesham, Muhammad Bilal, and Vittorio Curri (2020b). "Assessment of cross-train machine learning techniques for QoT-estimation in agnostic optical networks". In: *OSA Continuum* 3.10, pp. 2690–2706.

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## Conference Proceedings

- Alam, Shahzad, Ihtesham Khan, et al. (n.d.). "Routing and Spectrum Allocation Heuristic for Sliced Elastic Optical Network System". In: *2021 IEEE Photonics Society Summer Topicals Meeting Series (SUM)*, pp. 1–2. DOI: 10.1109/SUM48717.2021.9505961.
- Khan, Ihtesham, Maryvonne Chalony, et al. (n.d.). "Effectiveness of Machine Learning in Assessing QoT Impairments of Photonics Integrated Circuits to Reduce System Margin". In: *2020 IEEE Photonics Conference (IPC)*. IEEE, pp. 1–2.
- Khan, Ihtesham, Muhammad Umar Masood, et al. (2023). "Two-step machine learning assisted extraction of VCSEL parameters". In: *Physics and Simulation of Optoelectronic Devices XXXI*. vol. 12415. SPIE, pp. 159–162.
- Masood, Muhammad Umar, Lorenzo Tunesi, et al. (2023). "Network performance analysis of a PIC-based reconfigurable add-drop multiplexer for multiband applications". In: *Next-Generation Optical Communication: Components, Sub-Systems, and Systems XII*. vol. 12429. SPIE, pp. 81–86.
- Tunesi, Lorenzo, Ihtesham Khan, Muhammad Umar Masood, Enrico Ghillino, Andrea Carena, Vittorio Curri, et al. (2023). "Photonic-integrated wavelength selective switch for S+ C+ L applications". In: *Optical Components and Materials XX*. vol. 12417. SPIE, pp. 149–153.
- Khan, Ihtesham, Lorenzo Tunesi, Muhammad Umar Masood, Enrico Ghillino, Paolo Bardella, Andrea Carena, and Vittorio Curri (2022a). "Optimal control of Beneš optical networks assisted by machine learning". In: *Next-Generation Optical Communication: Components, Sub-Systems, and Systems XI*. ed. by Guifang Li and Kazuhide Nakajima. Vol. 12028. International Society for Optics and Photonics. SPIE, pp. 102–111. DOI: 10.1117/12.2608595. URL: <https://doi.org/10.1117/12.2608595>.
- Khan, Ihtesham, Lorenzo Tunesi, Muhammad Umar Masood, Enrico Ghillino, Andrea Carena, Paolo Bardella, et al. (2022). "Performance Analysis of Novel Multi-band Photonic-integrated WSS Operated on 400ZR". In: *2022 IEEE Photonics Society Summer Topicals Meeting Series (SUM)*, pp. 1–2. DOI: 10.1109/SUM53465.2022.9858263.
- Khan, Ihtesham, Lorenzo Tunesi, Muhammad Umar Masood, Enrico Ghillino, Andrea Carena, Vittorio Curri, et al. (2022). "Machine Learning Assisted Extraction of Vertical Cavity Surface Emitting Lasers Parameters". In: *2022 IEEE Photonics Conference (IPC)*. IEEE, pp. 1–2.

- Masood, Muhammad Umar, Ihtesham Khan, Lorenzo Tunesi, Bruno Correia, Enrico Ghillino, et al. (2022). "Network Performance of ROADM Architecture Enabled by Novel Wideband-integrated WSS". in: *GLOBECOM 2022-2022 IEEE Global Communications Conference*. IEEE, pp. 2945–2950.
- Masood, Muhammad Umar, Ihtesham Khan, Lorenzo Tunesi, Bruno Correia, Rasoul Sadeghi, et al. (2022). "Networking Analysis of Photonics Integrated Multiband WSS Based ROADM Architecture". In: *2022 International Conference on Software, Telecommunications and Computer Networks (SoftCOM)*. IEEE, pp. 1–6.
- Tunesi, Lorenzo, Ihtesham Khan, Muhammad Umar Masood, Enrico Ghillino, Andrea Carena, Paolo Bardella, et al. (2022). "Novel Design and Operation of Photonic- integrated WSS for Ultra-wideband Applications". In: *2022 IEEE Photonics Society Summer Topicals Meeting Series (SUM)*, pp. 1–2. DOI: 10.1109/SUM53465.2022.9858267.
- Tunesi, Lorenzo, Ihtesham Khan, Muhammad Umar Masood, Enrico Ghillino, Andrea Carena, Vittorio Curri, et al. (2022). "Modular Photonic-Integrated Device for Multi-Band Wavelength-Selective Switching". In: *2022 27th OptoElectronics and Communications Conference (OECC) and 2022 International Conference on Photonics in Switching and Computing (PSC)*, pp. 1–3. DOI: 10.23919/OECC/PSC53152.2022.9850062.
- Usmani, Fehmida, Ihtesham Khan, Muhammad Umar Masood, et al. (2022). "Transfer learning Aided QoT Computation in Network Operating with the 400ZR Standard". In: *2022 International Conference on Optical Network Design and Modeling (ONDM)*. IEEE, pp. 1–6.
- Usmani, Fehmida, Ihtesham Khan, Muhammad Umar Masood, Arsalan Ahmad, et al. (2022). "QoT- Estimation Assisted by Transfer learning in Extended C-band Network Operating on 400ZR". in: *2022 IEEE Photonics Society Summer Topicals Meeting Series (SUM)*, pp. 1–2. DOI: 10.1109/SUM53465.2022.9858280.
- Alam, Shahzad, Muhammad Umar Masood, et al. (2021). "Modeling Off-line Routing and Spectrum Allocation Problem in Elastic Optical Network". In: *2021 International Conference on Electrical, Communication, and Computer Engineering (ICECCE)*, pp. 1–6. DOI: 10.1109/ICECCE52056.2021.9514112.
- Khan, Ihtesham, M Umar Masood, Lorenzo Tunesi, Paolo Bardella, et al. (2021). "A Neural Network-Based Automated Management of N xN Integrated Optical Switches". In: *OSA Advanced Photonics Congress 2021*. Optical Society of America, NeF2B.2.
- Khan, Ihtesham, M Umar Masood, Lorenzo Tunesi, Enrico Ghillino, et al. (2021). "A Data-Driven Approach to Autonomous Management of Photonic Switching System". In: *2021 IEEE Photonics Society Summer Topicals Meeting Series (SUM)*, pp. 1–2. DOI: 10.1109/SUM48717.2021.9505780.
- Khan, Ihtesham, Lorenzo Tunesi, Maryvonne Chalony, et al. (2021). "Machine-learning-aided abstraction of photonic integrated circuits in software-defined optical transport". In: *Next-Generation Optical Communication: Components, Sub-Systems, and Systems X*. ed. by Guifang Li and Kazuhide Nakajima. Vol. 11713. International Society for Optics and Photonics. SPIE, pp. 146–151. DOI: 10.1117/12.2578770. URL: <https://doi.org/10.1117/12.2578770>.
- Khan, Ihtesham, Lorenzo Tunesi, Muhammad Umar Masood, Enrico Ghillino, Paolo Bardella, et al. (2021). "Machine Learning Assisted Management of Photonic Switching Systems". In: *Conference on Lasers and Electro-Optics*. Optical Society of America, JTu3A.32.
- Khan, Ihtesham, Lorenzo Tunesi, Muhammad Umar Masood, Enrico Ghillino, Paolo Bardella, Andrea Carena, et al. (2021). "Machine Learning Driven Model for Software Management of Photonics Switching Systems". In: *2021 IEEE Global Communications Conference (GLOBECOM)*, pp. 1–6. DOI: 10.1109/GLOBECOM46510.2021.9685878.
- Khan, Ihtesham, Lorenzo Tunesi, Muhammad Umar Masood, Enrico Ghillino, Paolo Bardella, Andrea Carena, and Vittorio Curri (2021b). "Machine Learning Assisted Model of QoT Penalties for Photonics Switching Systems". In: *Photonics in Switching and Computing 2021*. Optical Society of America, M2A.3. URL: <http://www.osapublishing.org/abstract.cfm?URI=PSC-2021-M2A.3>.
- Khan, Ihtesham, Lorenzo Tunesi, Muhammad Umar, et al. (2021). "Softwarized and Autonomous Management of Photonic Switching Systems Using Machine Learning". In: *2021 International Conference on Optical Network Design and Modeling (ONDM)*, pp. 1–6.
- Shahzad, Farooq et al. (2021). "Impairment-aware Virtual Network Embedding Using Time Domain Hybrid Modulation formats in Optical Networks". In: *2021 International Conference on Optical Network Design and Modeling (ONDM)*, pp. 1–6. DOI: 10.23919/ONDM51796.2021.9492380.
- Tunesi, Lorenzo, Giuseppe Giannuzzi, et al. (2021). "Automatic design of NxN integrated Benes optical switch". In: *Silicon Photonics XVI*. ed. by Graham T. Reed and Andrew P. Knights. Vol. 11691. International Society for Optics and Photonics. SPIE, pp. 164–174. DOI: 10.1117/12.2578834. URL: <https://doi.org/10.1117/12.2578834>.
- Usmani, Fehmida, Ihtesham Khan, Mehek Siddiqui, Mahnoor Khan, Muhamamd Bilal, et al. (2021). "Evaluating Cross-feature Trained Machine Learning Models for Estimating QoT of Unestablished Lightpaths". In: *2021 International Conference on Electrical, Communication, and Computer Engineering (ICECCE)*, pp. 1–6. DOI: 10.1109/ICECCE52056.2021.9514154.
- Khan, Ihtesham, Muhammad Bilal, and vittorio Curri (2020). "Cross-train: Machine Learning Assisted QoT-Estimation in Un-Used Optical Networks". In: *Proceedings of the 4rd International Conference on Telecommunications and Communication Engineering*. ICTCE '19. Singapore, Singapore: Association for Computing Machinery, pp. 1–5. DOI: [https://doi.org/10.1007/978-981-16-5692-7\\_9](https://doi.org/10.1007/978-981-16-5692-7_9).

- Khan, Ihtesham, Muhammad Bilal, and Vittorio Curri (2020a). "Advanced formulation of qot-estimation for un-established lightpaths using cross-train machine learning methods". In: *2020 22nd International Conference on Transparent Optical Networks (ICTON)*. IEEE, pp. 1-4.
- Khan, Ihtesham, Muhammad Bilal, Mehek Siddiqui, et al. (2020). "Qot estimation for light-path provisioning in un-seen optical networks using machine learning". In: *2020 22nd International Conference on Transparent Optical Networks (ICTON)*. IEEE, pp. 1-4.
- Khan, Ihtesham, Maryvonne Chalony, et al. (2020). "Machine learning assisted abstraction of photonic integrated circuits in fully disaggregated transparent optical networks". In: *2020 22nd International Conference on Transparent Optical Networks (ICTON)*. IEEE, pp. 1-4.
- Masood, M Umar, Ihtesham Khan, Arsalan Ahmad, et al. (2020). "Smart Provisioning of Sliceable Bandwidth Variable Transponders in Elastic Optical Networks". In: *2020 6th IEEE Conference on Network Softwarization (NetSoft)*. IEEE, pp. 85-91.
- D'Amico, Andrea, Stefano Straullu, Antonino Nespola, Ihtesham Khan, Sherif Abdelfattah, et al. (2019). "Machine-learning aided OSNR prediction in optical line systems". In: *45th European Conference on Optical Communication (ECOC 2019)*, pp. 1-4.