

Yubraj Bhandari

yubrajbhandari.com.np · github.com/yubrajbhandari923
linkedin.com/in/yubraj-bhandari · [Google Scholar](https://scholar.google.com/citations?user=...)

Duke University, Durham, NC, USA

yubraj.bhandari@duke.edu

Citizenship: Nepal

RESEARCH INTERESTS

- Classical simulation of quantum dynamics: Lie-algebraic (g-sim) and sparse Pauli propagation, Liouvillian Krylov methods, tensor networks, and rigorous, instance-specific control of truncation error
- Quantum algorithms and symmetry-constrained circuits: Hamiltonian simulation, error mitigation theory, energy-conserving and permutation-symmetric gate constructions
- Machine learning and numerics for the physical sciences: generative and representation learning over structured scientific data, neural quantum states, and inverse problems for PDE-governed systems

EDUCATION

Duke University

B.S. in Physics and Mathematics GPA: 3.76 / 4.00

Durham, NC, USA

Expected May 2027

- **Relevant coursework:** Quantum Mechanics, Quantum Information Theory, Statistical Learning, High-Dimensional Data Analysis and Optimization, Probability, Linear Algebra, Mathematical Modeling, Data Structures and Algorithms.

PUBLICATIONS AND PREPRINTS

Author order follows each field's convention; [†] denotes first authorship.

[1] Readout-aware defect estimation in truncated Heisenberg propagation[†]

Y. Bhandari, A. Bärligea, J. S. Kottmann. *Preprint, 2026*. A basis-agnostic formulation of operator propagation on a weighted commutator graph recovering exact Lie-algebraic simulation, sparse Pauli propagation and Liouvillian Krylov propagation as special cases, with a signed, instance-specific estimator of the error introduced by truncation.

[2] AbdomenGen: Sequential Volume-Conditioned Diffusion Framework for Abdominal Anatomy Generation[†]

Y. Bhandari, L. Dahal, W. P. Segars, J. Y. Lo. *Accepted, International Conference on Medical Image Computing and Computer-Assisted Intervention (MICCAI), 2026*. Conditional diffusion over signed distance fields generating 11 abdominal organs sequentially, with a habitus-decoupled Volume Control Scalar giving calibrated organ-wise size control; reduces Wasserstein distance to a hepatomegaly cohort by 73.6% without retraining.

[3] XCAT 3.0: A Comprehensive Library of Personalized Digital Twins Derived from CT Scans

L. Dahal, M. Ghoghnejad, L. Vancoillie, D. Ghosh, **Y. Bhandari**, D. Kim, F. C. Ho, F. I. Tushar, S. Luo, K. J. Lafata, E. Abadi, E. Samei, J. Y. Lo, W. P. Segars. *Medical Image Analysis*, 103:103636, 2025. Code and models: xcat-3.github.io.

[4] Five Models for Five Modalities: Open-Vocabulary Segmentation in Medical Imaging

L. Dahal, **Y. Bhandari**, W. P. Segars, J. Y. Lo. *CVPR 2025 Workshop on Foundation Models for Interactive 3D Biomedical Image Segmentation (MedSegFM)*. openreview.net/forum?id=VmeW9Lfjc9.

[5] Organ-Aware Attention Improves CT Triage and Classification

L. Dahal, **Y. Bhandari**, G. D. Rubin, J. Y. Lo. *arXiv:2601.13385*, January 2026. arxiv.org/abs/2601.13385.

RESEARCH EXPERIENCE

Quantum Algorithmics Group, University of Augsburg

DAAD RISE Fellow (Summer 2025), continuing as Research Collaborator — Supervisor: Prof. Jakob S. Kottmann

Augsburg

- Formulated g-sim, sparse Pauli propagation and Liouvillian Krylov propagation as one basis-agnostic operator-propagation problem on a layer-resolved weighted commutator graph, making all three special cases of a single interface.
- Proved a grade-selection rule under which a defect of minimum grade w has identically vanishing transfer moments through order $\lceil w/d \rceil - 1$, and used the resulting forbidden zeros to build signed, instance-specific estimates of dropping error for both continuous in-chain and discrete completed-layer truncation.
- Separated the finite-depth Krylov projection error from the dropping channel and controlled it with an a-posteriori terminal-residual bound under fixed-projector Lanczos.
- Implemented and validated the framework in Julia and Qiskit across Pauli-string and translation-invariant Pauli-cycle bases, reproducing identical physical results while substantially reducing coefficient and commutator counts in the cycle representation.

Symmetry-Constrained Quantum Circuits, Duke University

Durham, NC, USA

Independent Study — Supervisor: Prof. Iman Marvian

Fall 2025 – Present

- Studying the circuit model under global Abelian and non-Abelian symmetry constraints, and how representation theory and commutant structure restrict realizable circuit families and depths.
- Implemented symmetry-preserving unitaries in Qiskit — energy-conserving XY-interaction gates and permutation-symmetric N -body gates via Tavis–Cummings-type constructions — and benchmarked them in simulation.

Center for Virtual Imaging Trials, Duke University

Durham, NC, USA

Undergraduate Researcher — Supervisor: Prof. Joseph Y. Lo

Oct 2023 – Present

- Designed and led AbdomenGen (publication [2]): a conditional 3D diffusion model over signed distance fields learning a distribution of organ geometries given surrounding anatomy, yielding controllable generative priors for simulation and segmentation.
- Built reproducible 3D segmentation training and inference pipelines producing multi-organ masks used downstream for CT classification, triage and large-scale virtual imaging experiments.
- Developed a rigid and deformable registration pipeline to align 3D anatomical volumes and correct artifacts in segmentation-derived phantoms, packaged as reusable tooling for the lab. Work carried out on GPU/HPC clusters with Slurm; contributed to four peer-reviewed publications.

Physics-Constrained Air Quality Modelling, Duke University

Durham, NC / Kathmandu, Nepal

Independent Study, Bass Connections — Earthquake Early Warning in Kathmandu

Summer 2026 – Present

- Modelling urban pollutant transport over the Kathmandu valley by numerically solving the advection–diffusion equation under meteorological forcing, treating source estimation from sparse, noisy measurements as an inverse problem.
- Secured competitive grant funding (see Grants) to procure and deploy a low-cost ground sensor network in Nepal, providing the measurements used for model validation and data assimilation.

TECHNICAL SKILLS

Languages: Python (NumPy, SciPy, PyTorch), Julia, JavaScript/TypeScript, Bash

Quantum: Qiskit, PennyLane, Yao.jl, PauliStrings.jl / PauliPropagation.jl; quantum circuit simulation, operator propagation, Clifford formalism, tensor networks

Numerics & ML: Krylov and Lanczos methods, exponential integrators and φ -functions, diffusion models, 3D CNNs, U-Net, transformers, implicit neural representations, MONAI

Mathematics: Linear algebra, representation theory and Lie-algebraic methods, probability and statistics, optimization, numerical analysis

Computing: Git, Docker, GitHub Actions, Linux, GPU/HPC workflows (Slurm), CUDA programming

SOFTWARE

ShapeAtlas-UNet: Dual-encoder 3D U-Net injecting a probabilistic organ shape atlas at the bottleneck as a learned prior; up to 8-point Dice gain for compact models. github.com/yubrajbhandari923/shapeatlasUnet

obj2glTF: Published Python package converting OBJ meshes to glTF via CLI and API, used to serve XCAT-3 models on the web. pypi.org/project/obj2gltf

SCHOOLS, WORKSHOPS AND CONFERENCES

Numerical Methods in Quantum Information Science — UMass Amherst, 2025. Quantum simulation in Julia, Clifford formalism, tensor networks, CUDA programming.

Quantum Ideas Summer School — Duke University, 2024. Fundamentals of quantum computing and quantum error correction.

Virtual Imaging Trials in Medicine (VITM24) — Duke University, 2024. Conference volunteer.

TEACHING AND MENTORING

Unnchai Summer Program — Instructor and Mentor, virtual (Nepal), 2024–2025. Designed and delivered a project-based introduction to quantum algorithms for high-school students in Nepal, mentoring a cohort through implementation in Qiskit.

GRANTS AND FELLOWSHIPS

DAAD RISE Germany — German Academic Exchange Service. Competitive national fellowship funding a summer research placement in the Quantum Algorithmics Group at the University of Augsburg; the work begun there led to publication [1]. Summer 2025.

Duke University Libraries Summer Fellowship for LIFE Students — Awarded up to \$4,500 to procure and deploy a low-cost air-quality sensor network in Kathmandu for model validation. 2026.

HONORS AND AWARDS

Bronze Medal — International Olympiad on Astronomy and Astrophysics (IOAA), 2021

Silver Medal — American Mathematics Olympiad, 2021

Absolute Winner — OIThon 2022 (national hackathon, Nepal) — EaseMed medical assistant application

ADDITIONAL EXPERIENCE

Ecstatic Paradox, Butwal, Nepal — Lead Backend Developer, Sept 2020 – Dec 2022. Built and maintained a Django/Wagtail backend (CMS and HR workflows): relational schema design, REST endpoints, role-based access control and admin tooling. github.com/Ecstatic-Paradox

Last updated: September 2026