Hoang Anh (Benjamin) NGUYEN

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Professional Summary

PhD student in Geophysics at Colorado School of Mines working at the intersection of quantum computing, machine learning (ML) and scientific computing. I develop GPU-accelerated systems for large-scale elastic wave simulation and inverse problems, and design hybrid quantum–classical approaches to improve optimization and training efficiency in physics-informed neural network (PINN) models.

Education

Ph.D. of Geophysics | ***Major: Geophysics - Minor: Computer Science*** — Aug 2023 – 2027 (Expt.)
Colorado School of Mines (CSM) — Golden, CO, USA
Thesis: Solving Inverse Problems with Quantum Computing

Diploma of Earth Sciences | ***Major: Earth Sciences*** — Sept 2022 – Aug 2023
International Centre for Theoretical Physics (ICTP) - UNESCO — Trieste, Italy
Thesis: Ambient noise Tomography beneath the Banda Arc

Master of Physics | ***Major: Computational Physics*** — May 2021 – Sept 2023
Hanoi University of Science and Technology (HUST) — Hanoi, Vietnam
Thesis: Structural Simulation of MgSiO3 under Compression

Bachelor of Physics | ***Major: Computational Physics*** — Sept 2016 – April 2021
Talent Honours Program – HUST — Hanoi, Vietnam
Thesis: Computational Modelling of Microstructure of Magnesium Silicate

Research Experience

Research Assistant — Aug 2023 – Present
Department of Geophysics - CSM — Advisor: Prof. A. Tura

- Designed and implemented a hybrid quantum–classical PINN for seismic inverse problems, integrating finite-basis parameterization with ML-based optimization.
- Developing a quantum encoder–decoder neural architecture for full waveform inversion (FWI), enabling low-dimensional latent representations of high-resolution velocity models.
- PDEs solver & optimization using quantum computing.
- Built GPU-accelerated multicomponent elastic FWI framework with perfectly matched layer absorbing boundary conditions, achieving up to 50× speedup compared to baseline multiple CPU implementations.
- Implemented distributed acoustic sensing (DAS) elastic FWI workflows using strain-velocity wave equations.

Research Assistant — May 2023 – Aug 2023
Earth System Physics - ICTP — Advisors: Prof. A. Aoudia & Dr. D. Manu-Marfo

- Ambient noise tomography
- Nonlinear inversion

Research Assistant — Aug 2018 – July 2023
Department of Computational Physics - HUST — Advisor: Prof. V. H. Nguyen

- Molecular dynamics simulation
- Density functional theory

Work Experience

Incoming Geophysics R&D Research Intern — May 2026 – Aug 2026
Shell: a global integrated energy company — Houston, TX

- Anisotropic elastic FWI; specific project scope to be determined within the Geophysics R&D group

Geophysics R&D Research Intern — May 2025 – Aug 2025
TGS: an energy data and analytics company — Houston, TX

- Developed GPU-accelerated seismic wave solvers for high-performance computing environments
- Q-attenuation and compensation modeling in isotropic and anisotropic (VTI/TTI) media using Devito Pro
- Formulated anisotropic attenuation model on fully staggered grids for implementation
- Implemented Q-elastic gradient computation for reverse time migration (RTM) and FWI

Geophysics R&D Research Intern Sept 2021 – Feb 2022
VPI: a national petroleum and energy research institute Hanoi, Vietnam

- 3D ray-tracing
- Tomography

Academic Activities

Peer-review service
Geophysical Journals International (Oxford), IMAGE25 (SEG)

PhD application mentoring
Mentored 3 students attending PhD programs in the US

IMAGE25 post-convention workshop presentation Aug 2025
H. Nguyen, Optimization with quantum annealing method Houston, TX

IASPE-IAGA25 presentation Sep 2025
D. Manu-Marfo, **H. Nguyen**, A. Aoudia, Ambient noise tomography beneath the Banda basin reveals new insights into the arc-continent collision zone Lisbon, Portugal

IMAGE25 presentation Aug 2025
H. Nguyen, A. Tura, Crosswell traveltime inversion using a quantum computing method Houston, TX

RCP meeting 2025 presentation Apr 2025
H. Nguyen, A. Tura, Seismic wave propagation with gate-based quantum computing Golden, CO

RCP meeting 2024 presentation Apr 2024
H. Nguyen, A. Tura, Seismic inversion with quantum computing Golden, CO

Erasmus master exchange 2022 Feb 2022 – Jul 2022
Physics of complex systems - Polytechnic University of Turin (POLITO) Torino, Italy

HUST scientific research conference presentation May 2020
H. Nguyen, H.S. Nguyen, V.H. Nguyen, Study on structure of magnesium silicate material under densification Hanoi, Vietnam

Vietnam Robot National Contest 2019 May 2019
Team member of HUST Hanoi, Vietnam

Honors and Awards

[1] Fully funded scholarship for postgraduate program at ICTP 2023

[2] VEF 2.0 Program recommended candidate 2023: The VEF 2.0 Program is conducted by the Fellows and Scholars of the Vietnam Education Foundation (VEF) – an independent U.S. Federal Government agency created by the U.S. Congress

[3] Erasmus scholarship for master exchange students at POLITO 2022

[4] Fully funded scholarship for the master program at HUST 2021, 2022

[5] Certificate of Merit from School of Engineering Physics for undergraduates: Excellent Student in Fall Semester 2017, Spring Semester 2018, Fall Semester 2018, Spring Semester 2019

[6] The 20th Vietnam National Student Physics Olympiad 2018: Second Prize

[7] Lawrence S.Ting Scholarship 2017 for undergraduates

Other Certifications

[1] Deep Learning Specialization from DeepLearning.AI

- Neural Networks and Deep Learning (Certificate)
- Improving Deep Neural Networks: Hyperparameter Tuning, Regularization and Optimization (Certificate)
- Structuring Machine Learning Projects (Certificate)

Current Work & Publications

[1] Nguyen, H.A., Vashisth, D., Tura, A. Hybrid quantum–classical finite-basis physics-informed neural network for wave propagation and full waveform inversion. Manuscript in preparation for submission to *Communications AI & Computing* (2026).

[2] Nguyen, H. A., Manu-Marfo, D., & Aoudia, A. Ambient noise tomography beneath the Banda basin reveals new insights into the Arc-Continent collision zone. Under review at *Geophys. Res. Lett.* (2026). 10.22541/essoar.176790173.31128656/v1

[3] Plan, E.L.C.V.M., Phan, H., Nguyen, H.A. *et al.* Numerical simulation on structural and topological transitions of GeO2 liquid under compression. *Eur. Phys. J. B* **99**, 20 (2026). 10.1140/epjb/s10051-026-01143-0

[4] Nguyen, H.A., Tura, A. Seismic traveltime inversion with quantum annealing. *Scientific Reports* **15**, 17984 (2025). 10.1038/s41598-025-01188-8

[5] Lai, D.V., Nguyen, S.H., Nguyen, H.A. *et al.* Tailoring hydrogen storage performance of Mg–Mg_2Ni alloys: synergistic effects of composition and phase formation with first-principles insights. *RSC Advances* **15**, 31240–31254 (2025). 10.1039/D5RA04356E

[6] Nguyen, V.H., Pham, T.D., Nguyen, H., Mai, T.L. Molecular dynamics-based analysis of cavity distribution in GeO_2 glass: a novel computational method. (Manuscript). Link

[7] Nguyen, V.H., Nguyen, H.A. Crystallisation of liquid silica under compression: a molecular dynamics simulation. *Pramana - J Phys* **98**, 142 (2024). 10.1007/s12043-024-02839-7

[8] Nguyen, H.A., Nguyen, V.H. Study of the structure of $MgSiO_3$ system under compression by using ring statistics and voronoi analysis. *Phys. Scr.* **98**, 045919 (2023). 10.1088/1402-4896/acc5b7

[9] Nguyen, V.H., Nguyen, H.A., Iitaka, T., Mai, T.L. Computer simulation of phosphate-silicate and calcium phosphate-silicate systems. *Phys. Scr.* **98**, 065704 (2023). 10.1088/1402-4896/acd4fb

[10] Nguyen, H.A., Nguyen, S., Nguyen, V.H. Pressure-induced glassy networks of enstatite ($MgSiO_3$) and forsterite (Mg_2SiO_4). *VNU J. Sci. Math. - Phys.* **39**, 1 (2023). 10.25073/2588-1124/vnumap.4767

[11] Pham, T.H.H., Doan, H.H., Ta, Q.M., Mai, T.L., Nguyen, H.A. Some results of seismic travel-time reflection tomography study. *Petrovietnam Journal* **10**, 4–16 (2021). 10.47800/PVJ.2021.10-01

[12] Nguyen, H.S., Nguyen, H.A., Pham, H.K., Iitaka, T., Nguyen, V.H. Topology of SiO_x units and glassy network of magnesium silicate glass under densification: correlation between radial distribution function and bond angle distribution. *Modelling Simul. Mater. Sci. Eng.* **28**, 065007 (2020). 10.1088/1361-651X/ab9bb4

[13] Nguyen, H.S., Nguyen, H.A. Structural simulation of Mg_2SiO_4 under compression. *VNU J. Sci. Math. - Phys.* **36**, 4 (2020). 10.25073/2588-1124/vnumap.4484

Technical Skills

Programming: Python, C, C++, Fortran, Matlab
Machine Learning Frameworks: JAX, PyTorch, TensorFlow, scikit-learn
Geophysical Modeling: Anisotropic elastic FWI, RTM, DAS, ambient noise tomography, quantum PDE solvers
Optimization: Adjoint-state methods, quantum annealing
HPC: Slurm, MPI, OpenMP/OpenACC, GPU computing.