# Mohamed Abouagour

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## Research Interests

Computer vision and 3D scene understanding; GPU-based real-time graphics and shader programming; deep learning for point clouds, spherical and structured signals; large-scale visual datasets and generative models for scientific and real-world imagery.

## Education

**Indiana University Bloomington** — Bloomington, IN
*Ph.D. in Intelligent Systems Engineering; planned Minor in Computer Science* — *Aug. 2024 – Present*

- GPA: 3.976/4.0 — Luddy Summer Fellowship recipient (2025, 2026)
- Relevant coursework: Deep Learning Systems, Image Processing for Medical Applications, Topics in AI (CSCI-B 659), Intro to Computer Engineering

**Tanta University** — Tanta, Egypt
*B.Eng. in Electrical Engineering – Computer Engineering and Automatic Control* — *Sep. 2018 – Jul. 2023*

## Publications & Preprints

**Spherical Hermite Maps** — 2026

- **M. Abouagour**, E. Garyfallidis. *arXiv:2602.20063*, 2026.
- Derivative-augmented cubemap LUT for bicubic-quality reconstruction of spherical functions from a 2×2 texel footprint; 8–41 dB PSNR improvement over bilinear with analytic surface normals. Directly applicable to spherical CNN features, panoramic imagery, and SH-based neural representations.

**PRISM: Differentiable Analysis-by-Synthesis for Fixel Recovery in Diffusion MRI** — 2026

- **M. Abouagour**, A. Shah, E. Garyfallidis. *arXiv:2604.00250*, 2026.
- Differentiable forward-model framework combining physics priors with gradient-based optimization; resolves fiber crossings down to 20° with 3.5° mean angular error and 95% recall.

**GFLAN: Generative Functional Layouts** — 2025

- **M. Abouagour**, E. Garyfallidis. *arXiv:2512.16275*, 2025.
- Graph-conditioned generative model for functional 2D layouts; learns structured spatial priors over room adjacencies and produces floor plans that satisfy user-supplied topological constraints.

**ResPlan: A Large-Scale Vector-Graph Dataset of 17,000 Residential Floor Plans** — 2025

- **M. Abouagour**, E. Garyfallidis. *arXiv:2508.14006*, 2025.
- Built an end-to-end pipeline to scrape, clean, vectorize, and graph-encode 17,000 floor plans with room labels, walls, doors, and windows; enables benchmarking of layout generation, graph learning, and visual parsing.

## Research Experience

**Graduate Research Assistant – Garyfallidis Research Group** — Bloomington, IN
*Indiana University Bloomington, Luddy School* — *Aug. 2024 – Present*

- **3D / scientific visualization:** designed and implemented WebGPU-based rendering pipelines for volumetric and spherical data, including compute-shader tractography and real-time GPU glyph evaluation.
- **Deep learning for structured data:** developed a graph-conditioned generative model (GFLAN) for functional 2D layouts, including dataset construction, graph encoding, and evaluation.
- **Analysis-by-synthesis & inverse problems:** built PRISM, a framework that couples a physics-based forward model with gradient-based optimization to recover latent structure from noisy measurements.
- **Large-scale visual datasets:** curated ResPlan, a 17K-floor-plan vector–graph dataset, from scraping and vectorization to labeling and graph construction.

## Open-Source Contributions & Research Software

**FURY – Free Unified Rendering in Python** | *Core Contributor & Maintainer*

- Core contributor and maintainer of FURY v2, a WebGPU-based scientific visualization library; authored 54+ merged pull requests.
- Designed the keyframe animation system featuring hierarchical transforms, SLERP-based rotation interpolation, and playback controls.
- Built primitive actors, shader-based rendering components, FPS display, and core utility modules.

**DIPY – Diffusion Imaging in Python** | *Contributor*

- Implemented spherical harmonics glyph visualization in DIPY Horizon (Skyline) using Spherical Hermite Maps, a GPU-efficient derivative-augmented cubemap technique.
- Developed compute-shader-based streamtube generation for real-time 3D curve / tractography rendering in WebGPU.

## Teaching & Mentoring

**Indiana University Bloomington, Luddy School** Bloomington, IN

*Co-Instructor, DSCI-D 321 Data Representation (Undergraduate)* *Spring 2025 & Spring 2026*

- Co-designed curriculum and taught 150+ students time-series analysis, Fourier transforms, audio representations, graph theory, NumPy, and data engineering.

*Teaching Assistant, Intelligent Systems I (Undergraduate)* *Fall 2025*

- Led labs and office hours on search, probabilistic reasoning, and machine learning fundamentals.

**Google Summer of Code – Mentor** Apr. 2024 – Oct. 2024

*Python Software Foundation – FURY*

- Mentored a GSoC contributor on integrating LLM-powered assistants with Discord, GitHub, and X for open-source scientific visualization.

**Google Summer of Code – Contributor** May 2022 – Oct. 2022

*Python Software Foundation – FURY*

- Built a keyframe animation system supporting play/pause/rewind, SLERP rotation, linear and non-linear interpolation, hierarchical transforms, and motion paths.

## Technical Skills

**Computer Vision & ML**: PyTorch, NumPy, SciPy, scikit-learn, TensorFlow; generative models, graph neural networks
**3D & Graphics**: OpenGL, GLSL, WebGL, WebGPU, WGSL, compute shaders, CUDA, VTK, ray marching
**Structured / Scientific Data**: point clouds, meshes, spherical harmonics, diffusion MRI, NIfTI, large-scale vector-graph datasets
**Languages**: Python, C/C++, JavaScript/TypeScript, CUDA, SQL
**Tools**: Git, Linux, Docker, CI/CD (GitHub Actions), LaTeX