K S Nithurshen

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Research Interests: **Systems** (High-Performance Computing, Parallel & Sparse Numerical Computing, Scientific Computing, GPU Programming, Compilers & Code Generation, Operating Systems)
Visual Computing (Computer Vision, Neural Rendering (Gaussian Splatting, NeRF), Deep Learning, Image Processing, Computer Graphics)

EDUCATION

Shiv Nadar University, Delhi-NCR, India 2024 – 2028
B.Tech in Computer Science and Engineering | CGPA: **9.79 / 10.0** | Dean's List, all semesters (top 10%)

PUBLICATIONS

K S Nithurshen and Saurabh J. Shigwan. "SpineContextResUNet: A Computationally Efficient Residual UNet for Spine CT Segmentation." *IEEE CBMS 2026*, Limassol, Cyprus (**oral presentation**). [IEEE Xplore] | [arXiv] | [GitHub]

- 1.7M-param 3D ResUNet with ASPP context block: 88.17%/88.13% Dice (CTSpine1K/VerSe2020), ∼15% above a parameter-matched SwinUNETR.
- Gaussian-weighted sliding-window inference that runs on edge hardware where heavy nnU-Nets run out of memory.

EXPERIENCE

Undergraduate Researcher, Dept. of CSE, Shiv Nadar University Aug 2026 – Present
Advisor: Dr. Snehasis Mukherjee | Multi-Domain Image Restoration via Self-Supervised Domain Generalization

- Building an unpaired CycleGAN-based framework with Barlow Twins decorrelation and Alignment-Uniformity regularization, with custom CUDA kernels for the cross-correlation loss ($\mathcal{L}_{BT}$) and inter-domain gradient projection ($g_i^\top g_j$).
- Evaluating out-of-distribution restoration on haze/rain (Rain100, RESIDE), sensor noise (SIDD), and Monte Carlo rendering artifacts.

Google Summer of Code 2026 – EROFS Filesystem May 2026 – Nov 2026
Mentors: Xiang Gao, Yifan Zhao, Chunhai Guo [Final Report] | [GSoC Page]

- Architected a producer-consumer decompression pipeline in `fsck.erofs` with algorithm-aware pcluster batching, decoupling CPU-bound decompression from synchronous I/O.
- Parallelized directory traversal with a worker pool by localizing shared global state into per-task payloads, with mutex-protected hardlink and statistics tables.
- Cut extraction time by up to 77% (LZMA), 35% (ZSTD), and 31% (LZ4HC); series (1/2, 2/2) applied by the maintainer to `experimental-mt-extraction`.

Research Intern, Dept. of Materials Science & Engineering, IIT Gandhinagar May 2026 – Aug 2026
Advisor: Dr. Raghavan Ranganathan | 3D Score-Based Diffusion for Amorphous Carbon Structure Synthesis

- Built a 3D score-based diffusion model (GNN score function) on 512-atom *ab-initio* melt-quench data, with custom CUDA kernels for periodic neighbor-list construction and score evaluation.
- Generated 400 structures per density across 0.9–3.5 g/cm^3 and 13 system sizes (128–16,384 atoms); achieved zero-shot generation at unseen densities, validated via RDF, bond angles, and coordination numbers.

OPEN SOURCE CONTRIBUTIONS

erofs-utils, Apache DataFusion, Blender, pandas, scikit-learn, Mesa & aeon [GitHub] | [Blender]

- **erofs-utils (C):** Six patches merged upstream – use-after-free hardening, memory-leak fixes, and undefined bit-shift behavior in zstd `dict_size`.
- **Apache DataFusion (Rust):** Substrait consumer support for `like_match`/`like_imatch`; `elapsed_compute` metrics for CSV scans.
- **Blender (C/C++) and Python stack:** Merged fixes for Blender's Python API and Geometry Nodes, and across pandas, scikit-learn, Mesa, and aeon.

PROJECTS

- **Rigel** [GitHub]: Differentiable 3D Gaussian Splatting renderer and trainer from scratch in CUDA C++ – CUB radix depth-sorting, shared-memory tile rasterization, and analytical EWA backward kernels without autograd.
- **Irena** [GitHub]: GPU path tracer using OpenCL compute with Vulkan interop and a C++ BVH for ray-triangle intersection.
- **Avior & Avior-CUDA** [avior] | [avior-cuda]: Zero-dependency C++17 image denoiser ($O(1)$ NLM, custom PNG codecs) with a warp-optimized CUDA port.

TECHNICAL SKILLS

Languages: C, C++, CUDA, Python, Rust, Bash, SQL, GLSL | **GPU & Systems:** OpenCL, Metal, Vulkan, OpenGL, POSIX threads, Linux VFS
ML & Vision: PyTorch, PyTorch Geometric, TensorRT, ONNX Runtime, OpenCV, scikit-learn
Tools: Nsight Compute/Systems, compute-sanitizer, perf, GDB, Valgrind, AddressSanitizer, CMake, Docker, SLURM, Git

TEACHING & LEADERSHIP

Teaching Assistant, Discrete Mathematics, Shiv Nadar University (Dr. Arnab Ganguly) Aug 2026 – Present
AI/ML Team Lead, ACM Student Chapter, Shiv Nadar University Sep 2025 – Present