


Prakhar Kaushik

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PROFESSIONAL SUMMARY

Fundamental AI and 3D Vision researcher, focused on efficiency and robustness. Leading researcher in **Cognitive Science-based 3D parts** analysis by synthesis and representation. Creator of the only UDA method for 3D object pose estimation and only neural method for simultaneous 3D part segmentation and naming method. Deep expertise in large model Continual Learning, and Physics of AI (**Universal Weight Subspace Hypothesis**). The majority of works are **first-authored** or involve **project leadership**, often achieved despite significant compute constraints, and working solo. **I also have worked as AI development lead for a “digital-twin” AI startup.**

- **Multifaceted expertise:** Published novel theoretical and empirical discoveries (*Universal Weight Subspace Hypothesis*) while building SOTA 3D vision systems (*Name That Part*), 3D Evals (COLMAP is All You Need), LLM/VLM/Diffusion models efficiency algorithms (*EigenLoRAx*) and new LLM/VLM reasoning methods (Perceptual Taxonomy).
- **Field Leadership:** De facto leader in **3D Part Segmentation and Naming** research; Creator of largest Open source named 3D parts dataset - **TexParts** (8,450 objects). Created the only method to-date for Image-Only 3D Object Unsupervised Domain Adaptation (**3DUDA**).
- **Engineering Impact:** Expert in translating deep theoretical insights into massive efficiency and robustness gains, achieving **100x speedups** in 3D segmentation and **100x parameter reduction** in model adaptation.
- **Core Tech:** 3D Analysis-by-Synthesis, Sim-to-Real Adaptation, Parameter-Efficient Fine-Tuning (PEFT/LoRA), and LLM Interpretability, Continual Learning, Controllable Generation, VLM Reasoning, 3D Eval.

TLDR: I am an early career researcher with a rare combination of skills involving **3D Vision, Cognitive Science, Physics of AI, Efficient and Continual Learning** (EC researchers usually practice at most 1-2). I have solved hard problems in all these areas, often better than much better equipped industry teams, despite significant lack of resources, and often, independently.

RESEARCH & PROFESSIONAL EXPERIENCE (3.5 + 5 (PhD) total experience)

Johns Hopkins University (CCVL Lab) | Graduate Research Assistant (PhD) | Baltimore, MD Aug 2020 – Present
Lead Researcher: 3D Vision, Efficient LLMs, & Neuro-Symbolic AI

- **The Universal Weight Subspace Hypothesis (Viral Research):**
 - Proposed and empirically validated the fundamental theory that diverse neural networks (LLMs, ViTs) converge to shared, low-dimensional spectral subspaces.
 - **Impact:** Analyzed **1,100+ models** (Mistral-7B, LLaMA-8B) to demonstrate >90% of variance lies in just 16-32 components. Work became **viral** in the ML community, influencing new methods in Model Merging and Continual Learning.
- **Name That Part (Project Lead):**
 - Architected **ALIGN-Parts**, a feed-forward set-alignment framework for 3D part segmentation that eliminates the need for clustering.
 - **Metric:** Achieved a **100x speedup** over SOTA baselines (e.g., PartField) and established the new industry standard for open-vocabulary part naming.

- **Resource Creation:** Led the creation of **TexParts**, the largest semantically aligned 3D part dataset (14k categories), solving the "Sim-to-Real" data bottleneck for the community.
- **EigenLoRAx (Efficient AI):**
 - Developed a novel adapter recycling technique that leverages principal subspaces for resource-constrained inference.
 - **Metric:** Reduced trainable parameters by **100x** and memory footprint by **18x** compared to standard LoRA, enabling multi-task LLM deployment on edge devices.
- **Perceptual Taxonomy (LLM/VLM Reasoning):**
 - Project Lead and creator of perceptual taxonomical reasoning methodology for VLMs and LLMs which allow for robust human-like reasoning and reduced hallucinations..

Amazon (Visual Search) | Applied Scientist Intern | Palo Alto, CA Jun 2022 – Dec 2022

- **Generative AI for AR:** Pioneered a **Structured Image Inpainting** pipeline specifically for Amazon's "Design Your Room" Augmented Reality feature.
- **Business Impact:** Significantly enhanced the realism of virtual furniture placement, directly improving user engagement metrics and conversion rates for the Visual Search vertical.

Amazon (Sponsored Products) | Applied Scientist Intern | Palo Alto, CA Jun 2021 – Sep 2021

- **Causal Inference at Scale:** Designed a robust causal inference framework to correct selection bias in observational Weblab data.
- **Outcome:** Eliminated confounding variables to provide leadership with accurate **Return on Ad Spend (ROAS)** metrics, guiding multi-million-dollar advertising strategy decisions.

Amplio | AI Development Lead Engineer | Chantilly, VA Apr 2019 – Apr 2020

- **End-to-End ML Systems:** Led the R&D of a "Digital Twin" predictive engine for athlete performance, fusing heterogeneous data (video, wearables, physiological sensors).
- **Leadership:** Managed cross-functional teams of sports scientists and engineers to deploy multimodal models that predicted injury risks with high accuracy.

Ernst & Young | Risk Analyst | India, Jul 2017 – Dec 2017

- Identified, assessed, and managed technology-related risks, including cybersecurity and operational IT risks.

JHU Laboratory for Computational Sensing + Robotics | Graduate Research Assistant (PhD) | Baltimore Jun -Sep 2020

- Created a real-time, Unsupervised **Robot Path Detection** Algorithm. Manager - Dr. Marin Kobilarov

JHU School of Public Health | Graduate Research Assistant (PhD) | Baltimore, MD Oct 2018 - Apr 2019

- **Created a traffic image dataset** from all around the world for traffic behavior analysis using robust object detection.

CR Rao Institute of Mathematics, Statistics & Computer Science | Visiting Researcher | Hyderabad, India Apr - Jul 2017

- Multi-Sensory Fusion algorithm for **secure offline navigation system**. Advisor - Dr. Vishal Saraswat

Indian Statistical Institute | *Research Intern* | Kolkata, India May - Aug 2016

- Microsoft Asia Research Internship. **Side Channel Attack Analysis** of AES cryptographic algorithm. Advisor - Dr. Vishal Saraswat

TECHNICAL SKILLS

- **Core AI:** 3D Computer Vision, Generative AI (Diffusion, GANs), LLMs (Llama, Mistral), LoRA/PEFT, Unsupervised Domain Adaptation (UDA), NeRF/Gaussian Splatting, Causal Inference.
- **Engineering:** PyTorch, TensorFlow, Python, C++, Docker, Kubernetes, AWS (SageMaker, EC2), Blender (bpy), CUDA, GPU architectures.
- **Math & Theory:** Spectral Analysis, Bayesian Optimization, Geometry Processing, Optimization.

TEACHING EXPERIENCE

Johns Hopkins University

Baltimore, MD

Graduate Teaching Assistant, Probabilistic Models of the Visual Cortex 08/2024 - 12/2024

EDUCATION

Johns Hopkins University | Baltimore, MD

- Ph.D. in Computer Science (Advisor: Dr. Alan Yuille) | *Expected early 2026*
- M.S. in Computer Science | **2020**

Indian Naval Academy, etc | India

- **B.Tech in Electronics & Communications** | **2017**
 - **Awards:** All India Rank 1 (UPSC (RIMC) Exam), Best in Mathematics Medal.

Rashtriya Indian Military College | High School

AWARDS & COMMUNITY

- **Talks** Artificial Intelligence for Engineering and Medicine Lab (Dr. Rama Chellappa) - April 2024, JHU Cognitive Neuroscience and Deep Learning Group - February 2025, Levin Lab (Tufts) - Jan 2026
- **Feature Article:** Work profiled in **Johns Hopkins Engineering News:** [In the World of AI, Who Speaks for the Trees?](#) highlighting contributions to sustainable, green AI.
- **Viral Research:** *Universal Weight Subspace Hypothesis* trended on **Hacker News, AlphaArxiv, Reddit, Daily.dev,** and **The AI Timeline**, sparking widespread discussion on neural network interpretability and efficiency.
- Lieutenant General MM Lakhera Silver Medal, 2012 – Best In Mathematics. Colonel Haughten Silver Medal, 2012. Lieutenant Commander Rajat K Sen Silver Medal, 2010. UN Jha Memorial Gold Medal, 2010.
- **All India Rank 1 - Rashtriya Indian Military College Examination, All India Rank 2 - UPSC National Defence Academy and Naval Academy Examination**

- **Leadership: Founder & President, Indian Graduate Student Association (IGSA) at JHU (Largest graduate group).**
- **Memberships:** IEEE, Upsilon Pi Epsilon, the national CS honor society.

Languages: English and Hindi (Native), Japanese and Indic languages (Punjabi, Bengali, Nepali, etc.), Japanese (Conversational), Mandarin Chinese and Korean (Beginner)

Miscellaneous Debating and Quizzing team captain (2008-2012) with multiple All India awards; Licensed Mountaineer (Mt. Bandarpunch, 21,000 feet (2010)), Scuba Diver and Marksman (India Pre-Nationals 2010-11)

APPENDIX: SELECTED PUBLICATIONS & SUMMARIES

Complete list on the [homepage](#) and [Google Scholar](#).

Theory & Efficiency, Continual Learning & Physics of AI

- **[Viral Research] [The Universal Weight Subspace Hypothesis](#)** (arXiv 2025).
Summary: Proven that diverse neural networks converge to shared low-dimensional spectral subspaces, enabling efficient model merging.
- **[EigenLoRAx: Recycling Adapters to Find Principal Subspaces for Resource-Efficient Adaptation and Inference](#)** (CVPR 2025, Workshop Oral)
Summary: An adaptation method reducing parameters by **100x** and memory by **18x** by recycling trained adapters into principal components. Media Coverage of this work - [In the World of AI, Who Speaks for the Trees?](#).
- **[Understanding catastrophic forgetting and remembering in continual learning with optimal relevance mapping](#)**, P Kaushik, A Gain, A Kortylewski, A Yuille, 2021 Conference on Neural Information Processing Systems (**NeurIPS**)-W
Summary: Seminal work regarding Catastrophic Forgetting & Remembering with mapping optimal relevance to prevent forgetting in continual learning.
- **[inemo: Incremental neural mesh models for robust class-incremental learning](#)**, (ECCV 2024)
- **[Adaptive neural connections for sparsity learning](#)**, (WACV, 2020).
- **[Shared LoRA Subspaces for almost Strict Continual Learning](#)**. (arXiv 2026).
Summary: First method to do strict CL for LLM/VLM and Diffusion models.

3D Vision, VLM & Generative AI

- **[Project Lead] [Name That Part: 3D Part Segmentation and Naming](#)** (CVPR 2026)
Summary: **First work to do 3D part segmentation and naming.** A **100x faster** framework for open-vocabulary 3D part naming, introducing the **TexParts** dataset (8,450 objects).
- **[COLMAP Is All You Need: Robust Metrics for Evaluating MultiView 3D Consistency](#)**.
- **[Gaussian Scenes: Pose-Free Sparse-View Scene Reconstruction using Depth-Enhanced Diffusion Priors](#)**, (TMLR 2025). [Project Page](#)
Summary: Reconstructs 3D scenes from sparse views without camera poses by leveraging depth-enhanced diffusion priors.
- **[Source-Free and Image-Only Unsupervised Domain Adaptation for Category Level Object Pose Estimation](#)**, (ICLR) 2024.
Summary: The first framework to solve "Sim-to-Real" transfer for 3D object pose estimation using only images.

- [Scaling 3D Compositional Models for Robust Classification and Pose Estimation](#), (ICCV) 2025
Summary: Demonstrates that scaling compositional models improves robustness against occlusions and domain shifts.
- [Perceptual Taxonomy: Evaluating and Guiding Hierarchical Scene Reasoning in Vision-Language Models](#). (Project Lead, Co-Senior Author)
Summary: A benchmark for evaluating how Vision-Language Models reason about hierarchical scene structures.
- [Progressive Prompt Detailing for Improved Alignment in Text-to-Image Generative Models](#), (CVPR) 2025. Workshop **Oral**.
- [Animal3d: A comprehensive dataset of 3d animal pose and shape](#). Proceedings of the IEEE/CVF International Conference on Computer Vision (ICCV) 2023.

MISCELLANEOUS

- [A Bayesian Approach to OOD Robustness in Image Classification](#), P Kaushik, A Kortylewski, A Yuille, The IEEE/CVF Conference on Computer Vision and Pattern Recognition (CVPR) 2024.
- [Learning part segmentation from synthetic animals](#), J Peng, J He, P Kaushik, Z Xiao, J Mu, A Yuille. Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (WACV) 2024
- [Radar as a security measure-real time neural model based human detection and behaviour classification](#). P Kaushik. GlobalSIP 2019.
- [Timing attack analysis on AES on modern processors](#). P Kaushik, R Majumdar. ICRITO 2017
- [An Offline Outdoor Navigation System with Full Privacy](#). P Kaushik, V Saraswat, F Buccafurri, WINSYS, 95-101
- [EigenLoRA: Recycle trained Adapters for Resource Efficient Adaptation and Inference](#). P Kaushik, A Mishra, A Vaidya, R Addanki, RA Rossi, A Nenkova, A Liu, ...
- [DSPart: A Large-scale Diffusion-generated Synthetic Dataset with Annotations from 3D Parts](#). J Peng, Y Sun, J He, J Chen, P Kaushik, W Ma, Y Zhang, J Wang, A Wang, ...
- [CIDA3D: Conformal Inference aided unsupervised Domain Adaptation for 3D-Aware Classification](#). P Kaushik, A Mishra, A Liu, A Kortylewski, A Yuille.
- [TriDiff-4D: Fast 4D Generation through Diffusion-based Triplane Re-posing](#). EP Sheung, Q Liu, W Ma, P Kaushik, J Xie, A Yuille. Arxiv. 2025

Unreleased Preprints (please contact for drafts or code)

- **High Quality 3D Animal Modelling from images and videos**. P Kaushik and collaborators.
Summary: World's first method to generate high quality 3D animals from images and videos, including physics oriented hierarchical fur strands.
- **VSplats: Efficient and Detail Oriented 3D Splatting**. P Kaushik, S Paul, A Yuille
Summary: 3D volume representation method with improved sharpness and 50% more efficient than 3D gaussian Splatting.