Vibhas Kumar Vats

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Education

2021 – present **Ph.D. Computer Science, Indiana University** Bloomington, IN.
GPA: *4.0/4.0* | Research Interest: *3D Reconstruction and Generation, Multi-View Stereo, Scene understanding, Deep representation learning, Deep Learning (DL), DL - Case-Based Reasoning Integration.*

2019 – 2021 **M.Sc. Data Science, Indiana University** Bloomington, IN.
GPA: *3.97/4.0* | Thesis title: *Response-Based Knowledge Distillation. (pdf)*

2011 – 2015 **B.Tech. Electrical Engineering, National Institute of Technology** Patna, India.
CGPA: *8.77/10.0.*

Research Publications

Journal Articles

1. **V. K. Vats** and D. J. Crandall, "Geometric constraints in deep learning frameworks: A survey," *ACM Comput. Surv.*, Apr. 2025, Just Accepted, ISSN: xxxx-xxxx.
2. C. Wang, M. A. Reza, **V. K. Vats**, *et al.*, "Deep learning-based 3d reconstruction from multiple images: A survey," *Neurocomputing*, p. 128 018, 2024, ISSN: 0925-2312. DOI: https://doi.org/10.1016/j.neucom.2024.128018.

Conference Proceedings

1. **V. K. Vats**, Z. Wilkerson, H. Sato, D. Leake, and D. J. Crandall, "Learning case features with proxy-guided deep neural networks," in *accepted at International Conference on Case-based Reasoning (ICCBR)*, 2025.
2. **V. K. Vats**, S. Joshi, D. J. Crandall, M. A. Reza, and S.-h. Jung, "Gc-mvsnet: Multi-view, multi-scale, geometrically-consistent multi-view stereo," in *Proceedings of the IEEE/CVF Winter Conference on Applications of Computer Vision (WACV)*, Jan. 2024, pp. 3242–3252. URL: https://vkvats.github.io/GCMVSNet-page/.
3. **V. K. Vats**, Z. Wilkerson, D. Leake, and D. J. Crandall, "Extracting indexing features for cbr from deep neural networks: A transfer learning approach," in *International Conference on Case-based Reasoning (ICCBR)*, 2024.
4. Z. Wilkerson, **V. K. Vats**, K. Acharya, D. Leake, and D. Crandall, "Examining the impact of network architecture on extracted feature quality for cbr," in *Case-Based Reasoning Research and Development*, S. Massie and S. Chakraborti, Eds., Cham: Springer Nature Switzerland, 2023, pp. 3–18.
5. **V. K. Vats** and D. Crandall, "Controlling the quality of distillation in response-based network compression," in *AAAI International Workshop on Practical Deep Learning in the Wild*, 2022.

Preprint / Under Review

1. T. Ha, **V. K. Vats**, M. A. R. Soon-heung Jung, and D. Crandall, *Hvpunet: Hybrid-voxel point-cloud unsampling network (under review - iccv)*, 2025.
2. **V. K. Vats**, M. A. Reza, D. J. Crandall, and S.-h. Jung, *Blending 3d geometry and machine learning for multi-view stereopsis (under review - transaction on pattern analysis and machine intelligence)*, Nov. 2024.

Patents

1. **V. Vats**, S.-h. Jung, D. Crandall, M. A. Reza, and S. joshi, "Learning method and device for estimating depth information of image," 20 250 061 596, Feb. 2025. URL: https://www.freepatentsonline.com/y2025/0061596.html.

Skills

Languages & tools Python, R, SQL, Docker, R-Studio, PostgreSQL, C (intermediate)

Frameworks PyTorch (advanced), TensorFlow (advanced), Keras (advanced)

Work Experience

Summer-2024 **Summer Intern**, GeoAI group, Oak Ridge National Laboratory (ORNL), Tennessee.
- Collaborated with a multidisciplinary team of researchers to apply AI in geospatial analysis
- Developed a generative diffusion model to predict and analyze land use and land cover patterns
- Designed a multi-branch conditional normalization technique to control the diffusion model
Dataset: National Land Cover Database (NLCD)

2017-2019 **External Research Fellow**, National Institute of Technology Patna, India
`Project title`: Sustainable Smart Grid Framework for Energy Management System Incorporating Available Renewable Resources, funded by the SERB, Government of India
- Developed a model to mitigate the Communication-link failure in a smart meter-based load forecasting system using machine learning
- Implemented an electrical load forecasting system using a weighted polynomial regression model

2015-2017 **Senior Manager**, Tata Motors Ltd. Pantnagar, India.
- Optimized maintenance schedule of Generator yard equipment using past maintenance data
- Developed SOP for building and maintenance of earthing pits

Research Experience

2021-present **Graduate Research Assistant**, Indiana University Bloomington
◇ **3D Reconstruction, Generation and Scene Understanding:** Developed an MVS algorithm that enforces multi-view geometric consistency in the end-to-end learning process
- Exploring the integration of 3D geometric constraints in deep learning-based MVS frameworks
- Exploring structure-based attention for preserving geometric structure in feature extraction
- Exploring the application of the Diffusion Process in 3D depth volume manipulation
Datasets: DTU, Tanks & Temples, BlendedMVS, ETH3D
◇ **Mode-Collapse in Diffusion Models:** Studying the attributes of diffusion model leading to mode-collapse on recursively trained and generated dataset
Dataset: MNIST, Modified ImageNet
◇ **Action Segmentation:** Developing a multi-stream active speaker detection pipeline for videos, combining synchronized audio and video frames for more accurate speaker identification.
- Leveraging attention-based feature extractors to generate conditionals for diffusion models
- *Dataset:* Ego4D Audio-Visual tasks
◇ **Deep Learning (DL) - Case-Based Reasoning (CBR) Integration:** Developed an algorithm to examine the impact of DL features on CBR models
- Developed hybrid system leveraging knowledge-engineered and network-learned features together
- Exploring methods to integrate feedback from a CBR model in training a DL model
- Exploring proxy functions of a CBR model to learn similarity-based features in a DL framework.
Dataset: AWA2, Flower102, MNIST

2020-2021 **Masters thesis** on Response-based Knowledge Distillation (*pdf*)
- Analyzed the knowledge distillation process under varying conditions of networks
- Proposed the soft-label hypothesis to explain the behavior of the distillation process
- Developed method to pre-train teacher model for effective knowledge distillation

Teaching Experience

2022-2025 **Co-instructor/course designer, Computer Vision (CSCI-B657)**, Indiana University Bloomington
- Led deep learning discussions with Prof. David Crandall in Spring 2022, 2023, and 2024
- It extensively covers seminal papers on *CNNs*, *MLPs*, *Transformers*, *Generative Adversarial Networks*, *Variational Autoencoders*, and *Diffusion Models*
- A complete list of papers covered in Spring'24 and Spring'25

Awards and Achievements

2022 **Associate Instructor of the Year**, Indiana University Bloomington

2017 **Outstanding Work Award** by Tata Sustainability group for distinctive work in the CSR program.

2015 **Best Graduate**, National Institute of Technology Patna, batch of 2015.