Pratyay Dutta

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E-Mail | Google Scholar | LinkedIn | Github

Research Interests

Broad interest: Computer Vision, Deep Learning, Physics based modeling

Specific interest: Physics-based modeling, Diffusion models, Person Re-Identification, Re-ranking, Occlusion detection, Uncertainty Quantification, Latent feature reconstruction, Heat diffusion transformer systems, Reinforcement learning, GNNs, Graph Attention, Data structures and algorithms, LLMs, VLMs, RLHF, DPO.

Education

University of California, Riverside — Sep 2023 – Present
Doctor of Philosophy (Ph.D.) in Computer Science | *Grade* : 3.94/4 — *California, USA*

Jadavpur University — Jul 2019 – July 2023
Bachelor of Electronics and Telecommunication Engineering | *Grade* : 9.5/10 — *Kolkata, India*

Calcutta Boys' School — Jul 2005 – July 2019
Primary, middle and high school — *Kolkata, India*

Research Experience

Research Assistant — Sep 2023 – Present
University of California, Riverside – Advisor: Dr. Bir Bhanu — *California, USA*

- **Anisotropic Heat Diffusion algorithm** in Transformer architectures for event based data. Developing an edge robust heat diffusion algorithm to employ instead of self-attention in Vision Transformer architectures to ensure gradient aware information flow in 2D.
- **Virtual Cloth Try-off using Stable Diffusion and Flux-Kontext:** Developed a virtual garment extraction system that maps images of clothed individuals to flat lay representations of their clothing. Fine-tuned the denoising pipeline of **Stable Diffusion 1.5** on the VTON dataset and bench marked it against **Flux-Kontext 1.0** (Black Forest Labs) and Google's **Nano-Banana** two new vision-language models, which demonstrated superior visual quality and semantic accuracy.
- **Image inpainting with diffusion models:** Developed a robust pipeline to edit images using instance segmentation masks and diffusion models. Used bounding box prompts with **SAM** and **Dino** for text prompted segmentation to locate area of editing. Used Control-Net to finetune **Stable Diffusion 1.5** to accurately in-paint background after human body removal using **LoRA**.
- **Rigid body collision simulation:** Designed a **MuJoCo** simulator with custom physics-based modeling to prevent infinite bouncing, using a time integration scheme which handles collisions and contact separately. [Git]
- **Atari with Deep Recurrent Q-networks:** Leveraged **baseline DQN with LSTM** to solve Atari games as POMDPs, outperforming standard DQN by leveraging temporal information and flow of information.[Git]
- **Efficient Multiple Sequence Alignment:** Implemented a Numba-accelerated version of **Hirsch's algorithm** for 3-way MSA using space-saving dynamic programming. It runs efficiently by accelerating big matrix multiplications in numpy.[Git]

Research Internship — Jun 2022 – Aug 2022
Dalhousie University – Advisor: Dr. Yannick Marchand — *Halifax, Canada*

- Built a predictive modeling pipeline on **Lichess** chess data, identifying features critical to classifying problem difficulty for educational use and built an RL agent which beats amateur players under a certain FIDE rating using **PPO**.

Research Internship — Jun 2021 – Nov 2021
Virginia Commonwealth University – Advisor: Dr. Preetam Ghosh — *Virginia, USA*

- Worked with a mentor to develop an optimized multi-vaccine distribution strategy based on demographic and heterogeneous factors in Chicago district, using linear optimization (**PuLP**) and clustering algorithms. Published subsequent paper at IEEE BIBM.
- Presented virtually to IEEE BIBM.
- Developed on the previous scheme to include hierarchical clustering and vaccine redistribution among zones for better allocation. Published subsequent journal paper at IEEE TCBB.

Current Projects

Latent diffusion guided feature inpainting for generalized de-occlusion March. 2025 - Present
UC Riverside *Riverside, California*

- Developed a robust feature inpainting method using a modified reconstruction loss term in the denoising objective to obtain clean feature representations from occluded features for downstream CV tasks i.e segmentation, object detection and Re-Identification.
- Incorporated occlusion priors for latent space feature inpainting.

Adaptive anisotropic-isotropic heat diffusion information flow. May. 2025 - Present
UC Riverside *Riverside, California*

- Utilized entropy to hierarchically subdivide feature patches to detect regions of interest.
- Self supervised switching of anisotropic and isotropic heat diffusion method for information flow instead of self-attention in transformer architecture.
- Formulated a novel stacked routing mechanism that beats existing SOTA by ∼2.5% for event based object detection.

Technical Skills

Languages: Python, MATLAB, Java, C/C++, SQL
Developer Tools: Git, Docker, Google Cloud Platform, VS Code, PyCharm, Virtual environments, CUDA parallel DDP and FSDP.
Libraries: Pytorch, TensorFlow, OpenCV, Pandas, NumPy, Matplotlib

Publications

- *Pratyay Dutta*, Padmaja Jonnalagedda, Bir Bhanu. POANet: Parts-based Occlusion Aware Network for Person Re-ID, *IEEE Transactions on Biometrics, Behavior, and Identity Science (TBIOM), 2025.* [doi]
- *Pratyay Dutta*, Bir Bhanu. A Physics-Based Anisotropic Heat Diffusion Framework for Enhanced Edge-Robust Spatiotemporal Representation Learning," (submitted to an A^* conference)
- *Pratyay Dutta*, Bir Bhanu. Latent Diffusion-Guided Feature Inpainting for Occluded Person Re-Identification With Hybrid Re-Ranking," *IEEE Transactions on Circuits and Systems for Video Technology (TCSVT)* (minor revision undergoing)
- Satyaki Roy, *Pratyay Dutta*, Preetam Ghosh, "Hierarchical Vaccine Allocation based on Epidemiological and Behavioral Considerations," *IEEE/ACM TCBB 2022.* [doi]
- Satyaki Roy, *Pratyay Dutta*, Preetam Ghosh, "Generalizable multi-vaccine distribution strategy based on demographic and behavioral heterogeneity," *IEEE BIBM 2021.* [doi]

Achievements/Awards

- **Bishop Thoburn Award, 2019**: Student of the year award from Calcutta Boys' School (Highschool) for outstanding academics, sports and extra-curricular acumen. (Acceptance Rate - 1 in 120 students).
- **MITACS Fellowship, 2020** for Summer Research Internship in Canada (Acceptance Rate - 18%).
- **Dean's Fellowship, 2023** for outstanding research acumen. (Acceptance Rate - 15%).

Miscellaneous

Teaching: CS111: Discrete Structures, CS258: Intro. to Reinforcement Learning, EE152: Image Processing, EE114: Probability and Random Variables, CS105: Data Analysis Methods.

Reviewer: CVPR, WACV, ICCV, ECCV, NeurIps, TBIOM, TCBB, TCSVT.