Vivekjyoti Banerjee

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RESEARCH INTEREST AND PERSONAL PROFILE

Accomplished professional with over **2 years** of experience in computer vision for real-world military and commercial robotics applications. Passionate about researching the **information-theoretic limits for neural networks** and their applications in robotics tasks. Seeking to leverage academic experience and research expertise to advance research initiatives, particularly in the field of **multi-modal representation learning** and **data-efficient training frameworks**. Demonstrated ability to foster interpersonal relationships and collaborate effectively within teams. Proven problem-solver with a record of delivering exceptional productivity and accelerated learning. Strong communicator with excellent oral and written skills.

EDUCATION

University of Maryland, College Park Aug 2018 – Dec 2021

- **Degree:** Bachelor of Science in Computer Science, Specialization in Machine Learning
- **Degree:** Bachelor of Science in Mathematics, Statistics Specialization
- **Honors Program**: Quality Enhancement Systems and Teams (QUEST)
- **Coursework:** Computer Vision, Machine Learning, Data Science, Advanced Calculus, Computational Geometry
- **Spoken Languages**: English, Spanish, Bengali, Hindi

TECHNICAL SKILLS

- **Neural Networks**: ResNet (2D/3D), (Vision) Transformer, (Grounded) SAM, DINO(v2), MoCo-V2, WGAN
- **Learning Frameworks**: (Momentum) Contrastive Learning, Active Learning, Self-Supervised Learning, Self-Distillation
- **Tools/APIs**: PyTorch, Git, AWS (EC2), LogQS, QDrant, OpenCV, Dash, Plotly Express, Pandas
- **Programming Languages**: Python, C++, C#, SQL, C

ACADEMIC PORTFOLIO

- **Patent**: LaRose D., Atkinson J., **Banerjee V.** "A Method and a System for Training a Task Specific Engine" Carnegie Robotics LLC. Pittsburg, PA 2024. Application number: 18/749060
- **Peer-review Publications**:
  - Connor J. Parde, Virginia E. Strehle, **Vivekjyoti Banerjee**, Ying Hu, Jacqueline G. Cavazos, Carlos D. Castillo, and Alice J. O'Toole. 2023. Twin Identification over Viewpoint Change: A Deep Convolutional Neural Network Surpasses Humans. ACM Trans. Appl. Percept. 20, 3, Article 10 (July 2023), 15 pages. https://doi.org/10.1145/3609224
  - **Banerjee V**, Sharda N, Huse J, Singh D, Sokolov D, Czinn SJ, Blanchard TG, Banerjee A. Synergistic potential of dual andrographolide and melatonin targeting of metastatic colon cancer cells: Using the Chou-Talalay combination index method. Eur J Pharmacol. 2021 Apr 15;897:173919. doi: 10.1016/j.ejphar.2021.173919. Epub 2021 Feb 9. PMID: 33577837.
  - Blanchard TG, Czinn SJ, **Banerjee V**, Sharda N, Bafford AC, Mubariz F, Morozov D, Passaniti A, Ahmed H, Banerjee A. Identification of Cross Talk between FoxM1 and RASSF1A as a Therapeutic Target of Colon Cancer. Cancers (Basel). 2019 Feb 8;11(2):199. doi: 10.3390/cancers11020199. PMID: 30744076; PMCID: PMC6406751.
  - Blanchard TG, Lapidus R, **Banerjee V**, Bafford AC, Czinn SJ, Ahmed H, Banerjee A. Upregulation of RASSF1A in Colon Cancer by Suppression of Angiogenesis Signaling and Akt Activation. Cell Physiol Biochem. 2018;48(3):1259-1273. doi: 10.1159/000492012. Epub 2018 Jul 25. PMID: 30045022.
  - Banerjee A, **Banerjee V**, Czinn S, Blanchard T. Increased reactive oxygen species levels cause ER stress and cytotoxicity in andrographolide treated colon cancer cells. Oncotarget. 2017 Apr 18;8(16):26142-26153. doi: 10.18632/oncotarget.15393. PMID: 28412728; PMCID: PMC5432246.

- **Poster Presentation**: Connor J. Parde, Ginni Strehle, **Vivekjyoti Banerjee**, Ying Hu, Jacqueline G. Cavazos, Carlos D. Castillo, Alice J. O'Toole; Comparing Human and Deep Convolutional Neural Network Performance on Twin Identification. Journal of Vision 2022;22(14):3357. https://doi.org/10.1167/jov.22.14.3357.
- **Conference Attendances**:
  - CVPR conference June 17-21, 2024, Seattle, WA
  - Vision Sciences Society, May 17-22, 2022. Tampa, FL US.
- **Membership**: IEEE Regular 2024

RESEARCH AND WORK EXPERIENCE

Machine Learning Engineer, Carnegie Robotics LLC – Pittsburgh, PA March 2022 – Present

Minefield Hazard Detection*

- Improved GPR signal recognition for buried hazards, boosting detection model performance by over 10%
- Created novel fusion block by combining 2D & 3D convolutions on volumetric data
- Develop a 7-stage, tripling dataset size while reducing data generation time from 30+ hours to 2 hours.
- Reconstruct receiver end-effector positions for a 5-degree of freedom arm to improve dense radar data representation
- Conducted ablation studies using Bayesian Optimization and hyperparameter tuning to identify the best algorithm for single and multi-class hazard detection
- Develop custom network analysis tools to explain inference results and validate input data

Manifold Visualizer

- Compare self-supervised contrastive learning vs. momentum encoding vs. self-distillation with no labels frameworks for image retrieval tasks on proprietary data.
- Redesign and improve ResNet and vision transformer-based networks to generate embedding spaces.
- Design and iterate on a 4-stage parallelized multi-model inference pipeline to generate embeddings for 900+logs on EC2 using LogQS (cloud storage system for robotic logs) with 50x speedup.
- Implement an interactive tool to visualize and explore 3D embeddings spaces of various datasets with Dash.
- Generalize visualization tools to be integrated and used for a variety of detection and segmentation tasks.
- Manage an intern, create, and delegate tasks, and review intern git pull requests.

Machine Learning Researcher, University of Maryland, Center for Automation Research – College Park, MD Dec 2020 – Dec 2021

- Design controlled experiments to differentiate twin, fraternal, and sibling faces and measure human accuracy against a neural network developed by the lab during the IARPA Janus program.
- Evaluate networks and humans' performance on a variety of viewpoints to conclude that the network performs at the level of the best humans in the study or outperforms them with statistical significance.
- Reduce 512-dimensional face feature vectors using t-SNE and principal component analysis to identify similar face clusters used in experiment data.

Big Data Analytics Center Intern, Bechtel – Reston, VA Jun 2021 – Jul 2021

- Research and apply SotA document segmentation networks for engineering blueprints and table detection to digitize proprietary data.
- Experiment with transfer learning with a Res-Net model fine-tuned on company documents to achieve 98% detection accuracy.
- Develop synthetic data to leverage the benefits of an annotated dataset to improve accuracy by 10% on scanned data.

Volunteer Cancer Research Intern, Thomas Blanchard lab, University of Maryland School of Medicine – Baltimore, MD Mar 2016 – Nov 2020

- Studied the therapeutic single or combinatorial drug effect of colon cancer cells, its molecular mechanism, and data analyses using the Chou-Talalay combination index method.
- Analyses of gene expression by qRT-PCR.

- Analyses of protein expression by western blot.

TEACHING EXPERIENCE

Teaching Assistant for QUEST Honors Program, University of Maryland – College Park, MD — Nov 2019 – May 2021

- Planned and led exam review sessions in Applied Quantitative Analysis for 100+ 3rd year students.
- Coordinated materials, conducted weekly office hours, and graded assignments in a timely manner.
- Re-designed assignments, projects, and assessments interdisciplinary honors program

Enrichment Program Teacher, Coder Kids Inc – McLean, VA — Oct 2018 – Sep 2020

- Showed the basics of 3D printing to students (grade 6-8)
- Taught fundamentals of Scratch and Python principles of programming to elementary and middle school students for Coder Kids, Inc, McLean, Virginia.

LEADERSHIP EXPERIENCE

- Co-Lead of QCreative Student organization for QUEST — Dec 2019 - Dec 2021
- Judge for QUEST Tech Datathon comprised of 7 teams — March 2022
- Head programmer (RobotC) and Robot Designer — Jan 2018 – Jun 2018
- Autonomous driving and design lead of two high school VEX robotics teams — Jan 2018 – Jun 2018

RELEVANT HONORS AND AWARDS

- Selected Student Speaker at the Annual QUEST Conference for Cohort 34 — May 2022
- Outstanding Service Award, Quest Honors Program — Dec 2021
- Maryland Delegate Sydnor Merit-based Scholarship — 2019 – 2020
- University of Maryland Dean's List (5 times) — 2018 – 2021

REFEREES

- David LaRose, Ph. D
  Chief Scientist, Carnegie Robotics LLC, Pittsburgh, PA
  dlr@carnegierobotics.com
- Alice O'Toole, Ph. D
  Professor and Chair of School of Behavioral and Brain Sciences, University of Texas, Dallas
  otoole@utdallas.edu
- Carlos D. Castillo, Ph. D
  Former Assistant Professor, University of Maryland, College Park
  Principal Applied Scientist at Amazon, Seattle, WA
  carlos.d.castillo@gmail.com
- Thomas Blanchard, Ph. D
  Professor and Director of the University of Maryland Brain and Tissue Bank
  University of Maryland School of Medicine, Baltimore, MD
  TBlanchard@som.umaryland.edu
- Joseph P. Bailey, Ph. D
  Associate Research Professor and Associate Dean of Undergraduate Programs
  University of Maryland, College Park, MD
  jpbailey@umd.edu
- John Atkinson, M.S.
  Head of Machine Learning, Carnegie Robotics LLC, Pittsburgh, PA
  jatkinson@carnegierobotics.com