Krishnamurthy Vemuru, Ph. D. (Physics)

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Career Objective:

To apply the principles of Machine Learning, Brain-Inspired Computing, Vision Transformers, Large Language Models, State Space Models, Signal Processing, Systems Engineering, and Applied Physics together with my leadership qualities to solve cutting-edge problems in Artificial Intelligence for Defense, Aerospace, and Industrial Applications.

Summary of Qualifications: Clearance: SECRET (DoD)

- Computer Vision and Machine Learning: Supervised/Self-supervised/Deep Learning
- Vision Transformers, Neural Radiance Fields, ChatGPT, and LLMs for Generative AI
- Neuromorphic Computing: Spiking Neural Networks for Object Detection, Classification, Semantic Segmentation, Edge Detection, Edge AI using *Brainchip's* Akida Processor
- Neural Network Quantization: Quantization Aware Training, Post Quantization Training
- Algorithms and Demonstrations for Event-Based Neuromorphic Computer Vision
- Reinforcement Learning: Q-learning, SARSA, Policy Gradients, DRL, Multi-Agent RL
- Quantum Computing: Quantum CNNs for Classification, Quantum Error Correction
- Programming Robots for Path Planning and Obstacle Avoidance (Turtlebot, Crazyflie)
- Deep Learning Platforms: PyTorch, TensorFlow/Keras, and NENGO
- Programming in Python, MATLAB, R, C++, and C#
- Heterogeneous Data Fusion, Bayesian Networks, Statistical Methods for Data Analytics
- Signal Processing: Image Processing, EO-IR, Nuclear, X-ray, Gamma-Ray Spectroscopy
- 55 Journal Publications from research in Applied Physics, Nuclear Physics, and AI

Education:

UNIVERSITY OF VIRGINIA, CHARLOTTESVILLE, VA 22904
Master of Engineering in Systems Engineering, December 2017, GPA: 4.0
Courses: Convex Optimization for Machine Learning, Autonomous Mobile Robots, Data Mining, Reinforcement Learning, Mobile Health and Sensing, Advanced Digital Signal Processing
Research: Computer Vision for Jet Engine Turbine Blade Thermal Barrier Coatings, Computer Vision for Manufacturing, Mission-Aware Cyber Security
Non-degree Program graduate course: Graph Mining, GPA: 3.7 (Spring2021)

GEORGE MASON UNIVERSITY, FAIRFAX, VA 22030
Non-degree graduate student, GPA: 3.5
Courses: Systems Engineering Design, Heterogeneous Data Fusion (Spring2016)

TATA INSTITUTE OF FUNDAMENTAL RESEARCH, MUMBAI 400005, INDIA
Ph. D. in Experimental Condensed Matter Physics, December 1995
Thesis Title: Microscopic Studies of Magnetic Interactions in Metals and Alloys

SRI VENKATESWARA UNIVERSITY, TIRUPATI, INDIA
M. Sc. in Physics, January 1986
B. Sc. in Math, Physics, and Chemistry, July 1983

Work Experience:

SME III - AI/ML Contractor for S&T Div, DEPARTMENT OF HOMELAND SECURITY, USA & APOGEE ENGINEERING LLC., HERNDON, VA

Senior Principal - Technology, August 2023 – Present

- Evaluate explainable deep learning models for computer vision for DHS AI use cases
- Develop proposals and pitches for research in emerging AI topics and neuromorphic computing for edge AI solutions
- Reinforcement Learning based attack design and defense strategies for Cybersecurity of Critical Infrastructure
- Review and identify novel concepts and algorithms introduced in Large Language Models (LLMs) from latest publications and open source code repositories
- Audited a course: ECE5984 - Engineering Entrepreneurship, Virginia Tech, in Fall 2023

BRAINCHIP, INC., LAGUNA HILLS, CA (ON-SITE 5 DAYS/WEEK)

Principal Computer Scientist, June 2022-August 2023

- *Deep Learning Algorithms and Applications for Edge Computing*
  Implemented semantic segmentation algorithms of frame data and gesture recognition from event camera data to deploy on Brainchip's AKD1000 event domain neural processor
- Research in neural network models and inference with neural processing units for low-power edge applications based on deep learning and neuromorphic computing
- Compare and contrast the computational complexity of a variery of Attention layers and evaluate the advantages of new layers used in Vision Transformers
- Evaluate MACS/inference of Vision Transformer models for edge inference
- Model pruning and quantization for stereo matching CNNs, speech denoising RNNs, and music generation RNNs for low-power edge inference using Akida 1000/2000 processors

SRI INTERNATIONAL, PRINCETON, NJ

Principal Computer Scientist, Center for Computer Vision Tech., May 2021-June 2022

- *Deep Reinforcement Learning for Collaborative Autonomy (DARPA funded):*
  Enhanced multi-agent deep reinforcement learning algorithms for terrain-aware route planning and navigation of swarms in near-real and adversarial world representations
- Developed a zero-order stochastic gradient descent method for training neural networks
- Talks on Quantum Error Correction and Quantum Machine Learning (Reading Group)
- Multimodal Intent Classification from Social Media (Instagram, Reddit, Twitter/X) Text-Image Pairs for Cross-Platform Intent Classification using DNNs, CLIP for vision and RoBERTa for text processing

RIVERSIDE RESEARCH, ARLINGTON, VA

Principal Machine Learning Scientist, Washington Business Office, Mar. 2019-May 2021

Intelligent Systems Engineer, Open Innovation Center, Dayton, OH, Dec. 2017-March 2019

- *Machine Learning, Deep Learning and Neuromorphic Computing for Object Detection:*
  Research in machine learning for object detection/tracking in EO/IR video data, semantic segmentation using both artificial neural networks and spiking neural networks.
- Design of Spiking Neural Networks for edge detection and object classification

- Keras based edge computing/low-power algorithms for semantic segmentation and object detection (IRAD)
- Low exposure image frame synthesis algorithms using reinforcement learning (Q-learning) for generating millisecond events for object detection using IBM TrueNorth.
- Aviation either unmanned or manned with an injection of AI using Reinforcement Learning frameworks and simulation experiments
- Graph Neural Networks and graph mining for node classification, network alignment over unsigned networks eand signed networks, community detection
- Guides the team and the leadership by providing insights into the latest trends, technologies and algorithms in AI/ML for customer solutions and proposal writing.

UNIVERSITY OF VIRGINIA, CHARLOTTESVILLE, VA
*Graduate Research/Teaching Assistant**,** Dept. of Systems and Information Engineering, Aug.2016-December 2017,* ***GPA: 4.0***

- *Research and development in computer vision for advanced aerospace manufacturing:* Developed a computer vision instrument for image processing and image classification of turbine thermal barrier coatings and tape masking for efficient manufacturing. Developed a hybrid Threat Modeling Method for Cyber Security of UAVs.

GEORGE MASON UNIVERSITY, FAIRFAX, VA 22030
Adjunct Physics Faculty, Department of Physics and Astronomy, Jan. 2011- August 2012
Assistant Professor of Physics, Department of Physics and Astronomy, August 2012-May 2016

- Designed and taught courses in physics, solar cells, renewable energy at both graduate level and undergraduate level. Developed new physics labs.
- Developed physics models for analyzing x-ray and neutron scattering data from electronic materials. Published scientific papers in peer reviewed journals.

UNIVERSITY OF TENNESSEE-MARTIN, RIPLEY CENTER, RIIPLEY, TENNESSEE 38063
Adjunct Physics Instructor, January 2008-Dec. 2009
Lecturer of Physics, January 2010-January 2011

OAK RIDGE NATIONAL LABORATORY, OAK RIDGE, TENNESSEE 37831
Postdoctoral Research Associate, October 2004-September 2007, July 2008-June 2009

- Research in Materials Science and Neutron Scattering
- Presented talks at American Physical Society meetings, national and international conferences. Published scientific papers in peer reviewed journals.

UNIVERSITY OF ALABAMA, MINT CENTER, TUSCLOOSA, ALABAMA 35487

- Postdoctoral Research Fellow, April 2002-October 2004
- Research in the physics of high-density magnetic data storage and thin film deposition.
- Presentations at American Physical Society meetings and international conferences.

INSTITUTE OF PHYSICAL & CHEMICAL RESEARCH (RIKEN), WAKO, JAPAN
Foreign Exchange Fellow, July 1996-Nov. 1998 & Contract Researcher, Dec. 2001-Mar. 2002
Postdoctoral Research Associate Dec. 1998- Nov. 2001, RIKEN Harima Institute, SPring8

- Condensed matter physics research using muon spin relaxation spectroscopy and x-ray magnetic circular dichroism spectroscopy
- Presented talks and posters at national and international conferences. Published scientific papers in peer reviewed journals.

UNIVERSITÄT GÖTTINGEN, GÖTTINGEN, GERMANY

Postdoctoral Research Associate, September 1995-June 1996, II Physikalisches Institüt

- Structural Properties of Oxides using Recoil Implanted Nuclear Isotopes
- Performed quantitative analysis of the data by fitting the gamma ray angular distribution spectra measured at several temperatures.
- Developed models to interpret experimental data and published scientific papers.

TATA INSTITUTE OF FUNDAMENTAL RESEARCH, COLABA, MUMBAI, INDIA

Research Scholar, January 1989-August 1995 & Scientific Assistant, Nov. 1987-Jan. 1989

- *Instrument Development for Nuclear Spectroscopy* with a 7 Tesla superconducting magnet for in-beam gamma-ray spectroscopy experiments.
- Ph. D. Thesis research on the local magnetic properties of implanted ions in alloys.
- Measured nuclear g-factors of high spin isomeric states in mass 80-130 nuclei.
- Performed data reduction and data analysis.

Honors and Awards:

- Postdoctoral Research Fellowship from Oak Ridge Associated Universities, Oak Ridge National Laboratory, Oak Ridge, Tennessee, 2004-2009.
- Foreign Exchange Research Fellowship from Institute of Physical and Chemical Research, Wako, Japan, July 1996-1998, Synchrotron Radiation Postdoctoral Fellowship, 1998-2001.
- Postdoctoral Research Fellowship from University of Göettingen, Göettingen, Germany, September 1995-1996.

Selected Publications in Data Science:

1. Krishnamurthy Vemuru and J. D. Clark, "Low-exposure image generation algorithms for feature extraction and classification", Proc. SPIE, vol. 10996, Real-Time Image Processing and Deep Learning 2019, 109960D (14 May 2019).
2. Krishnamurthy V. Vemuru, S. D. Harbour and J. D. Clark, "Reinforcement learning in Aviation either unmanned or manned with an injection of AI", In Proc. Of 20th International Symposium on Aviation Psychology (pp. 492-497), May 7-10, 2019, Dayton, Ohio, USA.
3. J. D. Clark, W. D. Mitchell, S. D. Harbour and Krishnamurthy V. Vemuru, "Temporary Memory Neuron Model for the Leaky Integrate and Fire Neuron Model", In Proc. Of 20th International Symposium on Aviation Psychology (pp. 486-491), May 7-10, 2019, Dayton, Ohio, USA.
4. S. D. Harbour and J. D. Clark, W. D. Mitchell and Krishnamurthy V. Vemuru, "Machine Awareness", In Proc. Of 20th International Symposium on Aviation Psychology (pp. 480-485), May 7-10, 2019, Dayton, Ohio, USA
5. Krishnamurthy V. Vemuru, "Image Edge Detector with Gabor Type Filters using a Spiking Neural Network of Biologically Inspired Neurons", *Algorithms, 13(7), 165* (2020).
6. Krishnamurthy V. Vemuru, "Implementation of the Canny Edge Detector using a Spiking Neural Network", *Future Internet*, 14 (12), 371, (2022).

Techincal Notes (2018)

1. Nancy R. Mead, Forrest Shull, Krishnamurthy Vemuru and Ole Villadsen, "A Hybrid Threat Modeling Method," Technical Note, CMU/SEI-2018-TN-002, Carnegie Mellon University, March 2018.
2. Barry Horowitz, Peter Beling, Cody Fleming, Stephen Adams, Bryan Carter, Krishnamurthy Vemuru, Carl Elks, Tim Bakker, Kryzsztof Cios, Georgios Bakirtzis, Aidan Collins, Nancy Mead, Forrest Shull, "Security Engineering fy17 systems aware cyber security", Technical Report 2017/12/7, Stevens Institute of Technology, Hoboken, United States.

Book Chapter (2015)

1. Vemuru. V. Krishnamurthy, "Additive manufacturing of rare earth permanent magnets" in the book titled "*Additive Manufacturing: Innovations, Advances and Applications*", Edited by T. S. Srivatsan and T. S. Sudharshan, CRC Press, October 12, 2015.

Ph. D. Thesis

Microscopic Studies of Magnetic Interactions in Metals and Alloys, Tata Institute of Fundamental Research, Mumbai, India, March 1995.

Systems Engineering and Machine Learning Project Demos:

1. *Robot Forward Planning: Recognizing Objects and Visiting Object Locations*, SYS6581: Autonomous Mobile Robots, Fall2016.
2. *UML Design of an Emergency Support System for Connected Car*, SYST520: Systems Engineering Design and Integration (GMU), Spring2016
3. *Engineering Design of Masking Tape Width Analysis for Jet Engine Turbine Blades*, Fall2016-Summer2017, SYS9999: Graduate Research, University of Virginia
4. *Image Processing for Classification of Low Pressure Plasma Spray System for Aerospace Manufacturing*, Fall2016-Summer2017, SYS9999: Graduate Research, University of Virginia
5. *SysML Design of a Sentinel for the Cyber Security of a Ground Based Weapon System, Spring 2017, SYS9999: Graduate Research, University of Virginia*
6. *Next Generation Sensor Algorithms Proof-of-Principle Study for On-Board and Low SWaP Signal Processing*, Project Report for sponsored Research Porject, November 2019
7. *Hand movement gestured digit recognition by combining a Single-Shot Detector (SSD), image processing for hand tracking and Convolutional Neural Networks*, STEM Symposium at Nysmith School, Herndon, Virginia, March 30, 2019

Subject Matter Expert:

Reviewer for Physical Review Letters, Physical Review B, NeurIPS2019 Conference papers

Machine Learning/AI Conferences Attended in 2019:

Participant, NVIDIA GPU Technology Conference, March 2018, San Jose, CA
Participant, NVIDIA GPU Technology Conference, March 2019, San Jose, CA
Speaker, SPIE Defense+Commercial Sensing Conference, April 2019, Baltimore, MD
Invited Speaker, Ai4Cyber Security Conference, April 2019, New York, NY
Speaker, International Symposium on Aviation Psychology, May 2019, Dayton, OH

Participant/Reviewer for HADR Workshop, NeurIPS2019, Dec. 2019, Vancouver, BC, Canada
Participant, NeurIPS2020 Conference, December 2020, Online
Participant, NeurIPS2021 Conference, December 2021, Online
Participant, Summit for AI Institutes Leadership (SAIL2023), October 2023, Atlanta, GA

References:
Professor William T. Scherer, Chair, Systems and Information Engineering, University of Virginia, Phone: 434-982-2069

Mr. Ted Josue, Senior Lead Scientist, Booz Allen Hamilton, Dayton, Ohio, Phone: 937-838-5303