ANDREW R. BUCK, PH.D.

AI/ML Researcher & Engineer

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EDUCATION

University of Missouri – Columbia, MO
Doctorate in Electrical & Computer Engineering   May 2018
- Dissertation: "Multicriteria Pathfinding in Uncertain Simulated Environments"

University of Missouri – Columbia, MO
Master of Science in Computer Engineering   May 2012
- Thesis: "An Evolutionary Framework for Matching Geospatial Object Configurations"

University of Missouri – Columbia, MO
Bachelor of Science in Computer Engineering   May 2009
Bachelor of Science in Electrical Engineering   May 2009
- Minors: Computer Science, Mathematics, Information Technology, and Music

PROFESSIONAL EXPERIENCE

Assistant Research Professor | University of Missouri – Columbia, MO   2019-2025
Department of Electrical Engineering and Computer Science & Center for Geospatial Intelligence

Research Projects
  IVAS (U.S. Army)
  - Designed multicriteria decision-making algorithms for autonomous control of small aerial drones
  - Developed a simulation and mapping platform using AirSim, ROS, and Unreal Engine
  - Prototyped a 3D visualization framework in augmented reality using Microsoft HoloLens
  ATLAS (U.S. Army)
  - Evaluated and implemented methods for self-supervised monocular depth estimation
  - Utilized high-performance computing resources to train and test large-scale neural network models
  - Generated synthetic datasets for object detection and passive ranging using Unreal Engine
  Human-Robot Teaming
  - Used partially observable grid-world environments to study movement and "mental maps"
  - Guided the construction of a custom UAV platform for data collection and autonomy research
  - Developed a 3D simulation environment for scene understanding from point clouds

Teaching - *Introduction to Computational Intelligence*   Fall 2011, Fall 2013, & Fall 2024
  - Taught lectures on fuzzy systems, neural networks, and evolutionary computation
  - Created class projects based on developing an agent to compete in an international game competition
  - Graded homework and projects, and provided one-on-one assistance to students

Postdoctoral Fellow | University of Missouri – Columbia, MO   2018-2019
Center for Eldercare and Rehabilitation Technology

- Designed and implemented a research framework for managing large heterogeneous temporal datasets
- Built a web API and visualization tool to interactively explore personalized data timelines
- Supported ongoing real-time data collection efforts and student projects

Graduate Research Assistant | University of Missouri – Columbia, MO

Explosive Hazard Detection (U.S. Army) 2015-2018
- Organized and managed the processing workflow of big data sets for target detection applications
- Designed a novel 3D feature descriptor for volumetric radar imagery to improve classification performance
- Fused data from LIDAR, radar, and acoustic sensors to detect roadside explosive hazards

Human Geography (NGA) 2012-2015
- Visualized uncertain variables in human hyperspectral geographic data
- Implemented agent-based models of bounded rationality for decision-making with partial information
- Investigated methods for path planning and navigation in dynamic multi-objective environments

Spatial Relationships (NGA) 2009-2012
- Developed an evolutionary algorithm to conflate a hand-drawn map to satellite imagery
- Modeled uncertainty in spatial knowledge using fuzzy weighted graphs

Ranger Trainer | Philmont Scout Ranch – Cimarron, NM Summers 2006-2009
Boy Scouts of America

- Trained and supervised seven staff members in their duties as backcountry guides
- Led groups of 5-10 youths on rugged mountain backpacking treks ranging from 5-20 days with a partner
- Used experience as an Eagle Scout to teach outdoor skills and wilderness ethics in a hands-on environment

TECHNICAL SKILLS

- **Programming Languages:** Python, MATLAB, C++, JavaScript, Java, C#, SQL, PHP
- **Frameworks & Tools:** PyTorch, TensorFlow, JAX, Kubernetes, SLURM, Docker, ROS, Gazebo, Unity, Unreal Engine, AirSim, OpenGL, ThreeJS, D3.js, Matplotlib, Git, Microsoft Office
- **Research Areas:** Artificial intelligence, machine learning, deep learning, reinforcement learning, multi-objective optimization, decision-making & uncertainty, intelligent agents, evolutionary optimization, fuzzy systems, computer vision, 3D graphics, data visualization, spatial reasoning, path planning, SLAM, robotics, 3D depth estimation, game design

PUBLICATIONS

A. L. Aldridge, C. Hudson, K. Smink, **A. R. Buck**, D. T. Anderson, V. Paul, R. Anderson, D. Hoelscher, M. Quinn, M. Pleva, C. L. Bethel, and D. W. Carruth, "A Virtual Testbed for the Multidisciplinary Evaluation of Human-Agent Teaming Dynamics," in *2025 International Conference on Human-Computer Interaction (HCII)*, Gothenburg, Sweden, 2025.

J. Akers, J. Kerley, D. T. Anderson, **A. R. Buck**, D. Buffum, and J. M. Keller, "HiFiAerial: A Photorealistic Synthetic Dataset with Ground Truth for Dense Prediction in Aerial Imagery," in *Proc. SPIE 13459, Synthetic Data for Artificial Intelligence and Machine Learning: Tools, Techniques, and Applications III*, 2025.

A. L. Aldridge, **A. R. Buck**, D. T. Anderson, C. Hudson, K. Smink, V. Paul, R. Anderson, D. Hoelscher, M. Quinn, D. Carruth, and C. L. Bethel, "Exploring Trust and Autonomy: How Information Affects Human-Agent Teaming Performance," in *Proc. SPIE 13477, Unmanned Systems Technology XXVII*, 2025. (**Best Paper Award**)

D. Buffum, J. Akers, J. Kerley, D. T. Anderson, **A. R. Buck**, and J. M. Keller, "Explainable LLM-Based Drone Autonomy Derived from Partially Observable Geospatial Data," in *Proc. SPIE 13461, Geospatial Informatics XV*, 2025.

A. R. Buck, D. T. Anderson, J. M. Keller, C. Bethel, and A. Aldridge, "Designing reliable navigation behaviors for autonomous agents in partially observable grid-world environments," in *2024 International Joint*

Conference on Neural Networks (IJCNN), Yokohama, Japan, 2024.

J. Kerley, D. T. Anderson, **A. R. Buck**, and B. Alvey, "Generating simulated data with a large language model," in *Proc. SPIE 13035, Synthetic Data for Artificial Intelligence and Machine Learning: Tools, Techniques, and Applications II*, 2024.

D. R. Buffum, **A. R. Buck**, J. Akers, R. Camaioni, M. Deardorff, D. T. Anderson, and R. H. Luke III, "Autonomous drone behavior via MCDM of UFOMap layers," in *Proc. SPIE 13037, Geospatial Informatics XIV*, 2024.

A. Soloviov, D. T. Anderson, **A. R. Buck**, and B. Alvey, "MizSIM: a headless open-source simulation framework for training and evaluating artificial intelligence," in *Proc. SPIE 13035, Synthetic Data for Artificial Intelligence and Machine Learning: Tools, Techniques, and Applications II*, 2024.

A. Buck, P. Popescu, D. Anderson, J. Keller, and M. Talbott, "Leveraging a digital twin to train, evaluate, and understand single image depth estimation for infrared imaging," *MSS*, 2024.

A. R. Buck, J. D. Akers, D. T. Anderson, J. M. Keller, R. Camaioni, M. Deardorff, and R. H. Luke III, "Frame selection strategies for real-time structure-from-motion from an aerial platform," in *2023 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*, St. Louis, MO, USA, 2023.

J. Akers, **A. Buck**, D. Anderson, J. Keller, R. Camaioni, M. Deardorff, and R. Luke III, "Improving real-time aerial 3D reconstruction: towards fusion of a hand-crafted SfM algorithm with a data-driven deep neural network," in *2023 IEEE Applied Imagery Pattern Recognition Workshop (AIPR)*, St. Louis, MO, USA, 2023.

A. R. Buck, D. T. Anderson, R. Camaioni, J. Akers, R. H. Luke III, and J. M. Keller, "Capturing uncertainty in monocular depth estimation: towards fuzzy voxel maps," in *2023 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, Songdo Incheon, Korea, 2023.

B. Alvey, D. Anderson, J. Keller, and **A. Buck**, "Linguistic Explanations of Black Box Deep Learning Detectors on Simulated Aerial Drone Imagery," *Sensors* 23(15), 6879, Aug. 2023.

A. R. Buck, D. T. Anderson, J. Fraser, J. Kerley, and K. Palaniappan, "Ignorance is bliss: flawed assumptions in simulated ground truth," in *Proc. SPIE 12529, Synthetic Data for Artificial Intelligence and Machine Learning: Tools, Techniques, and Applications*, 2023.

J. Akers, **A. Buck**, R. Camaioni, D. T. Anderson, R. H. Luke III, J. M. Keller, M. Deardorff, and B. Alvey, "Simulated gold-standard for quantitative evaluation of monocular vision algorithms," in *Proc. SPIE 12525, Geospatial Informatics XIII*, 2023.

J. Kerley, D. T. Anderson, B. Alvey, and **A. Buck**, "How should simulated data be collected for AI/ML and unmanned aerial vehicles?" in *Proc. SPIE 12529, Synthetic Data for Artificial Intelligence and Machine Learning: Tools, Techniques, and Applications*, 2023.

B. Mooers, A. L. Aldridge, **A. Buck**, C. L. Bethel, D. T. Anderson, "Human-robot teaming for a cooperative game in a shared partially observable space," in *Proc. SPIE 12525, Geospatial Informatics XIII*, 2023.

A. Buck, J. Kerley, D. Anderson, and J. Keller, "Simulated data to train and evaluate deep learning-based passive monocular vision algorithms at medium to long ranges," *MSS*, 2023.

A. R. Buck, D. T. Anderson, J. M. Keller, R. H. Luke III, and G. Scott, "A comparison of relative position descriptors for 3D objects," in *2022 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, Padua, Italy, 2022.

A. Buck, R. Camaioni, B. Alvey, D. T. Anderson, J. M. Keller, R. H. Luke III, and G. Scott, "Unreal Engine-based photorealistic aerial data generation and unit testing of artificial intelligence algorithms," in *Proc. SPIE 12099, Geospatial Informatics XII*, 2022.

R. Camaioni, R. H. Luke III, **A. Buck**, D. T. Anderson, "EpiDepth: a real-time monocular dense-depth estimation pipeline using generic image rectification," in *Proc. SPIE 12099, Geospatial Informatics XII*, 2022.

J. Kerley, A. Fuller, M. Kovaleski, P. Popescu, B. Alvey, D. T. Anderson, **A. Buck**, J. M. Keller, G. Scott, C. Yang, K. E. Yasuda, H. A. Ryan, "Procedurally generated simulated datasets for aerial explosive hazard detection," in *Proc. SPIE 12116, Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XXIII*, 2022.

M. Kovaleski, A. Fuller, J. Kerley, B. Alvey, P. Popescu, D. Anderson, **A. Buck**, J. Keller, G. Scott, C. Yang, K. E. Yasuda, H. A. Ryan, "Explosive hazard pre-screener based on simulated data with perfect annotation and imprecisely labeled real data," in *Proc. SPIE 12116, Chemical, Biological, Radiological, Nuclear, and Explosives (CBRNE) Sensing XXIII*, 2022.

A. Buck, M. Deardorff, B. Murray, D. Anderson, J. Keller, M. Popescu, D. Ho, and G. Scott, "Estimating depth from a single infrared image," *MSS*, 2022.

B. J. Murray, M. Islam, **A. Buck**, C. Veal, D. Anderson, J. Keller, M. Popescu, G. Scott, and D. K. C. Ho, "You only morph once (YOMO): morphology-based object detection and localization neural architecture," *MSS*, 2022.

B. J. Alvey, D. T. Anderson, C. Yang, **A. Buck**, J. M. Keller, K. E. Yen, and H. A. Ryan, "Characterization of deep learning-based aerial explosive hazard detection using simulated data," in *2021 IEEE Symposium Series on Computational Intelligence (SSCI)*, 2021.

B. Alvey, D. T. Anderson, **A. Buck**, M. Deardorff, G. Scott, and J. M. Keller, "Simulated photorealistic deep learning framework and workflows to accelerate computer vision and unmanned aerial vehicle research," in *2021 IEEE/CVF International Conference on Computer Vision Workshops (ICCVW)*, 2021.

A. R. Buck, D. T. Anderson, J. M. Keller, R. H. Luke III, and G. Scott, "A fuzzy spatial relationship graph for point clouds using bounding boxes," in *2021 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, Luxembourg, 2021.

A. Buck, M. Deardorff, D. T. Anderson, T. Wilkin, J. M. Keller, G. Scott, R. H. Luke III, and R. Camaioni, "VADER: a hardware and simulation platform for visually aware drone autonomy research," in *Proc. SPIE 11758, Unmanned Systems Technology XXIII*, 2021.

M. Deardorff, B. Alvey, D. T. Anderson, J. M. Keller, G. Scott, D. Ho, **A. Buck**, C. Yang, and B. Libbey, "Metadata enabled contextual sensor fusion for unmanned aerial system-based explosive hazard detection," in *Proc. SPIE 11750, Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XXVI*, 2021.

B. Ruprecht, D. T. Anderson, F. Petry, J. Keller, C. Michael, **A. Buck**, G. Scott, and C. Davis, "Concept learning based on human interaction and explainable AI," in *Proc. SPIE 11735, Pattern Recognition and Tracking XXXII*, 2021.

J. Schulz, **A. Buck**, D. T. Anderson, J. M. Keller, G. Scott, and R. H. Luke III, "Human-in-the-loop extension to stream classification for labeling of low altitude drone imagery," in *Proc. SPIE 11748, Autonomous Systems: Sensors, Processing, and Security for Vehicles and Infrastructure*, 2021.

B. Alvey, D. T. Anderson, J. M. Keller, **A. Buck**, G. Scott, D. Ho, C. Yang, and B. Libbey, "Improving explosive hazard detection with simulated and augmented data for an unmanned aerial system," in *Proc SPIE 11750, Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XXVI*, 2021.

M. A. Islam, B. Murray, **A. Buck**, D. T. Anderson, G. J. Scott, M. Popescu, and J. Keller, "Extending the morphological hit-or-miss transform to deep neural networks," *IEEE Transactions on Neural Networks and Learning Systems*, Oct. 2020.

A. R. Buck, D. T. Anderson, J. M. Keller, T. Wilkin, and M. A. Islam, "A weighted matrix visualization for fuzzy measures and integrals," in *2020 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, Glasgow, United Kingdom, 2020.

C. Veal, J. Schulz, **A. Buck**, D. Anderson, J. Keller, M. Popescu, G. Scott, D. Ho, and T. Wilkin, "Doing more with less: similarity neural nets and metrics for small class imbalanced data sets," in *Proc. SPIE 11418, Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XXV*, 2020.

J. Schulz, C. Veal, **A. Buck**, D. Anderson, J. Keller, M. Popescu, G. Scott, D. K. C. Ho, and T. Wilkin, "Extending deep learning to new classes without retraining," in *Proc. SPIE 11418, Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XXV*, 2020.

D. Anderson, M. Deardorff, T. Havens, S. Kakula, T. Wilkin, M. Islam, A. Pinar, and **A. Buck**, "Fuzzy Integral = Contextual Linear Order Statistic," arXiv:2007.02874 , 2020.

A. R. Buck and J. M. Keller, "Evaluating path costs in multi-attributed fuzzy weighted graphs," in *2019 IEEE International Conference on Fuzzy Systems (FUZZ-IEEE)*, New Orleans, LA, 2019.

P. Plodpradista, D. K. C. Ho, J. M. Keller, M. Popescu, and **A. Buck**, "Analyzing three-dimensional radar voxel data using the discrete Fourier transform for SAEH detection," in *Proc. SPIE 10628, Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XXIII*, 2018.

A. Buck, J. M. Keller, M. Popescu, D. Sheen, and R. H. Luke, "Target detection in high-resolution 3D radar imagery," in *Proc. SPIE 10182, Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XXII*, 2017.

A. R. Buck and J. M. Keller, "A myopic Monte Carlo strategy for the partially observable travelling salesman problem," in *2016 IEEE Congress on Evolutionary Computation (CEC)*, Vancouver, BC, 2016, pp. 632-639.

A. Buck, J. M. Keller, and M. Popescu, "Improving the detection of explosive hazards with LIDAR-based ground plane estimation," in *Proc. SPIE 9823, Detection and Sensing of Mines, Explosive Objects, and Obscured Targets XXI*, 2016.

A. R. Buck and J. M. Keller, "Visualizing uncertainty with fuzzy rose diagrams," in *2014 IEEE Symposium on Computational Intelligence for Engineering Solutions (CIES)*, Orlando, FL, 2014, pp. 30-36. (**Best Student Paper Award**)

A. Buck, A. Zare, J. Keller, and M. Popescu, "Endmember representation of human geography layers," in *2014 IEEE Symposium on Computational Intelligence in Big Data (CIBD)*, Orlando, FL, 2014, pp. 1-6.

J. M. Keller, **A. R. Buck**, A. Zare, and M. Popescu, "A human geospatial predictive analytics framework with application to finding medically underserved areas," in *2014 IEEE Symposium on Computational Intelligence in Big Data (CIBD)*, Orlando, FL, 2014, pp. 1-6.

A. R. Buck, T. Banerjee, and J. M. Keller, "Evolving a fuzzy goal-driven strategy for the game of Geister: An exercise in teaching computational intelligence," in *2014 IEEE Congress on Evolutionary Computation (CEC)*, Beijing, China, 2014, pp. 28-35.

A. R. Buck, J. M. Keller, and M. Popescu, "An α-Level OWA implementation of bounded rationality for fuzzy route selection," in *Advance Trends in Soft Computing (Studies in Fuzziness and Soft Computing, no. 312)*, Springer, 2014, pp. 253-260.

A. R. Buck and J. M. Keller, "A graph-based memetic approach to sketch geolocation," in *2013 IEEE Workshop on Memetic Computing (MC)*, Singapore, 2013, pp. 44-51. (**Best Paper Award**)

A. R. Buck, J. M. Keller, and M. Skubic, "A Memetic Algorithm for Matching Spatial Configurations with the Histograms of Forces," *IEEE Transactions on Evolutionary Computation*, vol. 17, no. 4, pp. 588-604, Aug. 2013.

A. R. Buck, J. M. Keller, M. Skubic, M. Detyniecki, and T. Bärecke, "Object set matching with an evolutionary algorithm," in *2011 IEEE Symposium on Computational Intelligence for Security and Defense Applications (CISDA)*, Paris, France, 2011, pp 43-50.

A. R. Buck, J. M. Keller, and M. Skubic, "A modified genetic algorithm for matching building sets with the histograms of forces," in *2010 IEEE Congress on Evolutionary Computation (CEC)*, Barcelona, Spain, 2010, pp. 1-7.

AWARDS & HONORS

Academic Awards
- Donald K. Anderson Graduate Research Assistant Award (MU Campus)   2015-2016
- Outstanding Ph.D. Student Award (ECE Department)   2015-2016
- Outstanding Masters Student Award (ECE Department)   2011-2012
- IEEE Symposium Series on Computational Intelligence 2011 Student Travel Grant   2011

Competitions
- 1st place (Graduate division) – MU Computer Science and Information Technology Showcase   2015
- 1st place (Graduate division) – MU IEEE Computational Intelligence Society Poster Contest   2015
- 2nd place – IEEE Computational Intelligence Society Student Games Ghosts Competition 2014   2014
- 3rd place (Graduate division) – MU IEEE Computational Intelligence Society Poster Contest   2014
- 2nd place – IEEE Computational Intelligence Society Student Games Ghosts Competition 2013   2013
- 1st place (Graduate division) – MU IEEE Computational Intelligence Society Poster Contest   2011

PROFESSIONAL CONTRIBUTIONS & AFFILIATIONS

Memberships
- IEEE Member   2018-2025
- IEEE Student Member   2011-2018
- IEEE Computational Intelligence Society (CIS) Member   2011-2025
- SPIE Member   2023-2025

Conferences
- Session chair for AIPR 2023   2023
- Session chair for FUZZ-IEEE 2023   2023
- Assisted with the organization of the FUZZ-IEEE 2019 Conference   2019
- Session chair for FUZZ-IEEE 2019   2019

Journal Paper Reviews (81)
- IEEE Transactions on Artificial Intelligence (18)   2021-2025
- IEEE Transactions on Evolutionary Computation (1)   2018
- IEEE Transactions on Fuzzy Systems (25)   2018-2025
- IEEE Transactions on Geoscience and Remote Sensing (8)   2018-2025
- International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems (28)   2019-2025
- Sensors (1)   2023

Conference Paper Reviews (31)
- International Joint Conference on Neural Networks (IJCNN) (6)   2024
- IEEE International Conference on Fuzzy Systems (FUZZ-IEEE) (22)   2016-2025
- IEEE Symposium Series on Computational Intelligence (SSCI) (3)   2021