GREGORY BALES

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Research Scientist and Engineer | Human-AI Interaction | Experimental Systems

Research Interests

- Human-autonomy teaming
- Brain computer interface
- Human-robot interaction
- Trust in autonomous systems
- Neurophysiological measurement and analysis
- Multimodal behavioral sensing
- Autonomous systems evaluation
- Experimental robotics
- Smart material actuation and motion control
- Precision electromechanical system design

Education

PhD, Mechanical Engineering **9/2023**
University of California, Davis

Advisor: Dr. Zhaodan Kong
Dissertation: A Cognitively Informed and Network Based Investigation of Human Neural Activities, Behaviors, and Performance in Human-Autonomy Teaming Tasks
Laboratory: Cyber-Human-Physical Systems Lab

Bachelor of Science, Mechanical Engineering, *Cum Laude* **6/2001**
San Jose State University

Publications

Journal Articles

- G. Bales, A. P. A. Hayman, T. K. Clark, J. Dekarske, S. Joshi, and Z. Kong, "An EEG-network-metric based approach to real-time trust inference in human-autonomy teaming," *Frontiers in Neuroergonomics*, vol. 6, 2025. doi: 10.3389/fnrgo.2025.1627483.
- G. Bales and Z. Kong, "Neurophysiological and behavioral differences in human-multiagent tasks: An EEG network perspective," *ACM Transactions on Human-Robot Interaction*, vol. 11, no. 4, pp. 1–25, 2022. doi: 10.1145/3527928.
- J. Das, G. L. Bales, Z. Kong, and B. Linke, "Integrating operator information for manual grinding and characterization of process performance based on operator profile," *Journal of Manufacturing Science and Engineering*, vol. 140, no. 8, 2018. doi: 10.1115/1.4040266.
- G. L. Bales, J. Das, J. Tsugawa, B. Linke, and Z. Kong, "Digitalization of human operations in the age of cyber manufacturing: Sensorimotor analysis of manual grinding performance," *Journal of Manufacturing Science and Engineering*, vol. 139, no. 10, 2017. doi: 10.1115/1.4037615.
- G. Bales, J. Das, B. Linke, and Z. Kong, "Recognizing gaze-motor behavioral patterns in manual grinding tasks," *Procedia Manufacturing*, vol. 5, pp. 106–121, 2016. doi: 10.1016/j.promfg.2016.08.011.

Preprints

- J. Dekarske, G. Bales, Z. Kong, and S. Joshi, "Anytime trust rating dynamics in a human-robot interaction task," arXiv:2408.00238 [cs.HC], 2024.

Conference Papers

- L. Peters, G. Bales, V. Tran, A. Moghbel, Z. Kong, and K. Moxon, "Peak delta frequency regulates the timing of decisions," in *59th Asilomar Conference on Signals, Systems, and Computers (IEEE)*, 2025. doi: 10.1109/IEEECONF67917.2025.11443667.
- G. Bales and Z. Kong, "Cognitive correlates of EEG spectral power indicate human-swarm task performance," in *Proceedings of the 8th International Conference on the Internet of Things*, ACM, Santa Barbara, CA, 2018. doi: 10.1145/3277593.3277613.
- G. Bales and Z. Kong, "The impact of dynamic complexity on human-multi-agent performance: A neuro-behavioral perspective," in *2nd IFAC Conference on Cyber-Physical and Human-Systems (CPHS)*, Miami, FL, 2018.
- G. Bales and Z. Kong, "Neurophysiological and behavioral studies of human-swarm interaction tasks," in *IEEE International Conference on Systems, Man, and Cybernetics (SMC)*, 2017. doi: 10.1109/smc.2017.8122684.

Works in Progress

- Y. Qin, G. Bales, S. Leary, A. Hayman, T. Clark, and Z. Kong, "Real-time EEG-based trust inference in human autonomy teaming by using dynamic state-space models," submitted to *IEEE Access*.

Research Experience

Research and Development Engineer **9/2023–2/2025**
Cyber-Human-Physical Systems Lab, UC Davis *Davis, CA*

- Continued post-doctoral research program producing peer-reviewed publication on real-time EEG-based trust inference in human autonomy teaming in Frontiers in Neuroergonomics, 2025.
- Contributed to collaborative research on EEG-based neural decision timing published at the 59th Asilomar Conference on Signals, Systems, and Computers, 2025.
- Supported lab mentoring, external engagement, and program sponsor reporting.

Research Thrust Member, Decision Making and Interfaces (RT3) **2019–2023**
NASA Home Space Technology Research Institute (HOME STRi) *Multi-Institution Consortium*

- Served as sole doctoral student researcher on the Cognitive-Aware Human-Autonomy Teaming sub-project within Research Thrust 3 of the NASA HOME STRi, collaborating directly with RT3 lead Dr. Allison Hayman and Dr. Torin Clark at the University of Colorado, Boulder.
- Contributed experimental research on cognitive state inference and trust modeling to the thrust's collaborative agenda and contributed to quarterly and annual NASA program reports.
- Presented subproject research at annual HOME STRi program reviews attended by all research thrusts and NASA program stakeholders.

Doctoral Researcher **1/2015–9/2023**
Cyber-Human-Physical Systems Lab, UC Davis *Davis, CA*

- Owned research agendas investigating human interaction with autonomous and multi-agent systems from study design through peer-reviewed publication, supported by NASA and AFOSR.
- Designed controlled experiments measuring cognitive state, trust, and behavioral adaptation during human supervision of autonomous and multi-agent robotic systems.
- Developed multimodal data pipelines integrating EEG, physiological sensing, motion capture, and task performance streams, applying graph-theoretic network analysis and machine learning methods to characterize human cognitive state and performance.
- Authored two IRB protocols and built experimental platforms supporting rigorous human subjects evaluation across multiple funded research programs.

Funding and Sponsored Research

- **NASA HOME STRi**, Human Autonomy Teaming Program, 2019–2023. PI: Dr. Zhaodan Kong, UC Davis. Role: Graduate Researcher, Cognitive-Aware Human-Autonomy Teaming subproject, RT3.
- **Air Force Office of Scientific Research (AFOSR)**, Trust and Influence Program. PI: Dr. Zhaodan Kong, UC Davis. Role: Graduate Researcher.
- **Defense University Research Instrumentation Program (DURIP)**, DoD. PI: Dr. Zhaodan Kong, UC Davis. Equipment: g.tec Hi-Amp 64-channel EEG system, 2021.

Honors and Awards

- Graduate Fellowship, University of California, Davis, 2015.
- Cum Laude, Bachelor of Science in Mechanical Engineering, San Jose State University, 2001.

Selected Presentations

- "Metrics and Models for Real-Time Inference and Prediction of Brain State in Human-Autonomy Teaming," USSPACECOM Academic Engagement Enterprise (AEE) Fall Symposium, Colorado Springs, CO, November 2024.
- "Cyber-Human-Physical Systems Lab Research Overview," USSPACECOM Academic Engagement Enterprise (AEE), University of California, Davis, 2023.
- "HOME RT3: Human-Autonomy Teaming, Overview and Research Roadmap," NASA HOME STRi Annual Review, 2020.
- "Cognitive Correlates of EEG Spectral Power Indicate Human-Swarm Task Performance," 8th International Conference on the Internet of Things, ACM, Santa Barbara, CA, 2018.
- "Neurophysiological and Behavioral Studies of Human-Swarm Interaction Tasks," IEEE International Conference on Systems, Man, and Cybernetics, 2017.

Professional Service

- Peer Reviewer, IEEE International Conference on Systems, Man, and Cybernetics (SMC), 2025.
- IRB Protocol Author, "Metrics and Models for Real Time Inference and Prediction of Trust in Human Autonomy Teaming," University of California, Davis, 2023.
- IRB Protocol Author, "Space Habitats Optimized for Missions of Exploration," University of California, Davis, 2020.
- Member, Institute of Electrical and Electronics Engineers (IEEE).
- Member, American Society of Mechanical Engineers (ASME).

Applied Research and Engineering Experience

Contract Research and Design Engineer **2/2009–9/2014**
Bales Technical Service *San Jose, CA*

- Designed and delivered mechatronic systems across diverse technical domains including aerospace actuation, precision motion control, power electronics, and active vibration cancellation.
- Developed smart material servohydraulic actuation systems, piezoelectric control electronics, and embedded firmware for UAV flight control and laboratory instrumentation applications.
- Designed a miniature cam-driven diaphragm pump for a tire pressure regulation system, developing a torque-ripple-minimizing cam profile algorithm and accelerated lifetime test bed for validation.

- Managed full project lifecycle from client scoping through design, fabrication, test, and delivery across concurrent independent programs.

Electromechanical Design Engineer **6/2001–2/2009**
Moog CSA Engineering *Mountain View, CA*

- Designed active structural vibration control systems using piezoelectric bimorph actuators, achieving up to 85% reduction in peak bending moment during wind tunnel testing at Mach 0.95.
- Designed power electronics and control systems for large-scale motion simulation platforms, achieving NRTL safety certification.
- Developed LQR and LQG control architectures for active structural control and validated performance through subsonic and transonic wind tunnel experiments.
- Contributed to peer-reviewed publications and conference presentations at AIAA, ASME, and SPIE venues on smart material actuation, structural dynamics, and vibration control.

Technical Skills

- Python (NumPy, SciPy, Pandas, Scikit-learn)
- Matlab/Simulink and EEGLab
- Machine learning (classification, regression, clustering)
- Signal processing and spectral analysis
- Graph-theoretic and network analysis methods
- Statistical modeling and quantitative analysis
- Experimental design and human subjects research
- Control systems design (LQR, LQG, adaptive feedforward)
- EEG, EDA, eye tracking, and motion capture systems
- Multimodal sensing and data pipeline development
- Mechatronic system design and integration
- Smart material actuation and vibration control
- PCB layout and circuit board fabrication
- Precision machining and prototype fabrication
- CAD and engineering drawings with GD&T