

Derek Hollenbeck-Paniagua, Ph.D.

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Research Interests

Autonomous systems; unmanned aerial systems (UAS); digital twins; environmental sensing; inverse problems; control and estimation; mobile sensor networks; methane and trace gas emissions; aerospace systems; robotics for energy and climate applications.

Education

Ph.D. Mechanical Engineering , University of California, Merced	May 2023
Dissertation: <i>Digital Twin Enabled Collective Sensing and Steering for Source Determination Problems</i>	
B.S. Mechanical Engineering (High Honors) , University of California, Merced	May 2016
A.A. Mathematics & Physical Science , Lassen Community College	May 2012

Appointments

Postdoctoral Research Scholar, Center for Methane Emission Research and Innovation (CMERI), UC Merced Dec 2023 – Present

- Lead development of digital twin frameworks for methane emission detection, localization, and quantification.
- Supervise graduate and undergraduate researchers; coordinate interdisciplinary research activities.
- Contribute to proposal development and management of DOE-funded projects.

Research Consultant, SeekOps Inc. Mar 2023 – Jun 2023

- Developed digital twin-based localization algorithms for methane point-source emissions in oil and gas facilities.

Publications

Books

- **Hollenbeck, D.**, & Chen, Y. *Smart Sensing with Digital Twins: Methane Emission Source Determination with sUAS*. CRC Press, 2025.

Refereed Journal Articles and Book Chapters

- Li, Z., **Hollenbeck, D.**, Sherman, M., Shao, S., Sun, X., & Hassanalian, M. Multi-Agent Reinforcement Learning for UAV-Based Chemical Plume Source Localization. *Engineering Applications of Artificial Intelligence*, 2026. (In review)
- **Hollenbeck, D.**, Edgar, C., Euskirchen, E., & Manies, K. Towards Mobile Wind Measurements Using Joust Configured Ultrasonic Anemometer for Applications in Gas Flux Quantification. *Drones*, 9(2), 94. 2025.

- An, D., **Hollenbeck, D.**, Cao, K., & Chen, Y. “Soil Methane Emission Suppression Control Using UAV Swarm Application of Biochar Mulch.” *Journal of Information and Intelligence*, 2023.
- Viola, J., Rodriguez, C., **Hollenbeck, D.**, & Chen, Y. (2022). 13 A radio frequency impedance matching control benchmark and optimal fractional-order stochastic extremum seeking method. In *Outliers in Control Engineering* (p. 237).
- **Hollenbeck, D.**, & Chen, Y. “A Digital Twin Framework for Environmental Sensing with sUAS.” *Journal of Intelligent & Robotic Systems*, 2022.
- **Hollenbeck, D.**, Zulevic, D., & Chen, Y. “Advanced Leak Detection and Quantification of Methane Emissions Using sUAS.” *Drones*, 2021.
- Schloesser, D. S., **Hollenbeck, D.**, & Kello, C. T. “Individual and Collective Foraging in Autonomous Search Agents with Human Intervention.” *Scientific Reports*, 2021.
- Niu, H., **Hollenbeck, D.**, Zhao, T., Wang, D., & Chen, Y. “Evapotranspiration Estimation with Small UAVs in Precision Agriculture.” *Sensors*, 2020.
- Chen, Y., **Hollenbeck, D.**, Wang, Y., & Chen, Y. (2018). On optimal tempered Lévy flight foraging. *Frontiers in Physics*, 6, 111.

Refereed Conference Proceedings

- **Hollenbeck, D.**, Cao, S., Giri, S., Saeed, A., O’Day, P., Beutel, M., & Chen, Y. (2025). An Optimal Mobile Sensing sUAS Platform Using Digital Twins and the Observability Gramian. 2025 13th International Conference on Control, Mechatronics and Automation (ICCMA). IEEE. (In Press)
- Krzysiak, R., Amavizca, A., Ramirez, J., **Hollenbeck, D.**, Giri, S., & Chen, Y. (2025). Modeling and Control of a Prescribed Fire with UAVs as Sensors and Actuators. 2025 13th International Conference on Control, Mechatronics and Automation (ICCMA). IEEE. (In Press)
- Giri, S., LiWang, B., Kuang, A., **Hollenbeck, D.**, & Chen Y. (2025). A low-cost autonomous diffusing gas source detection system with a UGV and empirical observability Gramian. 2025 11th International Conference on Mechanical and Electronics Engineering (ICMEE). (In Press)
- Giri, S., Krzysiak, R., **Hollenbeck, D.**, & Chen, Y. (2025). AVIRIS-NG-Like Smart Virtual Remote Sensing via Spectra-Aware Physics Informed GANs. International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, 89251, V005T07A001. American Society of Mechanical Engineers.
- Giri, S., **Hollenbeck, D.**, & Chen, Y. (2025). Which information metric is the best, CRLB, FIM or EMGR for optimal mobile sensing of a diffusing source? 2025 American Control Conference (ACC), 5166–5171. IEEE.
- **Hollenbeck, D.**, & Chen, Y. (2024). Towards A Digital Twin Framework for Landfill Emission Source Determination using Hybrid VTOL Fixed-wing: A Simulation Study. 2024 20th IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications (MESA), 1–7. IEEE.
- **Hollenbeck, D.**, Zheng, K., Zulevic, D., & Chen, Y. (2023). Swarm Robotic Source Seeking with Fractional Fluxotaxis. 2023 International Conference on Fractional Differentiation and Its Applications (ICFDA), 1–5. IEEE.
- An, Di, Krzysiak, R., **Hollenbeck, D.**, & Chen, Y. (2023a). Battery-health-aware UAV mission planning using a cognitive battery management system. 2023 International Conference on Unmanned Aircraft Systems (ICUAS), 523–528. IEEE.
- An, Di, Krzysiak, R., **Hollenbeck, D.**, & Chen, Y. (2023b). Long endurance site-specific management of biochar applications using unmanned aircraft vehicle and unmanned ground vehicle. *IFAC-PapersOnLine*, 56(2), 8908–8913.
- **Hollenbeck, D.**, An, D., Krzysiak, R., & Chen, Y. (2023). Towards cognitive battery monitoring on

- hybrid vtol fixed-wing suavs with maximized safe endurance. 2023 11th International Conference on Control, Mechatronics and Automation (ICCMA), 80–85. IEEE.
- An, Di, Liu, Z., **Hollenbeck, D.**, & Chen, Y. (2022). A Greenhouse Gas Proximity Sensing System Using Chemiresistive Strip and Miniaturized Radar Array. 2022 10th International Conference on Control, Mechatronics and Automation (ICCMA), 173–178. IEEE.
 - Manies, K., **Hollenbeck, D.**, Golston, L., Euskirchen, E. S., Edgar, C., Chen, Y., & Waldrop, M. P. (2022). Methods for measuring wind speed and direction for accurate estimations of methane fluxes. AGU Fall Meeting Abstracts, 2022, A12E-04.
 - An, Di, **Hollenbeck, D.**, Gao, S., & Chen, Y. (2022). A Field Study of Soil Biochar Treatment Response Using Small Unmanned Aerial Systems (sUAS). Proceedings of the International Conference on Unmanned Aircraft Systems.
 - **Hollenbeck, D.**, Zulevic, D., & Chen, Y. (2022b). Single and Multi-sUAS Based Emission Quantification Performance Assessment Using MOABS/DT: A Simulation Case Study. 2022 18th IEEE/ASME International Conference on Mechatronic and Embedded Systems and Applications (MESA), 1–5. IEEE.
 - **Hollenbeck, D.**, Zulevic, D., & Chen, Y. (2022a). A Modified Near-Field Gaussian Plume Inversion Method Using Multi-sUAS for Emission Quantification. Proceedings of the International Conference on Unmanned Aircraft Systems.
 - Viola, J., **Hollenbeck, D.**, Rodriguez, C., & Chen, Y. (2021). Fractional-order stochastic extremum seeking control with dithering noise for plasma impedance matching. 2021 IEEE Conference on Control Technology and Applications (CCTA), 247–252. IEEE.
 - **Hollenbeck, D.**, Zulevic, D., & Chen, Y. (2021). MOABS/DT: Methane odor abatement simulator with digital twins. 2021 IEEE 1st International Conference on Digital Twins and Parallel Intelligence (DTPI), 378–381. IEEE.
 - **Hollenbeck, D.**, & Chen, Y. (2021b). Multi-UAV method for continuous source rate estimation of fugitive gas emissions from a point source. 2021 International Conference on Unmanned Aircraft Systems (ICUAS), 1308–1313. IEEE.
 - **Hollenbeck, D.**, & Chen, Y. (2021a). Digital twin behavior matching of gas plumes using a fixed sensor mesh and dynamic mode decomposition. International Design Engineering Technical Conferences and Computers and Information in Engineering Conference, 85437, V007T07A005. American Society of Mechanical Engineers.
 - **Hollenbeck, D.**, Manies, K., Chen, Y., Baldocchi, D., Euskirchen, E. S., & Christensen, L. (2021). Evaluating a UAV-based Mobile Sensing System Designed to Quantify Ecosystem-based Methane.
 - Schloesser, D. S., **Hollenbeck, D.**, & Kello, C. T. (2020). Social Foraging in Groups of Search Agents with Human Intervention. Proceedings of the Annual Meeting of the Cognitive Science Society, 42.
 - **Hollenbeck, D.**, & Chen, Y. (2020b). Characterization of ground-to-air emissions with sUAS using a digital twin framework. 2020 International Conference on Unmanned Aircraft Systems (ICUAS), 1162–1166. IEEE.
 - **Hollenbeck, D.**, & Chen, Y. (2020a). A more optimal stochastic extremum seeking control using fractional dithering for a class of smooth convex functions. IFAC-PapersOnLine, 53(2), 3737–3742.
 - Whitticar, M., **Hollenbeck, D.**, Billwiller, B., Salas, C., & Christensen, L. (2019). Application of the bc GHGMapper™ platform for the Alberta Methane Field Challenge (AMFC). Geoscience BC Summary of Activities, 2020–2002.
 - **Hollenbeck, D.**, Dahabra, M., Christensen, L. E., & Chen, Y. (2019). Data quality aware flight mission design for fugitive methane sniffing using fixed wing sUAS. 2019 International Conference on Unmanned Aircraft Systems (ICUAS), 813–818. IEEE.
 - **Hollenbeck, D.**, Nunez, G., Christensen, L. E., & Chen, Y. (2018). Wind measurement and estimation with small unmanned aerial systems (suas) using on-board mini ultrasonic anemometers. 2018

International Conference on Unmanned Aircraft Systems (ICUAS), 285–292. IEEE.

- Fatehiboroujeni, S., **Hollenbeck, D.**, & Goyal, S. (2017). Effect of Softening Constitutive Law on Column Buckling. ENOC 2017.

Grants and Funding

DOE-EM, Key Personnel, “Development and Testing of sUAS for Real-Time Detection of Methane Leaks and Mercury Emissions,” 2025.

DOE FOA 3256, Senior Personnel, E2E-Methane-IQ, 2024.

Teaching Experience

Instructor of Record:

- Circuit Theory (ENGR 057)

Teaching Assistant / Lecturer:

- Circuit Theory
- Statics & Dynamics
- Mechatronics
- Unmanned Aircraft Systems
- Capstone Design

Mentoring

- Postdoctoral mentor for undergraduate research teams in UAS-based methane and mercury sensing.
- Graduate mentor, AIAA Design/Build/Fly (2016–2020).

Service and Leadership

- Daily operations and coordination for CMERI research initiatives.
- Reviewer for IEEE, Springer, MDPI, and other control systems conferences.

Technical Skills

Programming (MATLAB/Simulink, Python); Modeling (Computational Fluid Dynamics, digital twins); Data (analysis, signal processing, sensor fusion); sUAS (design, operations); control systems (linear, non-linear, robust); CAD/CAM; embedded systems; machine learning;

Certifications

FAA Part 107 Remote Pilot