Holly **Dinkel**

Ph.D. Candidate in Aerospace Engineering, NASA Robotics Research Fellow

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Education

University of Illinois Urbana-Champaign (UIUC) *Urbana, IL*
Ph.D. Aerospace Engineering (Anticipated) *May 2025*
- Thesis: Representing and Manipulating Deformable Linear Objects (project: **RMDLO**)
- Supervisor: **Timothy Bretl** (UIUC Coordinated Science Laboratory)
- Research Directors: **Brian Coltin** and **Trey Smith** (NASA Ames Research Center)
- Committee: **Timothy Bretl** (Chair), **Nancy Amato**, **Huy Tran**, **Justin Yim**, **Brian Coltin**, and **Trey Smith**

Stanford University *Stanford, CA*
M.S. Aeronautics and Astronautics, Certificate in Entrepreneurship *June 2020*
- Research Director: **Monroe Kennedy III** (Stanford University Department of Mechanical Engineering)

University of Missouri *Columbia, MO*
B.S. Chemical Engineering, B.A. Music - University Honors *May 2017*
- Senior Project: Chromatographic Studies of Yttrium-90 for Radiolabeling of Pharmaceuticals
- Supervisor: **Patrick Pinhero** (University of Missouri Department of Chemical Engineering)
- Research Director: **Megan Bennett** (DOE Argonne National Laboratory, Deceased)

Honors & Awards

International

2023	**Best Poster Finalist**, IEEE IROS Workshop on Robotics and AI in Future Factory	*Detroit, MI*
2023	**P.E.O. Scholar** (110/825 doctoral applicants), P.E.O. International	*Des Moines, IA*
2023	**Amelia Earhart Graduate Fellow** (30 awarded), Zonta International	*Oak Park, IL*
2023	**First Prize, Core Track of OpenCV AI Competition** (7/45 teams), OpenCV	*San Francisco, CA*
2022	**Amelia Earhart Fellowship Finalist** (30 awarded), Zonta International	*Buffalo, NY*
2021	**Best Technical Presentation Finalist** (12/500 papers), IAF GLEX	*St. Petersburg, Russia*
2020	**Space Cooperation Delegate** (5% accepted), Stanford U.S.-Russia Forum	*Stanford, CA*

National

2023	**Future Leader in Aerospace**, MIT Aeronautics and Astronautics	*Boston, MA*
2022	**Critical Language Scholar (Russian, 10% accepted)**, Department of State	*Washington D.C.*
2021	**Space Technology Graduate Research Opportunity Recipient** (70 accepted), NASA	*Washington D.C.*
2020	**Graduate Assistant in Areas of National Need**, Department of Education	*Washington D.C.*
2016	**Nuclear Energy University Programs Scholar (30 awarded)**, Department of Energy	*Idaho Falls, ID*
2015	**Nuclear Energy University Programs Scholar (50 awarded)**, Department of Energy	*Idaho Falls, ID*

Regional

2023	**Faculty Outstanding Graduate Student Award**, UIUC Aerospace Engineering	*Urbana, IL*
2021	**Graduate Fellow**, Illinois Space Grant Consortium	*Urbana, IL*
2020	**Mavis Future Faculty Scholar**, UIUC Grainger College of Engineering	*Urbana, IL*
2019	**Threshold Fellow** (12/80 accepted), Stanford Technology Ventures Program	*Stanford, CA*
2017	**Phi Beta Kappa**, University of Missouri	*Columbia, MO*
2015	**Junior Scholar (2 awarded)**, University of Missouri Honors College	*Columbia, MO*
2014	**Sophomore Scholar (3 awarded)**, University of Missouri Honors College	*Columbia, MO*
2012	**Engineering Excellence Award**, University of Missouri College of Engineering	*Columbia, MO*
2012	**Curator's Scholar**, University of Missouri	*Columbia, MO*
2012	**Bright Flight Scholar (3% of MO students)**, MO Department of Higher Education	*Jefferson City, MO*
2012	**International Baccalaureate Diploma Recipient**, St. Joseph Central High School	*St. Joseph, MO*
2012	**Valedictorian (Rank: 1/354)**, St. Joseph Central High School	*St. Joseph, MO*

Research Experience

UIUC Coordinated Science Laboratory *Urbana, IL*
NASA Graduate Research Fellow *Jun 2021–Present, 40 hrs/week*
- Led the **Representing and Manipulating Deformable Linear Objects (RMDLO)** team comprising seven undergraduate students, one M.S. student, and research scientists in the NASA Ames Research Center Intelligent Robotics Group and the NASA Johnson Space Center Dexterous Manipulation Laboratory to study perception and manipulation of deformable linear objects with applications to robotic caretaking of space habitats
- Built a robot work cell and custom desktop computer from components (two ABB IRB 120 industrial manipulators, one OnRobot 2FG7 parallel-jaw gripper, an Intel RealSense RGBD camera, and state-of-the-art computing components)
- Published TrackDLO, a state-of-the-art algorithm for tracking the shape of wires and ropes from RGBD imagery, as an open-source ROS package and as a paper in *IEEE Robotics and Automation: Letters*
- Developed COCOpen, software for perceiving wire instances in RGB imagery by training a Mask R-CNN deep learning-based instance segmentation model on synthetic images, as an open-source python library

NASA Ames Research Center *Moffett Field, CA*
Intelligent Robotics Group Visiting Researcher *June 2020–Present, varied*
- Developed, open-sourced, and published an algorithm for real-time scene change detection from camera imagery for the Astrobee free-flying robot on the International Space Station
- Developed and published a scene change detection algorithm operating on point cloud data, including reconstructed maps of the environment, for Astrobee
- Developed deformable object perception, segmentation, and reconstruction for Astrobee

NASA Johnson Space Center *Houston, TX*
Dexterous Robotics Laboratory Visiting Researcher *Jun 2022–Aug 2022, 40 hrs/week*
- Developed wire tip perception and grasping using a ZED Mini camera and a Sawyer robot arm

UIUC Coordinated Science Laboratory *Urbana, IL*
Graduate Research Assistant *Aug 2020–May 2021, 30 hrs/week*
- Led component selection and assembly of a robot work cell (two Universal Robots UR5 robot manipulators, two Robotiq Hand-E grippers, Intel RealSense and Basler cameras, two state-of-the-art computers for system monitoring and training deep learning-based perception models, a Baxter wheeled robot base for a mobile manipulator, and associated work benches and mounting equipment) used to solve an industrial assembly problem
- Developed real-time communication, control, and data interfacing for all components of the robotic work cell (the robots and their embedded force sensors, the grippers and their embedded force sensors, and the cameras)
- Automated labeling of 30,000 electronic components in RGB images based on one manually-labeled image, saving hundreds of hours of image annotation, for training a Mask R-CNN instance segmentation model used in part pose estimation
- Automated pose estimation of the pose of an electronic component from camera imagery by optimizing the Intersection-Over-Union score between an instance segmentation mask predicted by Mask R-CNN and a template mask

NASA Ames Research Center *Moffett Field, CA*
Distributed Spacecraft Autonomy Intern *Mar 2020–Jun 2020, 30 hrs/week*
- Developed Distributed Spacecraft Autonomy (DSA) tools for simulating lunar Positioning, Navigation, and Timing (PNT)
- Generated synthetic measurements among PNT assets considering line of sight, satellite attitude, noise, signal variation due to selected hardware or operational mode
- Developed distributed orbit determination and time synchronization algorithms
- Evaluated localization accuracy using DSA tools considering hardware and operational choices, asset locations, algorithm accuracy, and access to ground truth measurements

Stanford Assistive Robotic Manipulation (ARM) Laboratory   *Stanford, CA*
GRADUATE STUDENT RESEARCHER   *Jan 2020–Present, 6 hrs/week*
- Implemented the Rapidly-Exploring Random Tree (RRT) algorithm for a kinematic chain toward fast motion planning for catching flying objects with workspace obstacles

DOE Argonne National Laboratory   *Lemont, IL*
SCIENCE UNDERGRADUATE LABORATORY INTERN   *Jan 2016–Aug 2016, 40 hrs/week*
- Dissolved Scandium, Yttrium, and Titanium in hydrochloric, sulfuric, and hydrogen fluoride acids to optimize their separation for the production of electron linear accelerator-produced therapeutic and diagnostic medical radioisotopes
- Prepared scientific methods, results, and further studies of scandium medical radioisotope research for inclusion in U.S. patent No. 10344355, "Process for the separation and purification of scandium medical isotopes"
- Collected and analyzed radioactive decay data using Matlab for a project seeking to manufacture a Neptunium tracer for nuclear forensics use in the Argonne Analytical Chemistry Laboratory (ACL)

DOE Fermi National Accelerator Laboratory   *Batavia, IL*
LEE TENG FELLOW IN ACCELERATOR PHYSICS   *May 2015–Aug 2015, 40 hrs/week*
- Computed particle position, momentum, time, and data group identification (PDGid) information for particles tracked in G4Beamline, a particle tracking simulation software
- Performed a design trade study of a hadron monitor for the Long Baseline Neutrino Facility, the world's highest-intensity neutrino beam facility, using G4Beamline to simulate the electric field, the number of electron-ion pairs incident on the monitor, and the spatial arrangement of the neutrino beam cross section given input power.

University of Missouri Dept. of Chemical Engineering   *Columbia, MO*
HONORS UNDERGRADUATE RESEARCHER   *Aug 2013–Aug 2016, 6 hrs/week*
- Simulated irradiation and isotopic depletion of small samples of uranium and thorium using OrigenARP and the TRITON sequence in the Oak Ridge National Laboratory-developed SCALE package to assess the risks involved with utilizing thorium as a fuel source in accelerator-driven, portable-power systems
- Irradiated lithium-intercalated graphite and detected its radioactivity for advanced beta-voltaic battery research using the cyclotron at the University of Missouri Research Reactor (MURR)

Engineering Experience

NASA Marshall Space Flight Center   *Huntsville, AL*
PROBABILISTIC RISK ASSESSMENT (PRA) ANALYST, BASTION TECHNOLOGIES INC.   *May 2017–Aug 2018, 40 hrs/week*
- Developed fault tree analyses for Artemis Program loss of mission and loss of crew scenarios
- Developed system-level PRAs for the Space Launch System upper stage reaction control system (RCS); core, booster, and upper stage thrust vector control systems; and ground systems
- Awarded a Bastion Technologies contract-wide on-the-spot award for identifying an upper stage RCS design in violation of NASA's single-fault-tolerance requirement and presenting the risks of this design to the SLS chief safety officer
- Recruited and mentored a Bastion full-time employee and a NASA Pathways intern in PRA and supported their developments of the interim cryogenic propulsion stage RCS PRA and the exploration upper stage RCS PRA
- Analyzed reliability of the self-propelled modular transporter to identify risks of transporting the SLS core stage between NASA centers
- Collaborated with a NASA reliability engineer to collect historical space shuttle hydrazine leak data and analyze statistics on this data for use in SLS risk quantification

Skills

Programming Python, C++, Matlab, Bash, ROS, Git, Docker, LaTeX
Languages English (native), Mandarin Chinese (advanced), Russian (intermediate)

Grant Writing

NASA *Urbana, IL*
Space Technology Graduate Research Opportunity *Nov 2021*
- Wrote grant proposal for $328,000 for four years of funding from the NASA Space Technology Graduate Research Opportunity program
- Grant title: Instance-Aware Semantic Mapping for Robotic Caretaking of Space Habitats
- Status: Awarded

DOE *Urbana, IL*
Fermi National Laboratory Oscura Experiment *Feb 2023*
- Wrote grant proposal for $2,321,112 for five years of funding to support manufacture of detectors for the Oscura Experiment
- Grant title: Robotic Work Cell for Assembling Multi-Chip Modules for Detectors for High-Energy Physics Experiments
- Status: Denied

NASA *Urbana, IL*
NASA Lunar Space Technology Readiness Solicitation *Apr 2023*
- Wrote grant proposal for $1,600,000 for two years of funding to support multi-agent robotic exploration of lunar craters
- Grant title: Robotic Exploration and Multi-Agent Teammate Extraction (REMOTE)
- Status: Denied

Teaching Experience

UIUC, NASA *Urbana, IL*
Undergraduate Research Mentor *Jan 2021–Present, 10 hrs/week*
- Mentored undergraduate and graduate research through the following programs and courses:
    - Illinois Space Grant Consortium Undergraduate Research Opportunity Program (UROP)
    - Undergraduate Research Apprenticeship Program (URAP)
    - Promoting Undergraduate Research in Engineering (PURE)
    - AE 597: Graduate Independent Study
    - AE 497: Undergraduate Independent Study
    - AE 298: Undergraduate Research Mentoring.
    - ECE 497: Senior Thesis
    - ECE 397: Undergraduate Independent Study
    - CS 397: Undergraduate Independent Study
    - NASA Office of STEM Engagement

Stanford Dept. of Aeronautics and Astronautics *Stanford, CA*
Global Positioning System (AA 115Q) Course Development Assistant *Dec 2019–Mar 2020, 10 hrs/week*
- Wrote and tested course projects on celestial navigation and the global positioning system

Stanford Athletic Academic Resource Center *Stanford, CA*
Academic Skills Tutor *Sep 2019–Jun 2020, 6 hrs/week*
- Facilitated undergraduate group tutorial sessions for Dynamics, Probabilistic Analysis, Introduction to Optimization, Mechanics of Materials, and Introduction to Single-Variable Calculus

Stanford Schwab Learning Center *Stanford, CA*
Academic Skills Tutor *Jan 2019–Jun 2020, 5 hrs/week*
- Provided individual tutoring to ensure academic success for students with attention-deficit hyperactivity disorder, dyslexia, and other learning disabilities for Dynamics and Physics: Light and Heat

University of Missouri Community Music Program *Columbia, MO*
Community Music Program Clarinet Instructor *Aug 2016–May 2017, 5 hrs/week*
- Coached clarinet performance techniques to middle- and high-school music students, stressing the importance of performance as a learning tool through encouraging every student to participate in a public recital each semester

Mentored Students

- **Achintya Gahalaut**, January 2023 - Present
  Program: UIUC Undergraduate Research Apprenticeship Program
  Project: Adaptive Gripper Finger Position and Force Control
  Current Junior in Computer Engineering
- **Justin Galardi**, May 2017 - August 2017
  Program: Argonne National Laboratory Student Research Participation Program
  Project: Scandium-47 Separation Chromatography
  2018 SUNY Brockport B.S. Chemistry graduate, current Ph.D. Candidate in Biochemistry at the University of Rochester
- **Naixiang Gao**, January 2023 - Present
  Program: ECE 397 Independent Research
  Projects: Wire Tracking Under Occlusion (TrackDLO) (see: [6])
  Current UIUC Senior in Computer Engineering, Incoming M.S. Mechanical Engineering student at Stanford University
- **Cameron Hines**, May 2018 - August 2018
  Program: NASA Pathways Internship Program at NASA Marshall Space Flight Center
  Project: Space Launch System Interim Cryogenic Propulsion Stage Probabilistic Risk Assessment
  2019 Georgia Institute of Technology B.S./M.S. AE graduate, current P.I. at NASA Marshall Space Flight Center
- **Zikun Liu**, August 2022 - Present
  Program: UIUC Promoting Undergraduate Research in Engineering, ECE 397 Independent Research
  Projects: Gripper Finger Prototyping for In-Hand Tactile Sensing, Optical Flow on Tactile Images
  Current Sophomore in Computer Engineering
- **Raghavendra Navaratna**, August 2022 - Present
  Program: AE 597 Independent Research
  Projects: Coordinated Manipulation of Two Robotic Manipulators, Extrinsic Calibration of Two Robot Arms
  2023 UIUC M.S. AE graduate, current Research Engineer at Princeton University
- **Yash Rathod**, August 2022 - August 2023
  Program: UIUC Promoting Undergraduate Research in Engineering, CS 397 Independent Research
  Projects: Automated Data Generation and Labeling (COCOpen), Deep Learning on Supercomputers, Instance Segmentation
  Current Junior in Computer Science
- **Fuad Samhouri**, August 2022 - May 2023
  Program: AE 298 Undergraduate Research Mentoring, AE 497 Independent Research
  Project: 3D Object Reconstruction from RGB Imagery with OpenSfM (see: [8])
  2023 UIUC B.S. AE graduate, current space roboticist at NASA Johnson Space Center
- **Jamie Santos**, March 2023 - Present
  Program: NASA Office of STEM Engagement
  Project: Unsupervised Change Detection for Space Habitats Using 3D Point Clouds (see: [4, 5])
  2023 Chalmers University M.S. Complex and Adaptive Systems graduate, current research engineer at Texas A&M University Robotics and Automation Design Lab
- **Jingyi Xiang**, January 2022 - Present
  Program: UIUC Undergraduate Research Apprenticeship Program, Illinois Space Grant Consortium Undergraduate Research Opportunities Program, ECE 397 Independent Research, ECE 497 Senior Thesis
  Projects: Automated Data Generation and Labeling (COCOpen), Camera Extrinsic Calibration, Robotic Manipulator Control and Motion Planning, Wire Tracking Under Occlusion (TrackDLO) (see: [6, 7, 11])
  Current UIUC Senior in Electrical Engineering, incoming UIUC Ph.D. student in Computer Science
- **Harry Zhao**, January 2021 - August 2023
  Program: AE 497 Independent Research, Illinois Space Grant Consortium Undergraduate Research Opportunity Program
  Projects: Object Detection, Automated Data Generation and Labeling (COCOpen), Wire Tracking Under Occlusion (TrackDLO) (see: [6, 11])
  2023 UIUC B.S. AE graduate, current M.S. Candidate in Aeronautics and Astronautics at Stanford University

References

[1] **H. Dinkel**, J. Di, J. Santos, K. Albee, P. Borges, M. Moreira, R. Soussan, O. Alexandrov, B. Coltin, and T. Smith, "*AstrobeeCD: Change Detection in Microgravity with Free-Flying Robots*," in *Under Review*, 2024. [**Code**].

[2] **H. Dinkel**, R. Navaratna, J. Xiang, B. Coltin, T. Smith, and T. Bretl, "*KnotDLO: Toward Interpretable Knot Tying*," in *IEEE International Conference on Robotics and Automation (ICRA) 3D Visual Representations for Manipulation*

Workshop, May 2024. [**Paper**].

[3] J. Xiang, **H. Dinkel**, H. Zhao, N. Gao, B. Coltin, T. Smith, and T. Bretl, "*TrackDLO: Tracking Deformable Linear Objects Under Occlusion With Motion Coherence,*" in *IEEE International Conference on Robotics and Automation (ICRA) Workshop on Representing and Manipulating Deformable Objects*, May 2024. **Best Paper Finalist**. [**Paper**, **Video**].

[4] J. Santos, **H. Dinkel**, J. Di, P. V.-K. Borges, M. Moreira, B. Coltin, and T. Smith, "*Unsupervised Change Detection for Space Habitats Using 3D Point Clouds,*" in *AIAA Scitech Forum*, January 2024. [**Paper**, **Video**,**Code**].

[5] **H. Dinkel***, J. Di*, J. Santos, K. Albee, P. V.-K. Borges, M. Moreira, O. Alexandrov, B. Coltin, and T. Smith, "*Multi-Agent 3D Map Reconstruction and Change Detection in Microgravity with Free-Flying Robots,*" in *IAF International Astronautical Congress (IAC)*, October 2023. [**Paper**, **Video**, **Code**].

[6] J. Xiang, **H. Dinkel**, H. Zhao, N. Gao, B. Coltin, T. Smith, and T. Bretl, "*TrackDLO: Tracking Deformable Linear Objects Under Occlusion With Motion Coherence,*" in *IEEE Robotics and Automation Letters*, vol. 8, pp. 6179–6186, August 2023. [**Paper**, **Video**, **Code**].

[7] J. Xiang and **H. Dinkel**, "*Simultaneous Shape Tracking of Multiple Deformable Linear Objects with Global-Local Topology Preservation,*" in *IEEE International Conference on Robotics and Automation (ICRA) Workshop on Representing and Manipulating Deformable Objects*, May 2023. [**Paper**, **Video**, **Code**, **Poster**].

[8] F. Samhouri and **H. Dinkel**, "*3DRP: OpenSfM for Manipulating Deformable Objects,*" in *UIUC Coordinated Science Laboratory Student Conference*, February 2023.

[9] M. Q. Ta*, **H. Dinkel***, H. Abdul-Rashid, Y. Dai, J. Myers, T. Chen, J. Geng, and T. Bretl, "*The Impact of Time Step Frequency on the Realism of Robotic Manipulation Simulation for Objects of Different Scales,*" in *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) Workshop on Robotics and AI in Future Factory*, 2023. **Best Poster Finalist**. [**Paper**, **Video**, **Poster**].

[10] **H. Dinkel*** and J. Cornelius*, "*Vela: A Data-Driven Proposal for Joint Collaboration in Space Exploration,*" in *IAF International Astronautical Congress (IAC)*, September 2022. [**Paper**, **Presentation**].

[11] **H. Dinkel***, J. Xiang*, H. Zhao, B. Coltin, T. Smith, and T. Bretl, "*Wire Point Cloud Instance Segmentation from RGBD Imagery with Mask R-CNN,*" in *IEEE International Conference on Robotics and Automation (ICRA) Workshop on Representing and Manipulating Deformable Objects*, May 2022. [**Paper**, **Video**].

[12] T. Chen, Z. Huang, J. Motes, J. Geng, Q. Ta, **H. Dinkel**, H. Abdul-Rashid, J. Myers, Y. Mun, W. Lin, Y. Huang, S. Liu, M. Morales, N. Amato, K. Driggs-Campbell, and T. Bretl, "*Insights from an Industrial Collaborative Assembly Project: Lessons in Research and Collaboration,*" in *IEEE International Conference on Robotics and Automation (ICRA) Workshop on Collaborative Robots and Work of the Future*, May 2022. [**Paper**, **Video**].

[13] J. Cornelius*, **H. Dinkel***, and A. Kurgan, "*Development of a Private Space Sector in the U.S. and Russia,*" in *IAF Global Space Exploration (GLEx) Conference*, June 2021. **Best Technical Presentation Finalist**. [**Paper**, **Video**, **Lightning Talk**].

[14] **H. Dinkel** and K. Hashemi, "*Ground Asset Placement Optimization for Lunar Positioning, Navigation, and Timing,*" in *NASA Summer Intern Poster Symposium*, June 2020.

[15] **H. Dinkel** and F. Hark, "*An Assessment of Launch Failures from 1989 - Present,*" in *Reliability, Availability, and Maintainability (RAM) X Training Summit*, October 2017. [**Presentation**].

[16] **H. Dinkel**, M. Bennett, M. A. Brown, and D. Rotsch, "*Separations and Chromatography Studies of Yttrium-90 for Radiolabeling Pharmaceuticals,*" in *Argonne National Laboratory Summer Research Symposium*, August 2016.

[17] K. Yonehara, R. Abrams, **H. Dinkel**, B. Freemire, and R. Johnson, "*Gas Filled RF Resonator Hadron Beam Monitor for Intense Neutrino Beam Experiments,*" in *International Conference on Particle Accelerator Physics (IPAC)*, May 2016. [**Paper**].

[18] **H. Dinkel** and K. Yonehara, "*Pressurized Gas Hadron Monitor for the Long Baseline Neutrino Facility,*" in *Fermi National Accelerator Laboratory Summer Research Symposium*, August 2015. [**Paper**, **Poster**].

*Denotes Equal Contribution