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)

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   *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

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	**Travel Grant Recipient**, UIUC Grainger College of 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	**Magna Cum Laude with University Honors** , University of Missouri	*Columbia, MO*
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   *Mar 2023–Jun 2023, 40 hrs/week*
- Developed real-time scene change detection for the Astrobee free-flying robot on the International Space Station

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*
INTELLIGENT ROBOTICS GROUP INTERN   *Jun 2020–Aug 2020, 40 hrs/week*
- Developed deformable object perception, segmentation, and reconstruction for the Astrobee free-flying robot

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 from scratch for an articulated kinematic chain for 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
- Supported the development, review, and assessment of the Day-of-Launch I-Load Update (DOLILU) operations support plan, which determines the day-of-launch weather-dependent SLS trajectory optimization routines
- 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, respectively
- Analyzed system reliability of the self-propelled modular transporter to identify risks of transporting the SLS core stage between NASA centers
- Supported presentation of the integrated SLS PRA model to the SLS engineering review board
- Communicated PRA element model design and results to the NASA PRA team ahead of schedule, and developed a team template for all future presentations
- 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 *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

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 involving using a sextant for celestial navigation and determining the accuracy of global positioning system measurements in the presence of interference

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

Mentored Students
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Various
May 2017–Present
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- **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)
  Current Senior in Computer Engineering
- **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
  Current UIUC M.S. student in Aerospace Engineering
- **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
  2023 UIUC B.S. AE graduate, current space roboticist at NASA Johnson Space Center
- **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)
  Current UIUC Senior in Electrical Engineering
- **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)
  2023 UIUC B.S. AE graduate, current M.S. Candidate in Aeronautics and Astronautics at Stanford University

Outreach and Review

International Astronautical Federation (IAF) Abstract Mentor Program
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Online
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MENTOR
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Feb 2023–Present
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- Review and provide feedback on abstracts submitted by young researchers to IAF events including the International Astronautical Congress

Robotics and Automation Letters
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Online
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REVIEWER
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Sep 2021–Present
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- Review manuscripts submitted to *IEEE Robotics and Automation Letters*

References

[1] T. Chen, Z. Huang, J. Motes, J. Geng, Q.M. Ta, **H. Dinkel**, H. Abdul-Rashid, J. Myers, Y.J. Mun, W.C. Lin, Y.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**].

[2] 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**].

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

[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] 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**].

[6] **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**].

[7] **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**].

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

[9] **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**].

[10] **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.

[11] **H. Dinkel**, T. Bretl, B. Coltin, T. Smith, and M. Moreira. *"Conditional Variational Autoencoders on Astrobee RGB-D Imagery"*. In *NASA Summer Intern Poster Symposium*, August 2020.

[12] **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**].

[13] **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**].

[14] 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**].

[15] 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"'*. *IEEE Robotics and Automation Letters*, 8(10):6179–6186, 2023. [**Paper**, **Video**, **Code**].

[16] 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**].

*Denotes Equal Contribution