

Tanner D. Harms

DATA SCIENTIST · AEROSPACE ENGINEER

261 N. Madison Ave., Apt. 308, Pasadena, CA 91101

☎ (+1) 303-726-2818 | ✉ HarmsTannerD@gmail.com | 🏠 www.tannerharms.com

Promoting human flourishing through science and technology.

Ethos

- Curious** I am inspired by the beauty and wonders of our incredible universe.
- Resolute** I am unwavering in my pursuit of a better future through technology.
- Purposeful** I am committed to solving problems that make real-world impact.
- Ethical** I am dedicated to finding solutions that promote human flourishing globally.
- Prosocial** I am devoted to building healthy communities in the workplace and beyond.

Areas of Specialization

- Aerospace** I have 8 years of experience studying complex flow behavior with a host of modern tools.
- Data Science** I have 6 years of experience developing and implementing methods from applied math and AI.
- Experimentation** I have designed, executed, and analyzed numerous experiments, both physical and numerical.
- Communication** I have written and presented frequently to both technical and non-technical audiences.

Education

California Institute of Technology

Pasadena, California

DOCTOR OF PHILOSOPHY, AEROSPACE ENGINEERING WITH A MINOR IN COMPUTER SCIENCE

June 2020 – PRESENT

- **Thesis:** Towards Autonomous Mobile Flow-Field Measurements: Detection of Flow Features from Sparse Data
- **Advisor:** Beverley J. McKeon
- **Committee:** John O. Dabiri, Steven L. Brunton, Morteza Gharib

California Institute of Technology

Pasadena, California

MASTER OF SCIENCE, AERONAUTICS

Oct. 2019 – June 2020

- **Emphases:** Fluid Mechanics, Control Theory, and Mathematics

University of Wyoming

Laramie, Wyoming

MASTER OF SCIENCE, MECHANICAL ENGINEERING

June 2016 – July 2019

- **Thesis:** Experimental Investigation of the Cycle-to-Cycle Variations of Dynamically Stalled Airfoils for Varied Geometry and Flow Conditions
- **Advisor:** Jonathan Naughton
- **Committee:** Dmitri Mavriplis and Cameron Wright

University of Wyoming

Laramie, Wyoming

BACHELOR OF SCIENCE, MECHANICAL ENGINEERING

Aug. 2011 – June 2016

- **NCAA Division I Heavyweight Wrestler:** Team captain. 2x national tournament qualifier. Big 12 Winter athlete of the year. Top male student athlete at UW.
- **Finalist:** Top Graduating Senior

Experience

Graduate Researcher

GRADUATE AEROSPACE LABORATORIES (GALCIT) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena, CA

June 2020 – Present

- **Principal Investigator:** Prof. Beverley McKeon
- Developed advanced mathematical tools for identifying coherent structures from sparse data.
- Implemented state-of-the-art methods from computer vision and data-science to develop first-of-their-kind flow analysis tools.
- Presented the work to experts in peer-reviewed journals and at international conferences.

Technical Project: Computer Vision for Identifying Flow Structures

GRADUATE AEROSPACE LABORATORIES (GALCIT) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena, CA

June 2023 – present

- Built a first-of-its-kind generalizable framework for studying any flow of natural tracers.
- Gained experience developing and implementing large computer vision models.
- Successfully practiced transfer learning to accomplish detection and tracking tasks.

Technical Project: Lagrangian Gradient Regression

GRADUATE AEROSPACE LABORATORIES (GALCIT) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena, CA

Mar. 2022 – Nov. 2023

- Developed the first mathematical framework to compute velocity gradients solely from tracer trajectory data.
- Incorporated advances in dynamical systems theory and data science to extend the analysis to finite-times.
- Produced two first author papers, three conference presentations, and a public GitHub repository.

Technical Project: Stability Experiments on an Asymmetric Wake

GRADUATE AEROSPACE LABORATORIES (GALCIT) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena, CA

June 2021 – Aug. 2022

- Designed and built an experiment to study hydrodynamic stability problems.
- Implemented state-of-the-art tools to analyze the data.
- Worked with international collaborators to accomplish project objectives.

Technical Project: Dynamic Masking of PIV Images

GRADUATE AEROSPACE LABORATORIES (GALCIT) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Pasadena, CA

June 2020 – Aug. 2020

- Developed computer vision software to identify non-flow regions in PIV (experimental flow field) image data.

Graduate Researcher

UNIVERSITY OF WYOMING

Laramie, WY

Aug. 2016 – Aug. 2019

- **Principal Investigator:** Prof. Jonathan Naughton
- Used modern instrumentation and analysis tools to study rotating blade configurations.
- Produced two first author articles, a thesis, and four international conference talks.

Assistant Coach, NCAA Division I Wrestling

UNIVERSITY OF WYOMING WRESTLING TEAM

Laramie, WY

Aug. 2016 – May. 2019

- Coached and mentored elite student athletes, including some earning All-American status.
- Gained experience in personnel management by engaging athletes uniquely based on their temperament.

Undergraduate Research Assistant

UNIVERSITY OF WYOMING

Laramie, WY

June 2015 – May 2016

- **Principal Investigator:** Prof. David Mukai
- Designed specialized test equipment to perform mechanical experiments under high pressures.

NCAA DI Wrestler

UNIVERSITY OF WYOMING

Laramie, WY

Aug. 2011 – May 2016

- Captain: 2015 and 2016—Four-time letter winner, Heavyweight—NCAA National Tournament qualifier: 2015 and 2016
- Excelled academically while competing at the highest level in collegiate athletics.

Engineering Intern

SPECIAL AEROSPACE SERVICES

Boulder, CO

Aug. 2014 – June 2014

- Research and development for rocket propulsion systems.

Teaching and Mentorship

Lead Mentor, Caltech|Base11 Aerospace Mentorship Program

Pasadena, CA

GRADUATE AEROSPACE LABORATORIES (GALCIT) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Jan. 2022 – June 2022

- Created a curriculum which exposed underrepresented students to modern aerospace engineering practices.
- Organized professors, academic staff, and graduate students to ensure the success of the participants.
- Guided students to successful outcomes on their final research projects.

Head Teaching Assistant, Experimental Methods Course Series

Pasadena, CA

GRADUATE AEROSPACE LABORATORIES (GALCIT) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

Sep. 2020 – June 2022

- Prepared lectures and supplementary material to enhance student learning outcomes.
- Mentored teams of students to complete successful experiments, including novel experiments not studied in the literature.

Summer Student Mentor, Caltech|Base11 Aerospace Mentorship Program

Pasadena, CA

GRADUATE AEROSPACE LABORATORIES (GALCIT) AT CALIFORNIA INSTITUTE OF TECHNOLOGY

June 2021 – Aug. 2021

- Scoped a project that would be both didactic for a summer student with moderate technical experience and intellectually interesting for seasoned members of the field.
- Developed various tutorials and lectures to promote learning and enhance project outcomes.
- Adjusted project scope based on the student's performance to ensure a successful result.

Tau Beta Pi Engineering Tutor

Laramie, WY

UNIVERSITY OF WYOMING

Summers 2015, 2017

- Provided academic assistance to students enrolled in engineering courses at UW.

Publications

Estimating dynamical flow features in groups of tracked objects

ICML (in review)

HARMS, T., BRUNTON, S. L., AND MCKEON, B. M.

Feb. 2024

Lagrangian Gradient Regression for the Detection of Coherent Structures from Sparse Data

arXiv (in review)

HARMS, T., BRUNTON, S. L., AND MCKEON, B. M.

Nov. 2023

Velocity- and derivative-free computation of velocity gradients from Lagrangian particle trajectories

ISPIV 2023

HARMS, T., BRUNTON, S. L., AND MCKEON, B. M.

June 2023

Reducing uncertainty in dynamic stall measurements through data-driven clustering of cycle-to-cycle variations

AHS Journal

RAMASAMY, M., SANAYEI, A., WILSON, J. S., MARTING, P. B., HARMS, T., NIKOUEEYAN, P., AND NAUGHTON, J.

Jan. 2021

Experimental assessment of an airfoil optimized to delay the onset of dynamic stall

75th VFS Forum

NIKOEYAN, P., HARMS, T., NAUGHTON, J., AND AHUJA, J.

May 2019

Data-driven optimal basis clustering to characterize cycle-to-cycle variations in dynamic stall measurements

75th VFS Forum

RAMASAMY, M., SANAYEI, A., WILSON, J. S., MARTING, P. B., HARMS, T., NIKOUEEYAN, P., AND NAUGHTON, J.

May 2019

Static and dynamic aerodynamic performance parameters for S814 and S825 airfoils at moderate Reynolds number

AIAA SciTech

HASSANZADEH, A., HARMS, T., AND NAUGHTON, J.

Jan 2019

Modal analysis of the cycle-to-cycle variations observed in dynamic stall

74th AHS Forum

HARMS, T., NIKOUEEYAN, P., AND NAUGHTON, J.

May 2018

An experimental evaluation of cycle-to-cycle variations observed in dynamic stall

AIAA SciTech

HARMS, T., NIKOUEEYAN, P., AND NAUGHTON, J.

Jan. 2018

Experimental investigation of dynamic stall on the SC1094R8 airfoil and comparison with computational predictions

NIKOEYAN, P., HARMS, T., NAUGHTON, J., AHUJA V., FABIANO, E., AND POTSDAM, M.

AIAA SciTech

Jan. 2018

Selected Talks

Invited Talk: Sparse Estimation of Flow Gradients with Applications in Fluids

AI INSTITUTE FOR DYNAMICAL SYSTEMS

Seattle, WA

Feb. 2024

Sparse Detection of Flow Features using Natural Tracers

APS DIVISION OF FLUID DYNAMICS FORUM

Washington DC

Nov. 2023

Lagrangian gradient regression: derivative-free approximation of velocity gradients

INTERNATIONAL SYMPOSIUM FOR PIV

SDSU, San Diego, CA

June 2023

Identifying geometric LCS from sparse trajectory data

SoCAL FLUIDS

SDSU, San Diego, CA

April 2023

Efficient methods for identifying and tracking coherent structures

STANFORD THERMAL AND FLUID SCIENCE AFFILIATES CONFERENCE

Stanford, Palo Alto, CA

Mar. 2023

Finite-Time Lyapunov Exponent via Locally Linear Regressions

APS DIVISION OF FLUID DYNAMICS FORUM

Indianapolis, IN

Nov. 2022

An introduction to aerospace engineering

CALTECH|BASE11 AMP PROGRAM

Caltech, Pasadena, CA

Jan. 2022

Modal analysis of the cycle-to-cycle variations observed in dynamic stall

AMERICAN HELICOPTER SOCIETY FORUM 74

Phoenix, AZ

May 2018

Experimental evaluation of the cycle-to-cycle variation of dynamic stall on the SC1094R8 airfoil

AIAA SciTECH CONFERENCE

Kissimmee, FL

Jan. 2018

Analysis of cycle-to-cycle pressure variations in dynamic stall

APS DIVISION OF FLUID DYNAMICS FORUM

Denver, CO

Nov. 2017

Analysis of cycle-to-cycle behavior of dynamic stall on thick airfoils

NAWEA/WINDTECH CONFERENCE

Boulder, CO

Oct. 2017

Outreach and Community Involvement

Presented “Chaos, Turbulence, and the Beauty of Uncertainty in Complex Systems”

CALTECH SCIENCE JOURNEYS

Pasadena, CA

Feb., 2024

Presented on “Vortices and Turbulence” to the DaVinci Camp Summer Institute

PROGRAM TO PROMOTE ACADEMIC EXCELLENCE IN STEM AMONG LATINO STUDENTS.

Pasadena, CA

June, 2023

Exhibitor for GALCIT at Pasadena City College’s Pi Day event with John Pederson, Conor Martin, and Liza Bradulina

STUDENT RUN EVENT TO PROMOTE STEM LEARNING AT PCC

Pasadena, CA

March, 2023

Presented on “Vortices and Turbulence” to the Pasadena Police Activities League

PASADENA POLICE DEPARTMENT PROGRAM TO ENCOURAGE LOCAL YOUTHS TO BE GOOD CITIZENS.

Pasadena, CA

March, 2023

<p>Presented with Salvador Gomez and Miles Chan on “The Hidden World of Fluid Mechanics” to the Pasadena Police Activities League</p> <p>PASADENA POLICE DEPARTMENT PROGRAM TO ENCOURAGE LOCAL YOUTHS TO BE GOOD CITIZENS.</p>	<p><i>Pasadena, CA</i></p> <p><i>Jan, 2021</i></p>
<p>Provided advice as a panelist for students entering into STEM research careers</p> <p>PART OF A PHYSICS COURSE OFFERED BY PASADENA CITY COLLEGE</p>	<p><i>Pasadena, CA</i></p> <p><i>Sep, 2021</i></p>
<p>Presented with Miles Chan on ”Real Life Aerodynamics” at Sierra Madre Elementary School PTA STEAM Night.</p> <p>LOCAL ELEMENTARY SCHOOL STEM PROMOTION.</p>	<p><i>Pasadena, CA</i></p> <p><i>Apr, 2021</i></p>
<p>Volunteer wrestling coach at San Marino High School</p> <p>A HIGH SCHOOL NEARBY TO CALTECH.</p>	<p><i>San Marino, CA</i></p> <p><i>2021–2022</i></p>
<p>Volunteer wrestling coach at Titan Mercury Wrestling Club</p> <p>AN ELITE TRAINING PROGRAM FOR MIDDLE AND HIGH SCHOOL ATHLETES IN CALIFORNIA</p>	<p><i>San Marino, CA</i></p> <p><i>2021–2022</i></p>
<p>Volunteer coach with Laramie Special Olympics</p>	<p><i>San Marino, CA</i></p> <p><i>2015–2019</i></p>

Honors, Awards, & Fellowships

<p>Charles Babcock Memorial Award</p> <p>GRADUATE AEROSPACE LABORATORIES (GALCIT) CALIFORNIA INSTITUTE OF TECHNOLOGY</p> <p>Given to the graduate student whose achievements in teaching have made a significant contribution to the Aeronautics program</p>	<p><i>Pasadena, CA</i></p> <p><i>2022</i></p>
<p>Jeff Pino Award</p> <p>AHS VERTICAL FLIGHT FOUNDATION</p> <p>Merit-based scholarship awarded to students demonstrating an interest in pursuing engineering related careers in vertical flight technology</p>	<p><i>Fort Worth, TX</i></p> <p><i>2017</i></p>
<p>Finalist, Ellbogen \$30K Entrepreneurship Competition</p> <p>UNIVERSITY OF WYOMING COLLEGE OF BUSINESS,</p> <p>Startup funding is awarded to the top three small business proposals entered by UW Students. Ten finalists selected to compete in the final round.</p>	<p><i>Laramie, WY</i></p> <p><i>2017</i></p>
<p>NCAA Postgraduate Scholarship</p> <p>NATIONAL COLLEGIATE ATHLETIC ASSOCIATION</p> <p>Awarded to the most accomplished student-athletes graduating from NCAA institutions</p>	<p><i>Laramie, WY</i></p> <p><i>2016</i></p>
<p>Tobin Award Finalist</p> <p>UNIVERSITY OF WYOMING</p> <p>Awarded to the outstanding graduating male student at the University of Wyoming. Seven Finalists are selected</p>	<p><i>Laramie, WY</i></p> <p><i>2016</i></p>
<p>Admiral Land Award</p> <p>UNIVERSITY OF WYOMING</p> <p>Presented to the graduating student-athlete who has demonstrated outstanding achievement in athletics and academics and has demonstrated exemplary personal conduct.</p>	<p><i>Laramie, WY</i></p> <p><i>2016</i></p>
<p>Big 12 Winter Scholar-Athlete of the Year</p> <p>BIG 12 CONFERENCE</p> <p>Awarded to winter sport athletes outstanding in academic and athletic performance.</p>	<p><i>Laramie, WY</i></p> <p><i>2016</i></p>
<p>Academic All-Big 12 Wrestling Team, First Team</p> <p>BIG 12 CONFERENCE</p> <p>Presented to athletes maintaining a GPA greater than 3.20 and competing in 20% of scheduled competitions.</p>	<p><i>Laramie, WY</i></p> <p><i>2016</i></p>
<p>NCWA Division I All-Academic Team</p> <p>NATIONAL COLLEGIATE WRESTLING ASSOCIATION</p> <p>Given to athletes outstanding in academic and athletic performance within NCAA DI wrestling.</p>	<p><i>Laramie, WY</i></p> <p><i>2015 and 2016</i></p>

Western Wrestling Conference All-Academic Team

WESTERN WRESTLING CONFERENCE

Presented to athletes maintaining a GPA greater than 3.20 while starters or key reserves for their teams.

Laramie, WY

2013, 2014, and 2015

Tau Beta Pi Outstanding Junior

UW COLLEGE OF ENGINEERING AND APPLIED SCIENCE

Awarded to the outstanding student of Junior standing with UW's College of Engineering and Applied Sciences by a process of peer review.

Laramie, WY

2014

Mountain West Scholar Athlete

MOUNTAIN WEST CONFERENCE, NCAA

Awarded to varsity athletes with a cumulative GPA of 3.5 or greater.

Laramie, WY

2013 and 2014

Outstanding Freshman

UW COLLEGE OF ENGINEERING AND APPLIED SCIENCES

Awarded to the students receiving a 4.0 GPA after their first semester.

Laramie, WY

2012

Technical Skills

Applied Math **Dynamical Systems, Numerical Methods**, Linear/Functional Analysis, Reduced-Order Modeling, Data Assimilation, Numerical Optimization, Probability and Statistics, Spectral Graph Theory.

Autonomy and AI **Deep Learning, Perception** (Detection and Tracking, Deep Vision Models), State Estimation, Control Theory (Linear, Optimal, Nonlinear, System ID), Pytorch, TensorFlow, OpenCV.

Science **Data-Driven Science, Fluid Mechanics, Experiment Design**, Turbulence, Hydrodynamic Stability, Signal Processing, Mechatronics, Machine Design, Thermodynamics, Composites.

Programming **Python, C/C++, Algorithms** MATLAB, Julia, GPU (CUDA), Software Engineering (Git, Agile, etc.)

Software **Microsoft** Office Suite, **Adobe** Graphical Suite, \LaTeX , SolidWorks, Linux

Societies

American Physical Society

2017–Present

American Institute for Aeronautics and Astronautics

2017–Present

American Helicopter Society

2017–2020

Tau Beta Pi

2013–Present

Personal Interests

Learning From philosophy and theology to psychology and economics, I love learning about new subjects.

Athletics I coach wrestling and participate in Brazilian Jiu Jitsu—the grind is therapeutic to me!

Outdoors Hiking, camping, backpacking, and climbing are a regular part of my life.

Photography Taking photos helps me to appreciate the natural beauty of the world around me.

Projects I enjoy putting my technical skills to use on side projects with friends.