CURRICULUM VITAE

PERSONAL INFORMATION

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EDUCATION

01/2025— Postdoctoral Research Associate

Beckman Institute for Advanced Science and Technology, Univ. of Illinois Urbana–Champaign

Postdoctoral researcher at the Interdisciplinary Health Sciences Institute, as part of the MarginDx project under the Precision Surgical Interventions grant awarded by ARPA-H. As the robo-optics lead, I am responsible for developing fundamental techniques and hardware required to bridge the gap between control theory and robotics, and biophotonics in *in vivo* imaging to operate under the effects of tissue deformation and motion. The project aims to develop a state-of-the-art device for high-resolution intraoperative optical imaging to enable cell-level identification of cancer margins and other forms of pathology, by leveraging nonlinear optical techniques and optical coherence tomography, coupled by adaptive precision robotic position and control.

Contributions:

Spatiotemporal Distortion Mitigation for Low-Rate Single-Pixel Imaging in Fast Dynamic Large-Area Microscopy:

- Developed novel approaches to mitigate temporal aliasing and motion-induced distortions in single-pixel and line-scan-based confocal imaging systems, addressing extreme scale separations between pixel dwell time and scanning motion speed.
- Enabled high-resolution, large-area imaging of unstructured surfaces, facilitating the translation of confocal microscopy techniques (e.g., OCT, fluorescence imaging, nonlinear optics) to applications such as intraoperative diagnosis, material testing, and portable biological sensors.
- Leveraged control theory to model scan mirror and exogenous motion uncertainties, enabling maximum likelihood reconstruction of anti-aliased images under spatiotemporal aliasing scenarios.
- Introduced high-resolution pose estimation for handheld imaging probes using electromagnetic tracking systems with multiple distributed sensors.
- Pioneered a real-time GPU-accelerated framework for low-rate, high-resolution imaging in dynamic settings with motion uncertainty, marking a first in the field.

Soft Body Deformation Compensation and Reconstruction using Intrinsic Elastography through Contact-Based Imaging:

- Developed a novel framework to compensate for soft tissue deformation during contact-based imaging, enabling accurate intraoperative microscopic diagnosis by preserving spatial fidelity under mechanical loading.
- Introduced intrinsic elastography techniques to estimate tissue elasticity in real-time, leveraging the imaging probe's contact force, optical coherence tomography imaging features, and deformation dynamics inferred through dynamic loading to reconstruct undistorted tissue morphology.

- Designed algorithms to model and correct for nonlinear tissue responses, ensuring robust reconstruction of microscopic features in the presence of varying contact pressures and probe orientations.
- Integrated electromagnetic tracking systems with multi-sensor 6-DOF pose estimation to monitor probe-tissue interactions, providing real-time feedback for deformation compensation and elastographic mapping.
- Demonstrated the application of this approach in intraoperative settings, enabling high-resolution imaging of soft tissues (e.g., breast, liver, and skin) for precise pathological assessment and surgical guidance, in addition to enabling mechano-optical palpation for pathology detection.

One-Shot Object Manipulation and Intrinsic Elastography through Visuo-Tactile Markers:

- Pioneered the concept of visuo-tactile markers, combining 3D-printed relief tags with Aruco marker patterns to enable simultaneous vision-based navigation, robotic grasping, and precision tactile manipulation using GelSight Mini sensors.
- Developed a non-intrusive framework for one-shot object manipulation, allowing both robotic and human use without obstructing tool functionality, particularly useful in surgical and industrial settings.
- Enabled indirect intrinsic elastography by integrating force sensors on robotic manipulators with visuo-tactile markers, providing real-time measurement of tool pressure and deflection for precise soft tissue characterization and pressure-sensitive tool manipulation.
- Demonstrated the application of these markers in surgical instruments, enhancing robotic-assisted surgery through improved tool localization, grasp stability, and tissue interaction feedback.
- Validated the approach in diverse scenarios, including delicate object manipulation and intraoperative settings, showcasing its versatility and robustness in dynamic environments.

Semantic Image–Pose Matching for Soft Body Deformation Mitigation in Low-Rate Single-Pixel Fast Dynamic Large-Area Microscopy:

- Developed a novel framework leveraging multimodal image-text embeddings based on VisualBERT/CLIP and hierarchical navigable small worlds (HNSW) search to enable robust pose-informed image matching for unstructured scanning on soft body surfaces.
- Introduced transformer-based semantic descriptors as an alternative to classical feature-based methods (e.g., SIFT, SURF), overcoming limitations in multimodal settings with significant image attenuation across sequential scans.
- Combined spatial location tagging from electromagnetic (EM) trackers with semantic embeddings to enable rapid 3D image reconstruction and comparison, even among disparate datasets, using techniques such as 3D Gaussian splatting.
- Enabled seamless interplay between coarse handheld scanning and high-precision robotic scanning, facilitating information transfer in multimodal soft body imaging scenarios without requiring extensive pre-processing or calibration.
- Demonstrated the framework's effectiveness in mitigating soft tissue deformation during low-rate single-pixel imaging, ensuring accurate large-area microscopy under varying pressure and pose uncertainty conditions.

08/2020—12/2024

PhD in Aerospace Engineering

Dept. of Aerospace Engr., Univ. of Illinois Urbana–Champaign

Jointly supervised PhD program in Aerospace Engineering and Mechanical Science and Engineering, focusing on control theory and safe robotics, especially regarding safety-critical control of complex systems in adverse or delicate environments with limited prior knowledge, as well as robust adaptive control of infinite-dimensional system, with applications to provably safe autonomous robotic energy-based surgery.

Research Focus:

***Viability under Adversity*: Safe Self-organizing Control of Systems in the Unknown.**

- Online guaranteed long-term reachability computation and viability analysis for systems experiencing impairment (diminishment of control authority, changed dynamics, impairment of sensor readings). In particular, theory that applies directly to complex nonlinear systems is the focus of this research area. Applications to safe autonomous control are currently in development, focusing on notions from viability theory, contraction theory, and differential inclusions; this latter work is a collaboration with Prof. Eduardo Sontag. This work enables safe adaptive control of systems in cases of rapidly changing dynamics, deliberate introduction of model order reductions, or incorrect/incomplete sensor readings, domains that are not covered by today's robust adaptive control techniques.
- Safe adaptive control and identification of partial differential equations (PDEs), with applications to autonomous electrosurgery. The goal is to develop tractable algorithms for model predictive control of PDEs, extending to real-time adaptation with robustness guarantees. This work ties into control of electrosurgical processes, where tissue biophysics are identified in real-time to support autonomous minimally-invasive surgical action. A key thrust here is also the incorporation of novel sensors, including microscopic thermography, near-infrared stereo vision, and tactile sensors to endow autonomous surgical systems with the means of making safe informed decisions. Implications of these techniques are vast, endowing robotic systems with critical feedback mechanisms that are crucial in advancing the field of robot-assisted healthcare in the operating room. This work is performed in tight collaboration with clinicians, including Dr. Richard Berlin, MD, a Level-1 trauma surgeon with the Carle Hospital System, as well as Dr. Pier Giulianotti and Dr. Enrico Benedetti of the Surgical Innovation and Training Lab (SITL) at the University of Illinois at Chicago.
- Fault detection, identification, and recovery (FDIR) on single- and multi-agent systems with *simultaneous* sensor and actuator faults. This is an ongoing collaboration with the Jet Propulsion Laboratory's Maritime and Multi-agent Autonomy (347N) group; these results have garnered direct attention from key stakeholders in the Office of the Chief Technologist and the Autonomous Systems Division at JPL.
- Development of fundamental theory for controlled partial differential-algebraic equations (PDAEs) and hybrid partial differential equations, with the goal of developing unified theory for real-time robust adaptive control of this class of systems.

Publications:
Journal papers:

- H. El-Kebir, A. Pirosmanishvili, M. Ornik, "Online Guaranteed Reachable Set Approximation for Systems with Changed Dynamics and Control Authority," *IEEE Transactions on Automatic Control*, vol. 69, no. 2, pp. 726–740, 2024.
- H. El-Kebir, R. Berlin, J. Bentsman, M. Ornik, "Viability under Degraded Control Authority," *IEEE Control Systems Letters*, vol. 7, pp. 3765–3770, 2023.
- H. El-Kebir, J. Ran, Y. Lee, L. P. Chamorro, M. Ostoja-Starzewski, R. Berlin, J. Bentsman, "Minimally Invasive Live Tissue High-fidelity Thermophysical Modeling using Real-time Thermography," *IEEE Transactions on Biomedical Engineering*, vol. 70, no. 6, pp. 1849–1857, 2023. Featured on the homepage of the IEEE Engineering in Medicine and Biology Society (EMBS).
- B. Petrus*, Z. Chen*, H. El-Kebir*, J. Bentsman, and B. G. Thomas, "Solid Boundary Output Feedback Control of The Stefan Problem: The Enthalpy Approach," *IEEE Transactions on Automatic Control*, vol. 68, no. 6, pp. 3485–3500, 2023.
- J. Ran, H. El-Kebir, Y. Povstenko, R. Berlin, J. Bentsman, M. Ostoja-Starzewski, "Shock Waves in Biological Tissues under Telegraph Equation Heat Conduction," *International Journal for Multiscale Computational Engineering*, vol. 20, issue 6, pp. 79–87, 2022.
- S. Zhang, J. Bentsman, X. Lou, C. Neuschaefer, Y. Lee, and H. El-Kebir, "Multiresolution GPC-Structured Control of a Single-Loop Cold-Flow Chemical Looping Testbed," *Energies*, vol. 13, pp. 1759–1787, 2020.

Conference papers:

* Shared co-first authorship.

- H. El-Kebir, M. Ornik, J. Bentsman, "Empowering Control Engineering Students Through Theory, Implementation, and AI-Assisted Learning: Evaluating a Project-Based Advanced Computer Control Course," submitted to *2025 IFAC Conference on Advances in Control Education*. Budapest, Hungary: IFAC, 2025.
- H. El-Kebir, M. Ornik, "Sum-of-Squares Data-driven Robustly Stabilizing and Contracting Controller Synthesis for Polynomial Nonlinear Systems," *2025 American Control Conference*. Denver, CO, USA: IEEE, 2025.
- H. El-Kebir, R. Berlin, J. Bentsman, M. Ornik, "Viability under Degraded Control Authority," *2024 American Control Conference*. Toronto, Canada: IEEE, 2024.
- H. El-Kebir, R. Berlin, J. Bentsman, M. Ornik, "Viabilizability of Control Signals under Control Authority Degradation," *2024 European Control Conference*. Stockholm, Sweden: IEEE, 2024.
- H. El-Kebir, M. Ornik, Y. K. Nakka, C. Choi, A. Rahmani, "Robust Detection and Identification of Simultaneous Sensor and Actuator Faults," to be presented at the *2024 IEEE Aerospace Conference*, Big Sky, MT, USA: IEEE, 2024.
- H. El-Kebir, J. Bentsman, and M. Ornik, "Lodestar: An Integrated Embedded Real-Time Control Engine," in *2023 Conference on Control Technology and Applications*. Bridgetown, Barbados: IEEE, 2023.
- H. El-Kebir, R. Berlin, J. Bentsman, M. Ornik, "Robustly Linearized Model Predictive Control for Nonlinear Infinite-Dimensional Systems," in *2023 World Congress of the International Federation of Automatic Control*. Yokohama, Japan: IFAC, 2023.
- S. K. Mazumder, C. Bao, H. El-Kebir, Y. Lee, J. Bentsman, R. Berlin, "Electrosurgery Power Electronics: A Revolution in the Making," in *2023 IEEE Applied Power Electronics Conference and Exposition* (APEC). Long Beach, CA, USA: IEEE, 2023, pp. 692–698.
- H. El-Kebir, J. Ran, M. Ostoja-Starzewski, R. Berlin, J. Bentsman, and L. P. Chamorro, "Infinite-Dimensional Adaptive Boundary Observer for Inner-Domain Temperature Estimation of 3D Electrosurgical Processes using Surface Thermography Sensing," in *2022 Control and Decision Conference*. Cancún, Mexico: IEEE, 2022, pp. 5437–5442.
- Z. Chen, H. El-Kebir, B. Petrus, J. Bentsman, B. G. Thomas, "Enthalpy-based Output Feedback Control of Two-sided Stefan Problem with Input Saturation," in *2022 Control and Decision Conference*. Cancún, Mexico: IEEE, 2022, pp. 7370–7375.
- H. El-Kebir, Y. Lee, R. Berlin, E. Benedetti, P. C. Giulianotti, L. P. Chamorro, and J. Bentsman, "Online Hypermodel-based Path Planning for Feedback Control of Tissue Denaturation in Electrosurgical Cutting," in *2021 IFAC Symposium on Biological and Medical Systems*. Ghent, Belgium: Elsevier, 2021, pp. 448–453.
- H. El-Kebir*, T. Shafa*, A. Purushottam, M. Ornik, A. Soylemezoglu, "High-Frequency Vibration Reduction for Unmanned Ground Vehicles on Unstructured Terrain," in *2021 NATO International Conference on Modelling and Simulation for Autonomous Systems* (MESAS'21). Brno, Czech Republic: Springer, 2021, pp. 74–92.
- H. El-Kebir and M. Ornik, "Online Inner Approximation of Reachable Sets of Nonlinear Systems with Diminished Control Authority," in *2021 SIAM Conference on Control and Its Applications*. Philadelphia, PA, USA: Society for Industrial and Applied Mathematics, 2021, pp. 9–16.
- H. El-Kebir and J. Bentsman, "PDE-Based Modeling and Non-collocated Feedback Control of Electrosurgical-Probe/Tissue Interaction," in *2021 American Control Conference*. New Orleans, LA, USA: IEEE, 2021, pp. 4045–4050.
- H. El-Kebir and M. Ornik, "In-flight Air Density Estimation and Prediction for Hypersonic Flight Vehicles," in *2021 AIAA International Space Planes and Hypersonic Systems and Technologies Conference*. Montreal, Canada: AIAA, 2021, pp. 9–16.

Academic Service:

- Served as a peer reviewer (21 times) for the following publications:
  - IEEE Transactions on Automatic Control (3 times);
  - IEEE Transactions on Cybernetics (3 times);
  - IEEE Control System Letters (5 times);

  - IEEE Conference on Decision and Control (3 times);
  - IEEE American Control Conference (7 times).
- Served as a co-chair for two sessions at the 2023 IEEE Conference on Control Technologies and Applications.

Mentorship and Teaching Assistantships:

- AE 298: Undergraduate Research Mentoring (Spring 2024): Served as a mentor to an undergraduate student in Aerospace Engineering on a self-proposed exploratory project on automatic object grasping and manipulation for robotic arms using visual and tactile feedback. This involved designing and producing tactile tags that are placed on a variety of objects, as well as developing compute vision algorithms and control algorithms for visual servoing of a robotic arm. The student was coached throughout the design and manufacturing stages, as well as mentored in programming and testing the robotic arm, hand, and visuotactile sensors. This work is to be applied to autonomous robotic surgery for automatic tool detection and manipulation.
- ME 462/498/598: Advanced Computer Control (Fall 2020, 2021, 2022, 2023): A course aimed at providing students a foundation in modern real-time-computable control design through progression from basic theory to advanced control algorithms that have proven successful in practice. Both discrete-time and continuous-time formats are employed and linked through discrete-continuous (sampled-data) concepts. The laboratory part of the course provides exposure to:
  - Elements of AI and machine learning proven useful in enhancing these algorithms,
  - Related Matlab toolboxes and algorithm implementations from the ground up,
  - Implementation of these algorithms on modern computing platforms (GPUs and FPGAs), and
  - Applications in aerospace, power generation, manufacturing, and other areas.

  I was responsible for grading homework, lab reports, and the final project (a project where students independently explore a robust adaptive control concept and apply it to their research). I was also responsible for developing the lab materials (a rigorous exploration of the theory, followed by interactive code examples and exercises related to real-life applications), in addition to and teaching lab lectures and having office hours. Original lab materials include, but are not limited to:
  - An interior point method based constrained discrete-time linear model predictive control (MPC) solver;
  - A massively parallel GPU implementation of a bank of PID controllers;
  - Generalized predictive control (GPC) algorithms with rate-constraints and adaptive extensions;
  - Recursive least-squares (RLS), multi-step-ahead predictive identification (MSPI), long-range predictive identification (LRPI) system identification algorithms.
- AE 461: Structures & Control Lab (Spring 2021, 2022, 2023, 2024): A course aimed at providing students hands-on experience with applied structures and control problems. I was responsible for the control part, administering lab sessions that focused on system identification and feedback controller design.

Courses:

- AE 504—Optimal Aerospace Systems. Focus on linear and nonlinear optimization techniques, culminating in model predictive control. The course project resulted in a published work on online model-based control of electrosurgery with the goal of controlling the denaturation boundary.
- AE 556—Robust Control. Course taught by Prof. Cedric Langbort, focusing on fundamental analysis and synthesis results in robust control (e.g., the KYP lemma, passivity/dissipativity analysis), culminating in a treatment of synthesis techniques such as the D–K iteration and sum-of-squares methods. For the final project, I wrote a survey on robust control of evolution equations (generalized infinite-dimensional systems).

- CS 598 APK—Fast Algorithms & Integral Equations. Course taught by Prof. Andreas Kloeckner, treating near-linear-complexity numerical algorithms and related numerical methods, mainly for the numerical solution of elliptic partial differential equations, such as Laplace, Helmholtz, Stokes, Maxwell's, or elasticity.
- CS 598 SML (audited)—Scientific Machine Learning. Course taught by Prof. Luke Olson and Prof. Matt West, focusing on scientific machine learning from domain decomposition and physics-informed neural networks to neural operators. I am currently leveraging the knowledge gained in this course to develop a new class of real-time model-predictive control algorithms for partial differential equations using neural operators.
- ECE 421—Neural Interface Engineering. This course focused on hardware and software technologies that enable control and readout of neural activity in the brain, treating the use of physical, chemical and biological principles to understand technology design criteria governing ability to observe and alter brain structure and function. Topics include noninvasive and invasive brain mapping and stimulation, neural interfaces and neural prosthetics, data processing problems, decoding/encoding techniques based on machine learning, future brain interfaces based on nanotechnology and optogenetics.
- ECE 549—Computer Vision. Course taught by Prof. Svetlana Lazebnik on classical and modern computer vision techniques, treating modern problems such as image segmentation, as well as techniques such as transformers and generative-adversarial networks. For the final project, I developed a novel noise-robust technique for online thermodynamic modeling using thermographer feedback, which I named *Attention-based Noise Robust Averaging* (ANRA).
- ECE 555—Control of Stochastic Systems. Course taught by Prof. M.-A. Belabbas, treating various classes of stochastic systems in discrete- and continuous-time, culminating in control techniques for systems using the Itô and Stratonovic calculi. For the final project, I wrote an extensive review on stochastic evolution equations, with applications to robust control.
- ECE 557—Geometric Control Theory. Course taught by Prof. M.-A. Belabbas, dealing with differential geometry, feedback linearization, control of Lie groups, and control on manifolds. Final project on closed-loop discernibility of control authority degradation on smooth manifolds.
- ECE 586 DL—Hybrid Systems and Control. Course taught by Prof. Daniel Liberzon, focusing on hybrid and switched systems theory, covering notions of solvability, stability, and controllability, as well as theory of hybrid, switching, and sliding model control and control with limited information. Final project on simultaneous active mode identification *and* determination for nonlinear control-affine systems.
- ECE 598 SG—Learning-based Robotics. Course taught by Prof. Saurabh Gupta, treating approaches to reinforcement learning across a large range of problems, focusing on humanoid robotics. The course culminated in a course project, wherein I developed a novel reinforcement learning framework for deceptive control of stochastic partial-information n-player zero-sum games, with applications to the 4-player limited information game of Japanese mahjong.
- MATH 447; MATH 540; MATH 541; MATH 546—Introduction to Real Analysis; Real Analysis; Functional Analysis; Hilbert Spaces. Advanced courses on fundamental functional analysis, all the way through the theory of closed and compact operators, with results being developed both on Hilbert and Banach spaces.
- MATH 550—Dynamical Systems I. A mathematical treatment of dynamical systems, including a treatment of continuous and discrete evolution equations on manifolds at a sophisticated level. Emphasis was placed on the fundamental theoretical concepts and the interaction between the geometry and topology of manifolds and global flows. Discrete dynamics includes Bernoulli shifts, elementary Anosov diffeomorphisms and surfaces of sections of flows.
- ME 498/598 JB—-Advanced Computer Control. Course taught by Prof. Joseph Bentsman, with course contents similar to ME 462 mentioned above. Culminated in a project on boundary control of a nonlinear partial differential equation (the Stefan problem) with applications to autonomous electrosurgery.

- ME 562—Robust Adaptive Control. Course taught by Prof. Naira Hovakimyan, with the focus being on model reference control (MRC), model reference adaptive control (MRAC), and $\mathcal{L}_1$ robust adaptive control, supported by robustness proofs and controller synthesis and design. Final project on robust adaptive control of the Duffing equations (a nonlinear mass-spring-damper system prevalent in industrial machining).

04/2024 **Principles of Fluorescence Techniques Workshop**

Fluorescence Foundation

A four-day workshop on state-of-the-art fluorescence techniques with a combination of lectures/discussions and lab practicals. Basic principles and applications domains are covered, culminating in confocal/multiphoton fluorescence microscopy, super-resolution techniques, and FFS and FLIM. This workshop is co-sponsored by the NIH Center for Label-Free Imaging and Multiscale Biophotonics (CLIMB) at the Beckman Institute of Advanced Science and Technology.

02/2024–04/2024 **NSF I-Corps Medical Device Workshop**

NSF I-Corps Great Lakes Hub

An intensive seven-week workshop covering the specifics on evidence-based entrepreneurship, the lean entrepreneurship framework, and the medical device lifecycle. As part of this experience, I conducted close to 30 customer discovery interviews to validate the viability and market need for a novel non-contact noninvasive diagnostic device for cancer margin detection and delineation based on longwave infrared sensing and near-infrared subsurface laser excitation, under the brandname *Calisone* (https://calisone.health).

05/2023–08/2023 **JPL Graduate Fellowship**

Jet Propulsion Laboratory, National Aeronautics and Space Administration

Prestigious fellowship awarded to a limited number of internees. Research performed under the mentorship of Dr. Changrak Choi of research group 347N, Maritime and Multi-Agent Autonomy. The project, entitled "Fault-tolerant Distributed Networks," and direct initiative of the Chief Technologist, is focused on developing control strategies for detecting and mitigating failure modes in limited-information networks comprised of dynamical agents, based on my work on guaranteed reachability theory and viability for impaired systems. Methods developed are real-time-viable and are based on stochastic ODE formulations, leveraging set-based observers and novel noise-robust parameter identification techniques.

08/2022–05/2023 **Mavis Future Faculty Fellow**

Grainger College of Engineering, University of Illinois

The Mavis Future Faculty Fellowship is awarded to a select number of senior graduate students who have shown interest in becoming faculty members, providing seminars on research, teaching, and mentoring. Activities include coaching for grant writing, mentoring, and teaching guidance, among others.

08/2019–12/2019 **Exchange at University of Illinois Urbana-Champaign**

Dept. of Aerospace Engr., Univ. of Ill. Urbana-Champaign

Semester-long exchange at the University of Illinois, focusing on hypersonic aerodynamics, viscous aerodynamics and heat transfer, and real-time computer control. *Independent research*:

- Dr. Melkior Ornik: Model-free state change-conscious estimation with limited system knowledge applied to estimation and prediction in aerospace vehicles.
- Dr. Joseph Bentsman and Dr. Francesco Panerai: Characterization and numerical modeling of pyrolysis of organic tissue applied to electrosurgery to achieve robust automatic control. Included an independently proposed lab testing campaign for pyrolysis characterization of porcine tissue at the Materials Research Laboratory.

Publications: El-Kebir, H., & Ornik, M. (2021). In-flight Air Density Estimation and Prediction for Hypersonic Flight Vehicles. In *2021 AIAA International Space*

Planes and Hypersonic Systems and Technologies Conference. El-Kebir, H., & Bentsman, J. (2021). PDE-Based Modeling and Non-collocated Feedback Control of Electrosurgical-Probe/Tissue Interaction. In *2021 American Control Conference*

07/2019 **CERN Honours Programme Summer School**

CERN & Delft University of Technology

A three week summer course at CERN IdeaSquare in Geneva, in which students worked in multidisciplinary teams to investigate a novel technology to find innovative applications which solve societal problems. *Publication*: A publication has been contributed to CERN's peer-reviewed CERN IdeaSquare Journal of Experimental Innovation entitled "Perceptions of Open Innovation at CERN: An Explorative Study."

06/2019 **Introduction to Space Law Training Course**

European Space Agency (ESA)

A week-long intensive training course on the concept of Space Law, including its implementation within the European space program and national legislature. Among the speakers were experts from ESA, as well as national officials from space offices in Europe and the Secretary-General of the United Nations Committee on the Peaceful Uses of Outer Space. The course was wrapped up with a model United Nations General-Assembly meeting.

2018–2020 **Honours Programme Bachelor**

Delft University of Technology

Independent research on the range-constrained Goddard Problem for sounding rockets, dealing with trajectory optimization by means of the calculus of variations, ultimately arriving at a guidance law that takes into account wind effects and instantaneous impact point predictions. This research was conducted under the supervision of Dr. Róbert Fónod.

2017–2020 **Bachelor of Aerospace Engineering**

Delft University of Technology

Bachelor of Aerospace Engineering, *cum laude*. GPA of 8.5/10.

CERTIFICATES & AWARDS

May 2024 **Cyber-Physical Systems (CPS) Rising Star 2024**

University of Virginia

This workshop, co-sponsored by the Cyber-Physical Systems program of the National Science Foundation and ACM SIGBED, aims to identify and mentor outstanding PhD students and postdocs who are interested in pursuing academic careers in CPS core research areas. CPS Rising Stars are selected based on research excellence and academic leadership potential. One of 36 awardees out of 220 international applicants.

May 2023 **Jet Propulsion Laboratory Graduate Fellow**

Jet Propulsion Laboratory, Caltech/NASA

A prestigious fellowship awarded to a limited number of interns at the Jet Propulsion Laboratory (10 awarded each year) to conduct graduate level research on lab. My work was entitled "Fault Tolerance for Distributed Systems" and will be presented at the 2024 IEEE Aerospace Conference.

August 2022 **Mavis Future Fellowship Recipient**

Grainger College of Engineering, Univ. of Illinois

The Mavis Future Faculty Fellowship is awarded to a select number of senior graduate students who have shown interest in becoming faculty members, providing seminars on research, teaching, and mentoring.

September 2021 **NASA LEAPFROG Competition Winner**

National Aeronautics & Space Administration

A constrained safe control challenge for a lunar lander vehicle that was to traverse *a priori* unknown terrain while avoiding obstacles and surveying regions of interest.

Received first place for the software challenge, which was a software-in-the-loop controller/observer design challenge in ROS, PX4, and Gazebo, being the only team to achieve soft lunar touchdown on an *a priori* unknown terrain.

September 2019 — Engineering Council Society Member of the Month

Engineering Council, University of Illinois

Society Member of the Month September 2019, among all engineering student organizations at the University of Illinois. Nominated by the executive board of the Illinois Space Society.

August 2017 — JLPT N1

Japan Foundation

N1-level Japanese Language Proficiency Test (Advanced Japanese).

July 2017 — IB English HL

International Baccalaureate

International Baccalaureate Higher Level English Certificate.

March 2017 — Grand Prize, 30th Japanese Speaking Contest

Embassy of Japan in the Netherlands

Grand Prize at the 30th Japanese Speaking Contest (Japanese five minute speech) held in The Hague, The Netherlands and sponsored by the Japanese Ministry of Foreign Affairs.

COMPUTER SKILLS

Basic — CSS, XML, Ada 2012

Intermediate — Ruby, OpenFOAM

Extensive — Microsoft Office, Adobe Creative Suite (Photoshop, Illustrator, After Effects), Microsoft Windows, Linux, HTML, JavaScript, C/C++ (object-oriented, real-time, and safety-critical design paradigms), ROS, Python (C++ bindings, multiprocessing, object-oriented programming and efficient data structure design), MATLAB, Simulink, BASH, LaTeX

- **Python**: Extensive experience, both in the capacity of a scripting language coupled with high-performance compiled (C/C++) libraries, as well as standalone usage. Includes in-depth knowledge of **PyTorch**, **TensorFlow**, **Keras**, **OpenCV**, **Point Cloud Library (PCL)**, **Pandas**, and **Numpy/SciPy**, among others. My biggest Python project involved developing an in-house software suite for continuous heterogeneous multi-scale surgical data taking and real-time control, handling data streams upwards of one terabyte for a single trial.
- **C/C++**: Experience developing high-performance control software subject to stringent resource constraint, both on dedicated Linux machines, as well as on embedded system. I have developed custom real-time continuous motion planning algorithms for teleoperation of robotic surgery in the kilohertz range applied to a Franka Emika Panda robotic arm. See the Lodestar Engine project[1] for more information on a real-time control library that I am currently developing.
- **ROS/Gazebo/MoveIt**: Experience in controlling simulated systems in a software-in-the-loop fashion using a combination of ROS and Gazebo; see my achievements in the NASA LEAPFROG competition. I also have extensive experience implementing controllers in ROS on hardware systems, both in C++ as well as externally through Python on a remote control station. I have used these frameworks to control, among others, a Crazyflie drone, Franka Emika Panda robotic arm, and Clearpath Robotics Jackal unmanned ground vehicle.
- **MATLAB**: Extensive experience with MATLAB, its control and system identification packages (Simulink, MPC, robust control, wavelets, reinforcement learning, etc.),

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as well as external optimization and set-manipulation packages (CORA, YALMIP, etc.).

OTHER INFORMATION

Extracurricular activities

08/2024—05/2025 · Illinois Science and Technology Coalition Mentor

I mentored a high school student through her AP capstone project on the equitable use of AI in healthcare fast track programs to decrease the time to treatment. I provided guidance on identifying areas of bias in AI-guided treatment decision systems, as well as scientific discussion on shortcomings in medical record training sets and ethical concerns in applying AI-based pathology classification pipelines in medical practice.

10/2023 · Member of the Aerospace Graduate Advisory Committee

I was responsible for preliminary planning of a student conference at the Dept. of Aerospace Engr. I was also the head of the Educational Outreach Committee.

8/2023 · Session co-chair at IEEE CCTA 2023

I co-chaired sessions on Robotic Systems and Health and Fault Analysis at the 2023 IEEE Conference of Control Technology and its Applications.

8/2017 · Participation in a program of TV Tokyo

Participation in an educational Japanese TV program by TV Tokyo, "I want to go to Japan!", about the North-Japanese dialect. This time concerning a continuation.

8/2017 · Member of Japan Local Buddy

Helping tourists in front of the Shibuya station with their questions about the area as a volunteer of Japan Local Buddy (JLB).

11-12/2016 · Participation in a program of TV Tokyo

Participation in an educational Japanese TV program by TV Tokyo, "I want to go to Japan!", about the North-Japanese dialect.

Language skills

Dutch	·	Fluent in word and writing
English	·	Fluent in word and writing
Japanese	·	Fluent in word and writing
Arabic	·	Average in word and writing
French	·	Average in word and writing
German	·	Basic in word and writing

Interests

Sailing, long-distance cycling, bouldering, lead climbing, guitar, tennis, history, reading, traveling, and Japanese language learning.