William E. Boeing Department of Aeronautics & Astronautics
College of Engineering
University of Washington, Seattle
UNIT SELF STUDY

Degrees

Bachelor of Science in Aeronautical and Astronautical Engineering (BSAAE)
Minor in Aeronautics and Astronautics
Master of Science in Aeronautics & Astronautics (MSAA)
Master of Aerospace Engineering (MAE)
PhD in Aeronautics and Astronautics (PhD)

Professional Education Certificate

Certificate in Dynamics and Control

Year of Last Review: 2011-2012

Chair: Kristi A. Morgansen Hill, Ph.D.
Rachel Reichert, Administrator
Kim Maczko, Assistant to the Chair
Amy Sprague, Communications Manager
Wanda Frederick, Communications Specialist
Betsy Winter, Director of Academic Services
Erica Coleman, Undergraduate Advisor
Paul Neubert, Graduate Programs Manager

Date Submitted: September 11, 2023

EXECUTIVE SUMMARY

The William E. Boeing Department of Aeronautics & Astronautics (A&A), has recently undergone an extensive period of strategic planning and a strengthening of governance and transparency. We are embracing a new Mission and Vision and have completed the first year of our five year Strategic Plan. This plan is our roadmap that will hold us accountable for excellence in the areas of Holistic Education, Research, Community, and Diversity, Equity & Inclusion (DEI). Our department committees and administrative teams have the primary responsibility to implement the strategies to achieve our goals in these four areas. We intentionally integrate faculty, staff and students in a process of transparent governance.

As we are aligning the culture and academic experience in our Department with our strategic goals, each of our constituent groups, faculty, staff, undergraduate students and graduate students, are growing. Student demand for admission to our department has always been higher than the capacity determined by state funding agreements with the University, and, more broadly, the demand for undergraduate enrollment in the College of Engineering has typically been twice the capacity. At the same time, workforce demand for additional engineers has been high and growing, and requests for additional state support has provided for some growth in undergraduate engineering student enrollment and more faculty lines to educate those students. In 2011, at the time of our last departmental

review, our undergraduate cohort sizes were typically 40-50 students. This increased to 72 in 2017, and will be further increasing to 96 graduating in June 2027. Further, our MAE enrollment doubled this year to 70 students in the first-year cohort, and we anticipate our total PhD enrollment to increase from 78 to 100 as we hire new faculty.

As we grow, we have set standards for faculty to secure research funding at levels consistent with top aerospace engineering departments, we are updating and modernizing our undergraduate curriculum, and we are building a new approach to interdisciplinary graduate education by developing three new graduate certificates that can be combined with certificates from other engineering departments into a stackable master's degree. In all of these efforts, we are striving to meet the needs of our local as well as national and global aerospace hub to serve both students and the industry.

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PART A: REQUIRED BACKGROUND INFORMATION

SECTION I: OVERVIEW OF ORGANIZATION

Mission & Organizational Structure

Department Mission

Our mission is for the work of the members of our department and of our graduates to positively influence aerospace technology development, policy, and application within the State of Washington, the nation, and beyond by

- Equipping all who aspire to aerospace engineering with the highest quality modern education and tools to become leaders in all aerospace related disciplines;
- Advancing aerospace discoveries and its applications to solve local, national and global challenges for the betterment of humanity;
- Serving society responsibly and sustainably through our core scientific and educational competency.

We will achieve this mission by

- Using a modern curriculum that augments fundamentals with experiential learning, practice in complex systems, and communication and project management skills
- Leveraging strong partnerships with the Pacific Northwest's premier air and space industry, our extensive network of active alumni, and the world-class research programs of our faculty.

Department Degrees and Certificates

- Bachelor of Science in Aeronautical and Astronautical Engineering (BSAAE)
- Master of Science (MSAA) with required research thesis and five transcripted tracks in: Controls, Fluids, Plasma, Structures, and Integrated Flight Sciences and Control.
- Master of Aerospace Engineering (MAE), our terminal professional degree with four transcripted tracks in Composites, Controls, Fluids, and Structures. This program has no research requirement and can be completed fully remotely.
- Doctor of Philosophy (PhD)
- Professional education certificate in Dynamics and Control.

Enrollment and Graduation Patterns

Undergraduate

Historically, enrollment in the BSAAE degree program has been exclusively for juniors and seniors. Beginning in Autumn 2018, the College of Engineering implemented a new Direct to College (DTC) process. All engineering freshmen spend their first year in the College of Engineering. After the first year, the College places students into one of the engineering departments. The demand for A&A has been rising. For the 2022 cohort, we were only able

to accommodate 60 percent of our first-choice applicants.

The remainder of the BSAAE students join us in their junior year through a competitive admissions process. The applicants for these positions include students transferring from Washington State Community Colleges as well as other 2-year and 4-year schools, both in and outside of Washington State, and UW students not directly admitted to the College of Engineering as freshmen or placed in A&A as sophomores.

Underrepresented minority student (URM) enrollment, as defined by the University, in our undergraduate program fluctuated between 3% and 8% between 2002 and 2007, but decreased beginning in 2008, possibly due to unfavorable state and national economic conditions. Currently, URM enrollment is 16% of the 236 undergraduate students consistent with national engineering and aerospace statistics, while women comprise 23% (national aerospace percentages are around 15%). The enrollment of women increased steadily beginning in the 1990s, growing to 23% of the undergraduate program in 2004 and 2005. It declined from 2005 to 2011 but has been rising since then to the current level of 23%. The related admission data are summarized in Appendix E.

In future years, the number of students placed through the DTC process will increase, resulting in higher graduation numbers. Sixty undergraduates graduated in 2016, then increased to approximately 72 students per year through the present. An increase to 80 graduates is planned for June 2025 and 2026, then rising to 96 graduates in June 2027.

Graduate
The graduate program enrollments in the Department have doubled in size from 150 students in 2011-2012 to an anticipated 311 in Autumn Quarter 2023.

- MSAA/MAE enrollment in 2011-2012 was 107. We anticipate enrollment for 2023-2024 at 233.
- PhD enrollment in 2011-2012 was 47. We anticipate enrollment in 2023-2024 at 78.

The percentage of URMs in our graduate programs has increased from 10.3% in Autumn 2014 to 12.3% in Autumn 2022 (nationally MS and PhD URM percentages in aerospace are around 9%). The number of students who self-identify as female in the graduate programs increased from 17.4% in Autumn 2014 to 18.1% in Autumn 2022 (on par with the 17-18% nationally in aerospace programs). Across our three graduate degrees, 18% of our incoming Autumn 2023 cohort are URM students, 24.25% for our Professional Masters degree.

For the admissions cycles of 2014-2015 thru 2022-2023, the graduate programs had 284 URM applicants. The Department offered admission to 52% of those applicants (148). Of those applications, 53% (79) accepted the offer, while 47% (69) declined. See Appendix E: Enrollment and Graduation Statistics for more information.

Department Staffing

Faculty. A&A holds 19 tenure-track faculty positions with three positions currently open, two research faculty positions, and three teaching faculty positions (one scheduled to start in August of 2024). Tenure-track and research faculty are distributed among four main disciplines: Controls, Fluids, Plasma Science, and Structures.

Details about the faculty ranks, disciplines, and additional details, including links to brief CVs, are found in Appendix C.

Staff. Twenty staff support the Department, broadly grouped into administrative, academic advising, fiscal, communications, facilities & computing, Space Grant, and Wind Tunnel. Select staff also participate in each governance committee. Refer to the complete organization charts provided in Appendix A.

Governance

The University administration is structured around faculty governance. Our Department governance revolves around committees, led by the Chair, with faculty, staff and student membership. Adding student representatives (generally one graduate and one undergraduate student from their respective Student Advisory Councils) began in the 2020-2021 academic year. Through their inclusion on committees, students learn about University governance, hone their communication skills, and provide an essential student perspective on policies and decisions. Students meet with the Department Chair to share ideas and voice concerns. We are committed to inclusive learning for students as well as to continuous improvement, which both require student input.

The Department is also advised by an External Advisory Board (EAB), with 15-20 aerospace experts from leading academic, industry, and government and other institutions. The current committee members are listed in Appendix F.

Budget & Resources

Departmental Budget Summary

Operations funding for the Department comes from the following sources:

- General Operating Funds (GOF)
- Indirect Cost Returns (ICR)
- Revenue from the Department's self-sustaining masters program and certificates
- Summer tuition and course fees
- Two discretionary endowed gift funds and other general gift funds

Our largest expense is faculty and staff salaries. In recent years, we have had around $500k in operating expenses, covering course expenses, facilities upkeep and renovations to support research, teaching, and our project-based experiences for students.

Also, in the past five years, over $500k from Chair funds have been used to complete renovations to A&A spaces that were not part of our operating budgets. These renovations include the following items, which have intentionally improved our climate and culture:

- Key card systems for access to all faculty labs, exterior doors and student spaces
- Renovations for the Aerospace Education Research Building (AERB) including:
    - Updated offices and painted hallways
    - Remodeled suite for Space Grant
- Digital monitors that provide information and highlight our students
- Artwork throughout all A&A Spaces

Effective Use of Funding and Resources

The Chair assesses the effectiveness of our use of resources with advice and inputs from the faculty and the administrative, advising, and facilities staff. This consultation occurs monthly at faculty meetings, twice-monthly through Leadership Committee meetings, weekly at senior staff meetings, and twice per year with our External Advisory Board. The budget and resources are evaluated against the University's Mission and Departmental Strategic Plan.

Priority Funding Acquisition Strategies

1) **Increasing self-sustaining degree and certificate program enrollment**
   During the current year, we increased and modified our recruitment strategies for our MAE (professional) degree which doubled our cohort. This increase brings a projected additional $393K to the department. We are also in the process of creating the following programs that are all slated to begin in September 2024:
   - Three graduate certificates
   - Stackable masters

   We anticipate to net $871,156 yearly relative to the current year (see appendix B).

2) **Incentivizing faculty to submit additional grants**
   Currently the UW has an indirect cost return rate of 55.5% for grants and contracts. We use the concept of a "grant unit" which equates to a grant/contract of around $125K. This amount will typically cover a graduate student for twelve months, a month of faculty summer salary, travel to a conference and supplies. It also provides us a return of around $15k. Faculty have discussed moving to an annual average of two grant units per faculty member. Currently the average is 1.17. Reaching two units will net an additional $213,734 annually. Faculty hold each other accountable for research productivity including grant funding through the annual merit process. See Appendix B: Budget Summary for a chart on our indirect cost recovery (ICR) history and goal.

3) **Fellowship and Advancement Activities**
   All departments in the College share staffing for Advancement. Currently we have one shared staff member for Corporate and Foundation Relations and two for Individual Giving. The Chair sets priorities with our advancement officers to raise funds for faculty development funds and professorships. These funds not only provide discretionary and gap funding for faculty, but are typically used to support students working in developing and novel research areas. Advancement facilitates and stewards relationships with alumni and other donors to maximize impact of gifts in alignment with department priorities. As of 2011, we held one endowed Professorship (Boeing) and no endowed faculty fellowships or development funds. In the past five years, Department faculty have been awarded College Professorships and a Chairship as well as a term professorship. (See Appendix C). We have also acquired endowments for a new faculty fellowship and multiple faculty development funds. We are leveraging these faculty development funds to reward faculty for initiatives in alignment with the strategic plan implementation.

Equity, Inclusion, and Justice

Equity & Inclusion Plan and Representation on the Diversity Committee

We have a DEI Committee drafting and implementing our Equity & Inclusion plan. This committee is composed of at least one Professor, one Associate Professor, one Assistant Professor, the Graduate and Undergraduate Advisers, the Space Grant Deputy Director, the Communications Manager, one graduate student, and one undergraduate student.

In Autumn 2022, the DEI Committee scored the Department on the effectiveness of our DEI efforts, initiatives, strategies, as well as existing policies, practices and written materials based on the UW DEI Rubric. We have made much progress over the past year, and we will update this rubric in Autumn 2023.

We incorporated our scoring into our 5-year Strategic Plan in 2022, with a DEI integration across all of our pillars. Specifically, we are pursuing these three main strategies:

1. Attract, recruit, select and retain diverse students, faculty and staff
2. Develop structures, practices and people skills that embed and leverage the value of DEI in all Department activities
3. Build a robust Department community culture where all members thrive, are valued and feel a sense of belonging

Faculty and Staff Diversity

Aerospace engineering, as with mechanical and electrical engineering, falls well below the averages of engineering as a whole for the percentage of URM and women as faculty members. We are no exception to the national trend (national statistics were compared against our Department where we had data). We have made good strides since our last review, moving from one female faculty member to three. More diversity data will be posted soon College-wide, but our current department statistics indicate:

- Faculty: 15% Female, 85% Male, 5% URM
- Staff: 60% Female, 40% male (URM numbers to be released by the College)

Utilization of Institutional Resources and Partnerships

We leverage the resources provided by the UW Graduate Student Equity & Excellence (GSEE) program as well as by the Office of Diversity and Access within the College of Engineering to recruit URM students. These offices annually host visit days for new students to connect with other students of color, while providing services and advocacy to achieve equitable representation, access, and success for URM graduate students.

We annually apply for a “GSEE Graduate Excellence Award.” This award is a three-quarter merit-based research assistantship intended to assist with recruiting, developing, and supporting a diverse community of graduate scholars. While we have not been selected for the past two years, we will continue to apply for this award each cycle in the future.

Also, in collaboration with the Graduate School and the ARCS (Achievement Rewards for College Scientists) Foundation, we annually nominate the maximum number of allowable applicants for ARCS fellowships, including “diversity” specific ARCS fellowships. Recent

admission cycles have shown increasing success regarding these diverse nominees' accepting our offer of admission.

Outreach Strategies

Our undergraduate program collaborates with campus partners that serve URM students including the Office of Minority Affairs and Diversity and the Q Center as well as the College's Office of Inclusive Excellence. Undergraduate Advising also conducts outreach to Washington State Community Colleges to assist students with the transfer process.

At the graduate level, with each subsequent application cycle, increasing numbers of URM and self-identifying female students are applying to our degree programs. We are unable to report on the outcomes of efforts to recruit applicants with disabilities or from the LGBTQ+ communities because we do not collect that information in the application process. We attend (either in-person or by sending print materials) the Society of Hispanic Professional Engineers, National Society of Black Engineers, and Society of Advancement of Chicanos/Hispanics & Native Americans in Science (SACNAS) conferences.

We utilize various mailing lists and databases to gain a more diverse pool of applicants. Our graduate program emails select attendees from The California Forums for Diversity in Graduate Education, the National Name Exchange, the McNair Scholars Directory, and the Engineering National Graduate Institutional Name Exchange (ENGINE) database.

Initiatives to Support the Academic Success of Students from Underrepresented Identities

The undergraduate adviser meets with all students and acts as a liaison to campus offices which directly support underrepresented students as well as the Financial Aid Office, Veterans Center and mental health resources including the Counseling Center. All Undergraduate students can participate in a mentoring program with alumni.

At the Graduate level, one of the methods used for supporting individuals has been one-on-one meetings with the Graduate Program Adviser to check in on academic and personal progress. The program also extends invitations to the following groups to speak at the Graduate Student orientation each September: Out in Science, Technology, Engineering, and Mathematics (oSTEM), Women in Aerospace, the Grad Chapter of the Society of Women Engineers, and many more. Throughout the year, the Graduate Program Adviser sends a weekly digest of campus clubs and events including those that focus on diversity and offer support to graduate students.

Recruitment and Retention of Faculty from Underrepresented Identities

Recruitment

As a foundation to recruit excellent URM faculty candidates, we have worked with the University's Associate Vice Provost for Faculty Advancement, Chadwick Allen, on the effective use of hiring rubrics. Our female and URM faculty candidates have consistently cited their awareness of the UW Advance Center for Institutional Change and its importance in their decision to apply. The candidates are also drawn to the large number

of women faculty in the UW College of Engineering, especially a significant number in leadership roles in the College departments and Dean's office.

We have been able to offer key benefits in our offer negotiations, which have been key acceptance factors, including:

- Childcare slots at UW Childcare - two per year for College of Engineering. One was obtained as a critical factor in a faculty hiring acceptance.
- Homestreet home loan program - offered to a select number of faculty recruits. Also obtained as a critical factor in a faculty hiring acceptance.
- Proactive retention - A department chair normalized the salary for a faculty member from an underrepresented demographic..

Retention

A number of activities have been developed in the department to aid in retention of faculty from underrepresented identities. During the period of 2012-2023, only one faculty member departed for reasons other than denial of tenure. That case was for reasons outside the control of the Department and University. During that time period, we successfully retained two senior faculty who had competitive offers at other universities. The key activities that have been adopted over the past several years are as follows.

- Monthly lunch with Chair and assistant professors (one female, one URM, one first generation college graduate out of the six faculty). The Chair provides group mentoring and peer mentoring at these lunches. Topics include onboarding and typical expectations, grant writing, facilities management, strategic planning, Department climate and culture, etc. Assistant professors clearly value these lunches as they prioritize attendance.
- Individual weekly and/or monthly meetings with the Chair for all faculty not at the rank of Professor to work toward successful promotion. These meetings are for all faculty, but necessarily capture our women and URM faculty.
- All junior faculty are encouraged to participate in training and mentoring provided by the UW ADVANCE program. A wide range of workshops on topics such as proposal writing and time management are provided, peer mentoring groups are made available, and individual mentoring sessions are available.
- The UW Faculty Code around promotion indicates that promotion is based on accomplishment, not time in rank. The current Chair identified several faculty who could move forward from Associate Professor to Professor more quickly than the prior typical minimum time of six years between those ranks. In the past five years (the duration of the current Chair's appointment), the Department has had 100% success in promotion. The success rate from 2013 to 2018 was 40%. A primary difference between these two periods is the increased level of individual and cohort mentoring that has taken place.
- The Chair recently made a successful arrangement with the Dean to significantly increase new hire salaries of assistant professors to meet College norms. This adjustment will result in inversion of the other assistant professor salaries, but a two-year process of salary adjustments for the assistant professors has been communicated with them. The assistant professors have expressed appreciation for the transparency and the overall plan.

- The Chair regularly uses the available pre-emptive salary adjustment opportunities to reward high-performing faculty.
- We support our faculty during the birth, adoption, or fostering of children through our New Parent Policy, offering enthusiastic support of UW policies, including the tenure clock extension policy and Transitional Support Program, modified duties including teaching release and summer salary planning. These policies started for women faculty but are available to all of our new parent faculty.

Capacity-Building of Faculty and Staff to Create an Inclusive Climate

We are building capacity through two main vehicles: our Committees and Training. During the 2022-2023 academic year, we established a Community Committee which grew out of our strategic planning process to "Build our culture to create a community that inspires and empowers us." The Committee is merging with our DEI Committee in the 2023-2024 academic year due to alignment of goals and strategies.

During the first year of the Community Committee, we made major strides for inclusivity:

- **Ramping up SHARC Week** – a five day fun-and-food-filled "SHowcase of Research & Capstones" with an undergraduate showcase (research, Registered Student Organizations (RSOs), a graduate research showcase, a Capstone Film Festival, and a pizza bowling party in the HUB.
- **Expanding social media coverage of all graduating students** – highlighting every thesis, dissertation and capstone team on Instagram. We are able to offer this coverage because we have expanded our capacity with a team of student workers to deliver excellent graphics and overall communications assistance.
- **New Faculty Awards** – dedicated by the Chair from our endowments to advance our strategic plan goals, with an emphasis on DEI. This year's winning proposals:
    a. Strengthen the community of our fluids discipline
    b. Reinvigorate our Women in Aerospace group
    c. Train graduate students on developing successful applications for national grants and fellowships

Department faculty and staff also participated in trainings to promote an inclusive environment. Through the College of Engineering, we participated in Land Acknowledgement, Anti-Racism, and microaggressions prevention trainings as well as the College-wide DEI Assessment. Through the University, we participated in Hazing prevention, Title IX, and POD classes on emotional intelligence and communications styles. On the student side, we delivered training for student leaders in our RSOs to facilitate their administration of these clubs and improve collaboration among faculty, staff and students.

Leveraging Data to Advance Equity

We have used several sources of data as points of departure for action:

- We gathered comprehensive data on the participation of URM and women in engineering v. aerospace nationally and compared it to our Department as a clear call to action to improve these statistics.
- We gather data annually through our senior exit survey and calculate the statistics on the number of internships and the probability of having a job at graduation to stress the need for internships and internship support.

- We participated in the College of Engineering DEI Assessment and discussed the results in a faculty meeting to illustrate that we have work to do to foster inclusion.
- As part of our Strategic Planning, we performed a Community AUDiT with faculty, staff and our PhD students on how vibrant the Department is, if there are warning signs, and if there are major challenges. We discussed our results.

SECTION II: TEACHING & LEARNING

Student Learning Goals and Outcomes

Educating successful engineers is one of our primary missions. Our undergraduate program educational objectives are informed by our departmental values as well as the mission statements of the University of Washington and of the College of Engineering.

We aim to prepare our graduates to be successful, highly valued engineers in industry, government organizations, and institutions of higher learning. Our further objective is to graduate engineers who thoughtfully serve the region, the nation, the profession, and society at large in three primary ways:

- We will train our graduates to solve critical technical problems related to aerospace engineering and devise innovative ways to develop and apply new technologies.
- We will prepare our graduates to participate in identifying and responding to the problems facing society.
- We will prepare our graduates to engage in a lifetime of continuous learning, leadership, and contribution to all areas of aerospace engineering practice.

To achieve these objectives, our faculty, staff, and teaching assistants pursue excellence in the department's educational programs relying on state-of-the-art computing, high-quality instructional facilities, and continuously improving methods in educational delivery and engagement.

The goals and outcomes for our graduate programs build on those for our undergraduates, with the additional expectation that their graduate degree will give them a more in-depth and advanced academic view of the concepts of aeronautics and astronautics, and, for MSAA degrees with theses, a significant research component. PhD graduates conduct in-depth scientific research leading to substantial and original research contributions.

Overall, the expected learning outcomes for graduate students are that they will be:

- Skilled in engineering fundamentals, engineering design, laboratory skills, synthesis of various engineering disciplines and working in a team environment.
- Developed in strong interpersonal skills and a desire for life-long learning that will help them succeed in their chosen careers.
- Valued at local, national, and international industries, as well as at government organizations and institutions of higher learning.

The outcomes of each graduate degree program are:

- MAE graduates will emerge from the program with practical engineering skills

needed in industry and essential project management skills.
- MSAA graduates will have in-depth knowledge in their specific area of interest and will be able to pursue advanced degrees, and careers in industry or government.
- PhD graduates will be able to pursue leadership roles in academia, industry, and at top engineering research institutions.

Evaluation and Assessment of Student Learning and Satisfaction

The undergraduate and graduate programs use a variety of similar methods to evaluate student learning and satisfaction (see Table below). Quarterly, we assess the grades of each student to assure satisfactory progress toward degree. In undergraduate classes, a variety of methods are used in the classroom to assess learning on an ongoing basis such as weekly pop quizzes, incremental reviews during the capstone process, etc.

In addition to the above methods, we assess the overall student learning and integration of skills at the end of their undergraduate program as part of their participation in the required capstone senior design projects. Individual instructors may choose to conduct an ungraded intro knowledge quiz at the beginning of the quarter to help students self-assess preparedness for the course.

Primary methods of evaluation of student learning and satisfaction

	Course evals	Exams *	Course grades	Annual Reviews	Publications	Conference presentations	Awards & external recognition	Cohort Surveys
BSAAE	✔	✔	✔				✔	✔
MAE	✔	✔	✔				✔	✔
MSAA	✔	✔	✔		✔	✔	✔	
PhD	✔	✔	✔	✔	✔	✔	✔	

*For PhD candidates, exams include qualifying and general exams, and dissertation defense.

All faculty undergo periodic reviews of their teaching performance by a committee of senior A&A faculty. We conduct these reviews annually for assistant professors, every other year for associate professors, and every three years for full professors. Further information on the peer-evaluation process is in Appendix G.

We assess student satisfaction with the undergraduate program through a variety of formal and informal methods. We have an online form students can submit to express feedback on any topic. This form is received by the academic services team and routed appropriately for follow up, if the student desires. The College of Engineering's Center for Teaching and Learning surveys Juniors and Seniors at the end of each academic year. Other methods include informal communication between students and faculty, with the staff adviser, and by surveys during the undergraduate program and after graduation.

The Graduate School requests students complete an exit questionnaire upon graduation,

which asks students to rank their satisfaction with the program in the same areas as the undergraduate program survey, with an additional emphasis on research capabilities. Those data are presented in Appendix E. We use these data to assess the satisfaction of our students relative to both the College and the University as a whole. We also evaluate student satisfaction with the Department through one-on-one communications, an informal survey of the A&A graduate student association and Graduate & Professional Student Senate representatives, and feedback from alumni. As with the undergraduate program, efforts are made while they are in the program to ensure that they find support (academic or social) to enhance their experience in the Department.

Starting in the 2022-2023 academic year, we are asking PhD students to complete an annual review with their adviser. The annual review gauges progress to degree and milestones, effort in research, writing, and publications and identifies areas of improvement. As this process continues to evolve, the annual review will serve as a place to keep track of goals and successes throughout the student's time in the PhD program.

Improvements

From our student surveys, along with recommendations from faculty, alumni, and industry partners, we have implemented several improvements since 2012. With our undergraduate program undergoing accreditation in 2025-2026, we expect further restructuring.

Curricular changes over the last five years (see also Appendix J: Course Changes):

- Many courses received context and sequential consideration.
- Some courses that met for one hour for four days per week now meet two hours twice per week, to optimize student schedules.
- Many of our ten RSOs are now able to pitch a project for the senior capstone.

Student experience and representation changes:

- A refresh of graduate student desk areas provides a more inviting environment.
- Student representatives sit on nearly all Department Committees.
- We have newly-formed undergraduate and graduate student advisory councils (uSAC and gSAC) which represent their cohorts on committees and provide social and community-building activities for A&A students. Staff support them in their event planning and provide nominal funding.

Non-major Undergraduate Learning

A&A majors are not our only constituents. We offer two Engineering Fundamentals courses, AA210 Statics (offered all four quarters) and AA260 Thermodynamics (offered Spring and Summer). Statics is required by most of our other engineering departments, and Thermodynamics, required by A&A, is an option for two other departments. A&A applicants typically take these courses as sophomores, but non-A&A majors may take them later to meet their own graduation or electives requirements. The learning goals in these courses are the same for all students, regardless of intended majors. Undergraduates from other departments (predominantly engineering) also participate in a number of our graduate courses, as well as doing undergraduate research as AA299/AA499. We offer interdisciplinary capstone options for seniors, as well.

The A&A minor became available starting Spring 2016, with the first students earning the minor in Spring 2017 to address the demand in A&A courses from students not in the major. While many of the students in the minor are from other departments in the College of Engineering, students in Astronomy, Physics, Earth and Space Sciences, Chemistry, Mathematics, and Sociology have recently earned the minor as well. Since Spring 2017, 57 students have earned the minor upon graduation.

Instructional Effectiveness

Methods to Evaluate Instruction Quality

Faculty conduct peer evaluations of teaching to help assess whether learning goals are being met. The College of Engineering's Center for Teaching and Learning (CTL) provides additional resources that A&A faculty may use to evaluate the teaching and learning in their classroom, including course syllabus and assignment design, observation and critique, etc.

Training for Graduate Students in Teaching

We welcome graduate students to attend an annual UW TA workshop and recommended UW sessions on teaching. Course instructors train students for individual classes, give them job descriptions, and evaluate them at the end of the first two quarters. We give instructors (faculty, postdocs, and graduate students) the opportunity to participate in teaching symposia, to receive consultations from the Office of Advancement of Engineering Teaching & Learning, and to be mentored by senior faculty.

Beginning in the 2022-2023 academic year, we established a Lead TA position to assist with TA and Grader training, including communicating expectations and sharing best practices. The lead TA role continues to add trainings based on current TA and Grader needs and feedback and requests from faculty. The Lead TA is also a resource for advanced PhD students who teach in the department. A faculty member mentors these students as they prepare the content and pedagogical approach to the course.

Instructional Changes Due to Evaluation

At both the graduate and undergraduate levels, we use online tools much more now than at the time of the previous program review. In particular, we often provide lecture material (lecture notes, homework, examples of worked problems, etc.) online. The junior level lab sequence is currently undergoing revisions based on recent feedback from students and instructors. See Appendix J: Course Changes for additional changes.

Teaching and Mentoring Outside the Classroom

Faculty Involvement in Learning Outside the Classroom

Our faculty mentors supervised graduate and undergraduate students in research projects for independent study and theses/dissertations. Many faculty also serve as mentors to students through the Center for Evaluation and Research for STEM Equity (CERSE), MentorNet: The E-Mentoring Network for Diversity in Engineering and Science, the Washington NASA Space Grant Consortium Summer Undergraduate Research Program,

and other similar programs at UW and beyond. Faculty participate in outreach programs such as Louis Stokes Alliance for Minority Participation (summer program for STEM students, predominantly URM), Disabilities, Opportunities, Internetworking, and Technology (DO-IT), Summer Math Academy, and Research Experience for Undergraduates (REU). They present special seminars, participate in College of Engineering Discovery Days and other STEM activities.

Faculty and graduate students also encourage undergraduates (freshmen through juniors) to participate in extracurricular project activities and mentor them along the way in our A&A student organizations such as AIAA Design, Build, Fly (DBF), the Society for the Advancement of Rocket Propulsion (SARP), Women of Aerospace, the Washington State Academic RedShirt Program, and more recently NASA's University Student Launch Initiative. They provide guidance to these student-led organizations, many of which have won local and national competitions. Faculty have even taken students from within and outside our Department on Astro-viewing sessions, exposing them to an array of astronomical objects.

For outreach to high school students, faculty and graduate students have served as project supervisors or judges for science and engineering contests, and develop curriculum through the TAF Academy, where traditionally underrepresented students are given the opportunities and access to explore STEM careers and achieve academic success.

Through engagement with our programs, the City of Kent recently began a partnership with Green River Community College and us to help middle school and high school STEM teachers develop new space-focused curriculum for their classrooms. The first round of materials will be deployed in the 2023-2024 academic school year.

In addition to mentoring students, faculty serve as leaders and mentors in other UW and external organizations, such as the Center for Sensorimotor Neural Engineering, the Space Policy and Research Center (SPARC), the Joint Center for Aerospace Technology Innovation (JCATI), and the Center for Advanced Materials in Transport Aircraft Structures (AMTAS)—all of which provide development opportunities. Mentorship also takes place less formally in activities such as weekly reading groups, where students make presentations on book chapters or the status of their current research.

Recruitment

We participate in a number of recruitment activities throughout the year that have been effective in attracting students to the program, including:

Undergraduate

- College of Engineering Discovery Days and information sessions.
- Presentations to the College of Engineering's STARS students.
- Engineering Academy summer bridge program for incoming (predominantly URM) students in STEM.
- Faculty-mentored projects for undergraduates at all levels through the Washington NASA Space Grant Summer Undergraduate Research Program.
- Tours of the A&A labs and the Kirsten Wind Tunnel for the Museum of Flight's Washington Aerospace Scholars Program for high school students.
- Outreach activities to K-12 schools in the Puget Sound area by our AIAA chapter,

Women of Aerospace and other department RSOs.

Graduate

- Up-to-date, engaging, informative and user friendly website.
- In-person and synchronous but remote campus visits for prospective students.
- Personalized email to each applicant who has only a “partial” application completed, offering to answer any questions they may have about the process.
- Attending local and national graduate school fairs.
- Contacting self-identified undergraduate engineering students whose names are obtained through various graduate school recruiting agencies.
- Presenting workshops on applying to graduate school to our own undergraduates.
- Advertising on our local NPR station, KUOW.

Please see Appendix E: Enrollment and Graduation Statistics for more information.

Student Academic Support and Progress

The Department takes many steps to ensure students’ academic progress and overall success. For undergraduate students, the following actions take place:

- Review the progress of all transfer students and students changing majors and meet with all of them upon admission.
- Review the sophomores that the College places with us to be sure they are on track, and let them know which courses are required to ensure timely graduation.
- Prepare them for the next phase of their academic careers by letting them know about graduate school and how to prepare.
- Provide information from other units on campus to assist students with the next stage of their careers, such as the Fellowships Office and the Graduate School which offers courses on preparing for grad school.
- Provide scholarships for students to reward their academic merit and assist with financial need. Funding assists with steady academic progress.
- Liaise with offices such as Financial Aid, Veterans Affairs, Office of Minority Affairs & Diversity, and Student Life to be sure students are aware of available resources.

For all graduate students, we take the following actions:

- Require that new graduate students make an anticipated plan of study to plan out courses for the degree.
- Review the progress of all students quarterly for satisfactory academic progress (grades) to be sure they are on-track or find options if they aren't.

For PhD students:

- Place milestone expectations in multiple places.
- Implement a new annual review process.

The Department collaborates with other campus units to offer students opportunities to prepare for their next career phase:

- Career preparation for undergrads includes connection to the Career Center@Engineering during Orientation, AA 395: Career Seminar, and graduate degree options.
- Widely sharing study abroad and internship opportunities.
- Industry capstone projects.
- RSO involvement with hands-on activities, team work, and leadership opportunities.

- Career preparation for MSAA/PhD students include AA 598: New Student Seminar and early connection to the Career Center@Engineering.
- Career preparation for MAE students: the required AE 598 MAE Colloquium focuses on professional development with topics based on student and industry feedback.

SECTION III: SCHOLARLY IMPACT

Faculty, student, alumni impact

A&A faculty and students have made major, internationally-recognized contributions to aerospace and engineering technology. Several faculty are technical fellows recognized for extraordinary contributions. While Appendix C contains a more comprehensive list of faculty awards, recent examples include:

- **Behcet Acikmese** (IEEE and AIAA Fellow): “contributions to optimization-based nonlinear control and to planetary landing systems.” (IEEE)
- **Eli Livne** (AIAA Fellow, AIAA Holt Ashley Awardee for Aeroelasticity and Enoch Thulin ICAS Innovation in Aeronautics Award): for “his seminal contributions to the theory and practice of aeroservoelasticity for aircraft multi-disciplinary design optimization, and for pioneering work towards the maturation of aircraft active flutter suppression technology.” (Holt Ashley)
- **Kristi Morgansen** (Washington State Academy of Sciences (WSAS), AIAA Fellow): for “her leadership and significant advances in nonlinear methods for integrated sensing and control in engineered, bioinspired, and biological flight systems, and for leadership in cross-disciplinary aerospace workforce development.” (WSAS)
- **Mehran Mesbahi** (WSAS, IEEE Fellow and AIAA Associate Fellow): for “extraordinary contributions to guidance and control of autonomous and distributed aerospace systems, for leadership in educational innovations, and for advancing aerospace technology transfers leading to industry research collaborations.” (WSAS)
- **Uri Shumlak** (APS and IEEE Fellow): for “research of sheared flow stabilization of the Z pinch for fusion energy.” (IEEE)

Similarly, our students have received a number of prestigious awards, including the Brooke Owens Fellowship, NASA NSTGRO fellowships, NSF Graduate Research Fellowship Program fellowships, Fulbright Scholarships, and other fellowships. Our students have also won top paper awards and presentation honors at the regional AIAA conferences. (See Appendix I: Student Awards 2011-2023 for a comprehensive list).

Our alumni are employed at the highest levels of academia, industry and government. We have several outstanding alumni on our External Advisory Board, and we recognize one outstanding alum each year to receive our Distinguished Alumnus Award. Please see Appendix H for a comprehensive list of alumni achievements.

Adapting to Advances and Trends in Aerospace

We value the counsel of our External Advisory Board to make sure we are maintaining relevance for industry. In 2022, we mapped our program priorities with our Board:

1. Sustainable Aerospace
2. Access to Space
3. Advanced Space Exploration
4. Workforce Development
5. Super- and Hyper-sonic Flight
6. Advanced Air Mobility
7. Data-driven Aerospace
8. Human Spaceflight
9. Safe & Secure Autonomy
10. Emergency/Disaster Response

In addition, as part of our Strategic Plan, we are mapping our Department, College, University and regional research technical expertise against the NASA Technology Taxonomy. This mapping is being used to provide us with a framework for building collaboration bridges to address technology needs and to inform gaps where new hiring or new partnerships are needed.

We address these priorities through our disciplines of Controls, Fluids, Structures and Plasma Science, as well as through collaborations and partnerships.

Controls

The controls discipline area addresses all aspects of guidance, navigation, control and autonomy including position, direction, safety and communication aspects of a single vehicle or swarm of vehicles in motion through air, water or space.

Our key research Controls areas cover:

- Automatic Control
- Autonomous Vehicle Control
- Control Theory
- Dynamics and Optimization
- Flight Operations
- Underwater Vehicle Design
- Unmanned Aerial Systems
- Machine Learning
- State Estimation
- Motion Planning
- Autonomous System Safety
- Human Factors in Autonomy

Research highlights

We are working toward trajectory planning for precise space maneuvers with electric propulsion for local aerospace company Starfish Space for applications of rendezvous and docking with active satellites for trajectory realignment or repair. See *Tugs in space*.

We develop guidance algorithms to help land spacecrafts in areas that we don't have mapped out well, which will solve challenges of how and where to land on the Moon, Mars and beyond. See *Nailing the landings in space*.

We pursue more accurate sensing in flight to create more responsive control for a smoother, more fuel-efficient ride. Strategically-placed sensors on aircraft capture gust

information which is combined with other factors including speed and airplane orientation relative to the airflow. A&A tested this research in real flight conditions on the Boeing ecoDemonstrator, a rare opportunity for student research. See *A&A research takes flight*.

Structures

Structures research specializes in developing aerospace structures that are strong, lightweight and robust. The widespread adoption of composites - combined with advances in additive manufacturing, robotics and automation - has expanded our capacity to manufacture new forms and build unusual flight structures.

Our key Structures research areas cover:

- Aeroelasticity
- Aircraft Design
- Composite Materials
- Fatigue, Vibration and Impact
- Metamaterials
- Solid Mechanics
- Structural Analysis and Dynamics
- Wave Propagation
- Advanced Manufacturing
- Bioinspired Structures
- Numerical Methods

Research highlights

We add soft actuation to rigid structures for many key aerospace benefits, including strength, flexibility and efficiency. Structures with soft actuators are lightweight, can withstand extreme environmental conditions and reduce vibrations which then reduces fatigue. Adding bio-inspired distributive actuation, like a snake's vertebrae-inspired musculature, should create even higher efficiency. See *Put more muscle into that structure*.

In collaborative research with UW's Department of Mechanical Engineering on nanofoams, we are investigating a surprising finding that an insulative gas-injected polymer had an increase in toughness, which was the opposite of what would be expected since the gas basically injects defects into the material. This finding has implications for accelerating the development of lightweight materials for aerospace and other applications. See *Nanofoams are full or surprises*.

We have advanced a solution to reduce impact forces like spacecraft landings by creating a model of a metamaterial that uses "folding creases" inspired by origami. This innovation can assist in the reuse of landing gear. See *Origami-inspired materials could soften the blow for reusable spacecraft.*

Fluids

Our fluids research focuses on the fundamentals of low- and high-speed aerodynamics in and around solid bodies. Studies take the form of analysis, numerical methods, and experimental systems including wind tunnel testing.

Our key Fluids research areas cover:

- Aeroelasticity / Aeroservoelasticity
- Numerical Methods / Algorithms

- Aerodynamics
- Turbulent Flows
- Quantitative Flow Imaging
- Detonation-wave Engines
- Turbulent Boundary Layers
- Low Speed Behavior of Supersonic Flight
- Supersonic Retropropulsion
- Hypersonics
- Airbreathing Jet Engines
- Heat Transfer
- Combustion in Microgravity

Research highlights

We have discovered a new law of physics in the area of fluid mechanics that will aid the future of aircraft design. The "Law of Incipient Separation" defines the maximum slope of a fuselage to avoid the separation of airflow that increases pressure-drag. Getting the slope of the fuselage right will create a more efficient aircraft to reduce fuel consumption. See *New law of physics finds a sweet spot for aircraft efficiency.*

A rotating detonation engine promises to make rockets more fuel-efficient and lightweight and easier to construct. This engine is too unpredictable to be used in an actual rocket, so we have developed a mathematical model for how these engines work to make them more stable. See *Simple, fuel-efficient rocket engine could enable cheaper, lighter spacecraft*.

One major challenge in landing a large craft on Mars or beyond is slowing it down from orbital speeds to a touchdown that will be gentle enough for its payload or humans to sustain. Under Supersonic Retropropulsion, the vehicle slows down by firing its engines into the oncoming high-speed flow. But this procedure may cause instability. We are simulating configurations, conditions, and contours that would create this instability to learn how to avoid it. See *Landing big on Mars* feature story.

Plasma Science

Plasma science focuses on achieving a stable fusion reaction that might be a sustainable source for clean energy and for deep space propulsion. Our Department work focuses on theoretical, computational and experimental studies of fusion energy and plasma propulsion through Z-pinch systems, electric thrusters and plasma-material interactions.

Our key Plasma Science research areas cover

- Computational Plasma Dynamics
- Fusion Energy
- Finite Element Methods
- Electric / Space Propulsion
- Plasma Physics and Science
- Small Satellites and Space Systems
- Plasma-Material Interactions
- Ionospheric Plasmas
- Numerical Methods for Fluid and Kinetic Models

Research highlights

Professor Uri Shumlak, a co-founder of A&A spinoff company Zap Energy, is pushing the frontier of what is possible in plasma modeling with limited computing power by assembling a hierarchy of models and using the simplest possible model that still captures important physics in each region of study. We can target higher resolution and higher

fidelity models only where the local conditions require it, which will accelerate simulations. See *Fusion energy is finally getting its moment*.

We explore the plasma physics of electric propulsion systems for space travel. They are delving into the intersection of data science and plasma physics by developing a method to rapidly optimize electric thrusters by taking data from high-speed plasma diagnostics and applying machine learning and data discovery algorithms. See *A&A's Little to develop data science methods for plasma optimization*.

We enhance understanding of fundamental plasma physics relevant to space and astrophysical plasmas. Specific research topics include plasma-material interactions in thrusters and fusion devices and numerical algorithm development for fluid and kinetic models. The majority of fusion concepts suffer from plasma instabilities that require high-fidelity modeling efforts. To counter this, we explore plasma instabilities across a range of plasma parameters from high-energy-density fusion to near-earth space plasmas. See Associate Professor Bhuvana Srinivasan's profile.

Collaborative and Interdisciplinary Partnerships

A&A is home to or leads several excellent centers which cover many of our program priorities, especially Sustainable Aerospace and Workforce Development, in our region and beyond. These major partners and collaborations include:

- Kirsten Wind Tunnel
- WA NASA Space Grant
- Advanced Composites Center
- Space Policy & Research Center
- Aerospace Futures Alliance
- Pacific Northwest Aerospace Alliance
- Boeing Advanced Research Collaboration
- NASA University Leadership Initiative
- University Consortium for Applied Hypersonics
- Joint Center for Aerospace Technology & Innovation (JCATI)
- FAA Center of Excellence for Advanced Materials in Transport Aircraft Structures
- Space Systems & Infrastructure Networks Cluster Hire (UW College of Engineering)

Promotion & Tenure Policies to Mentor & Support Junior Faculty

Our policies and efforts that we describe above for the support and success of URM faculty benefit our junior faculty as a whole. In short, these were:

- Salary adjustments based on increasing assistant professor starting salaries
- ADVANCE programs are open to all faculty
- Department-specific parental policies

We share these policies and offer support through

- Faculty onboarding
- Monthly assistant professor lunches with Chair
- Monthly individual meetings with associate professors
- Documents on website (link to college info, faculty code)
- ADVANCE workshops

- Regular planning conferences with the Chair (as per UW Faculty Code). Assistant professors have annual conferences, associate professors have conferences every other year, and full professors have conferences every three years. Additional conferences are available at any time.

SECTION IV: FUTURE DIRECTIONS

Where the Unit is Headed

We train our students using a modern curriculum that augments fundamentals with experiential learning, practice in complex systems, and communication and project management skills. We are supported by strong partnerships with the Pacific Northwest's premier air and space industry, our extensive network of active alumni, and the world-class research programs of our faculty. Graduates from our department go on to influence technology development, policy, and application within the State of Washington, the nation, and beyond. And as we move forward with this vision, we are growing, improving, and adapting our programs to meet our mission and the needs of current and future aerospace technology.

The Department is growing. We are focused on growth to address the education of all of our students to meet aerospace workforce needs at all levels to close the workforce gap and perform consistently with the "top ten" US Aerospace Departments. We are aiming for:

- Undergrad cohort growth to 96 from a current size of 80
- PhD increase to 100 total from a current size of 78
- MAE growth to 75 per cohort from a previous size of 35
- New interdisciplinary "stackable masters" degree, graduate school certificates and masters level capstone with capacity of 30 students per year per certificate

The Department is improving. Through our five-year Strategic Plan, we are working toward continuous improvement structured around four main pillars:

- **Holistic Education**: Strengthen content, structure and access of curricular and extracurricular opportunities that foster technical and professional skills and advance innovations.
    - Enhance our curriculum and extracurriculars with additional new A&A offerings and established offerings from other departments.
    - Engagement with pre-A&A students to introduce aerospace engineering and Department research.
    - Active alumni and industry network to prepare students for technical careers.

- **Research**: Define and invest in our research identity in terms of scholarship and creative activity in alignment with next generation aerospace.
    - Clearly defined goals and values for excellence in research.
    - Active partnership planning and matching.
    - Strong system for research recognition.

- **Community**: Build our culture to create a community that inspires and empowers.

    - Foster a caring Department community where we support each member and all feel a sense of belonging.
    - Establish a just Departmental process that honors our contributors with a holistic strategy of diversity, equity and inclusion.
    - Celebrate and affirm our Department legacy and accomplishments
    - Encourage a culture of openness where we protect free speech and affirm working collaboratively.
    - Develop a disciplined Department where we accept our obligations to the group and governance norms to guide behavior for the common good.

- **Diversity, Equity & Inclusion Integration**: Operationalizing DEI as a sustained effort with ongoing assessment and strategic focus in each pillar.
    - Attract, recruit, select and retain diverse students, faculty and staff.
    - Develop structures, practices and people skills that embed and leverage the value of DEI in all Department activities.
    - Build a robust Department community culture where all members thrive, are valued and feel a sense of belonging.

Five-Year Strategic Plan Goals

Holistic Education

- BS curriculum with strength in fundamentals and flexibility for emerging areas of innovation
- BS: 95% career placement at graduation
- MS: 95% career placement at graduation
- BS: 2 internships/REU experiences before senior year
- Annual graduate program student data analysis
- Strong mentoring program throughout PhD program with feedback mechanisms
- Strong student onboarding and ongoing engagement
- Bridge to MS program with at least 10 students directed toward MS/MAE per year
- Formal professional development program for all students
- Increase continuing education offerings
- Formal integration of sophomores and potential transfer students into curriculum
- Intentional industry engagement program at all degree levels

Research

- 5-year hiring plan updated annually
- Clear definition of Department's research values incorporated into merit review
- At least 75% of MS students engaged in research
- At least 50% of BS students engaging in at least one research quarter
- Graduate 0.75 PhDs per faculty member per year
- Regular achievement of awards by current / graduating students at all levels

Community

- Peer mentoring program for all levels
- Improve the current onboarding process for all groups (students, staff, faculty)
- All community members engaged with annual DEI discussions
- 25-50% increase in all diversity metrics of faculty, staff, students

- Building connections between faculty and broader community (industry and community groups connected with impact)
- Acknowledge great examples of governance and stewardship
- Equity in faculty, staff and student publicity/acknowledgement
- Increase transparency of processes to promote fairness and understanding of resource allocation to faculty, staff, and students
- Grow inspirational programs with research applications for broader community
- Feature our history/heritage/legacy on our website and Department displays
- Develop a slate of events to celebrate our work, our values and each other

Diversity, Equity & Inclusion

- Establish ARSR (attract, recruit, select and retain) goals and best practices for underrepresented groups and/or specific dimensions of diversity
- Coordinate with the College on a diversity data collection to document, evaluate and share our recruitment and retention efforts
- Develop and actualize an integrated DEI structure to increase communication and collaboration programs and plans for leaders and staff
- Engage with the College's plan for a DEI leadership training and development program to enhance knowledge and skills to facilitate organizational change
- Leverage the College's intercultural development manager's training program and integrate intercultural development in our curriculum and orientation programs
- Develop and implement a Department-wide DEI communications plan
- Recognize, amplify and reward DEI and social good leadership in the Department
- Develop a class on outreach with underserved populations
- Participate in a one-quarter Fellowship for faculty and graduate students with the College's Office of Inclusive Excellence to learn how to integrate DEI into curriculum
- Increase dialogue around DEI through systems to increase awareness, prevention, reporting, response and resolution of bias and harassment incidents
- Identify, highlight, support and develop best practices on welcoming and supporting underserved or underrepresented faculty, staff and students
- Develop and put into action specific measures to acknowledge and support sovereignty and increase collaboration with tribal communities
- Deepen and expand practices that increase the voice and involvement of underserved or underrepresented groups in decision-making processes
- Prioritize the health and wellness of all our students, staff and faculty by listening, offering information and resources, creating flexibility when needed and ensuring no one feels they must choose between health and productivity

How We Will Reach Our Goals

We are keeping track of the progress of our strategic goals in a comprehensive dashboard. Our committees and administrative groups own or share ownership for the completion of each goal, as noted in the dashboard. The creation of our Strategic Plan came out of two years of scoping and crafting with the participation of all of our faculty and key staff as well as students, in consultation with our External Advisory Board and other external stakeholders. Most goals are SMART (Specific, Measurable, Achievable, Relevant, and Time-Bound goals) to ensure implementation and tracking.

Benefits of Realizing our Goals

The State of Washington is #1 in aerospace sales, exports and profits in the US, with the highest density of aerospace engineers. We are witnessing a growing space cluster in propulsion, avionics, satellites, structures and launch systems. Our alumni are contributing to this growth. We are tracking the technology trends against our skills and gaps to inform our faculty hiring plan and needs for collaborations. Specifically, we look to the following state and regional strategic reports on aerospace

- Washington State Aerospace 2019-2020 sector strategy
- PNAA
- Aerospace Futures Alliance
- Puget Sound Regional Council WA State Space Economy 2022 update
- OneRedmond Space District

We also know that there is a need for more aerospace engineers, and we are poised to increase our cohort numbers. Though we will be growing our undergraduate size, we are limited by the state funding system as to how many undergraduate degrees we can grant in a year. We can enroll a larger number of graduate students through our MAE, stackable MAE, and graduate certificates. Also, we are aiming to serve as a hub for connecting engineers, scientists and students from all disciplines to provide the skills necessary for aerospace technology challenges. We want to serve as many students as we can to fill in the workforce gap and also become competitive with the top ten ranked national aerospace departments.

Achieving our goals in the areas of Holistic Education, Research, Community and DEI, especially as we are growing, will lead us to higher excellence, relevance and fellowship. We will be more connected and responsive to local industry which will benefit student experiential learning (capstones) and career prospects (internships and jobs) and the relevance of faculty research. The commitment to community and diversity, equity, and inclusion ensures a welcoming and inclusive environment, where we recognize, hear and celebrate our community.

Washington State is also a hub of sustainable aviation. The Washington State Academy of Sciences just held a major conference on the topic. We have major sustainable fuel facilities here as well as extensive hydrogen research and we are the home of MagniX and Harbor Air. While we have not embraced these topics yet in the Department, as we pursue our Strategic Plan goals and align with the needs of the local industry, we will build this expertise. Our region also supplies most of the satellites in orbit, and we are growing our satellite capabilities with a recent hire who led the MIT SPHERES program and also upcoming hires with our Space Systems and Infrastructure Networks cluster. As we mentioned above, we have also mapped our priorities and our capabilities relative to the NASA technology taxonomy, and we will be adapting our curriculum accordingly.

PART B: UNIT-DEFINED QUESTIONS

COMPETITIVENESS / STRATEGIC PLAN

How do we best position our Department to achieve our vision in terms of catalyzing aerospace education and research? Has the curriculum kept pace with and/or is leading developments in the field? Or how can it?

We update undergraduate courses on a regular basis. For example, the junior lab sequence is being updated to incorporate design of experiments and statistics and alignment to lecture course sequence. However, meeting the ABET criteria constrains the curriculum. We (and most accredited aero departments) are unable to meet industry needs in avionics, computing, data science, human factors, and a wide array of space topics.

We also regularly update our master's courses based on feedback from industry. The stackable masters program is based around technology developments in the field of aerospace engineering and how best to meet them.

Are the research capabilities in the Department suitable for addressing emerging aerospace needs?

The department research expertise has been assessed against the NASA Technology Taxonomy categories. We are further assessing capabilities in the College, University, and throughout the state to fill capability gaps of the department and to target strategic partnerships.

We are currently able to meet facilities needs for the most part, however, our experimental capabilities for hypersonics are limited. We have excellent labs and Machine and Composites Shops (see Appendix L: Facilities, Equipment & Other Resources). We will also be benefitting from the new Interdisciplinary Engineering Building, which will relieve us of some space issues for experiential learning.

RESOURCES

Achievement of which Department goals is possible through reallocating existing resources? What goals can only be achieved through additional resources? What are innovative ways to address these needs? (faculty, staff, funding, facilities, etc)

We have the offices and labs for current plans (96 students undergrad cohorts, 100 PhD, current numbers of MSAA, and MAE). Our Board endorsed increasing from 96 students per undergrad cohort to 128 students. We do not have the labs or office space for these additional faculty and their research programs (including additional grants staff). Our experimental propulsion facilities are constrained and we do not have tenure track faculty doing a great deal of work in experimental propulsion. Hiring in the area of experimental propulsion will be addressed with the tenure

track position open due to a recent retirement. We are exploring partnerships with local industry to provide access to some capabilities. The cluster hire which has brought additional faculty lines to the department has allowed us to strengthen the astronautics side of the department. Hiring teaching faculty who have interest in particular research areas has also been a success.

STUDENTS

How do we best attract, support and graduate a diverse group of students that meet the needs of aerospace industry and research?

Our diversity numbers are currently at or above national aerospace statistics. However, aerospace in general is not meeting national demographic levels. In order to meet workforce needs, the only option is to draw in students who have not traditionally been part of engineering. These students do not have the background that we have historically expected, in large part due to resource constraints, but also due to a variety of societal factors such as lack of role models. We have seen success with increased diversity in our professional education opportunities. We believe this success comes from working with the students to determine what they need and how best to partner with them in terms of class times, course content, and professional development.

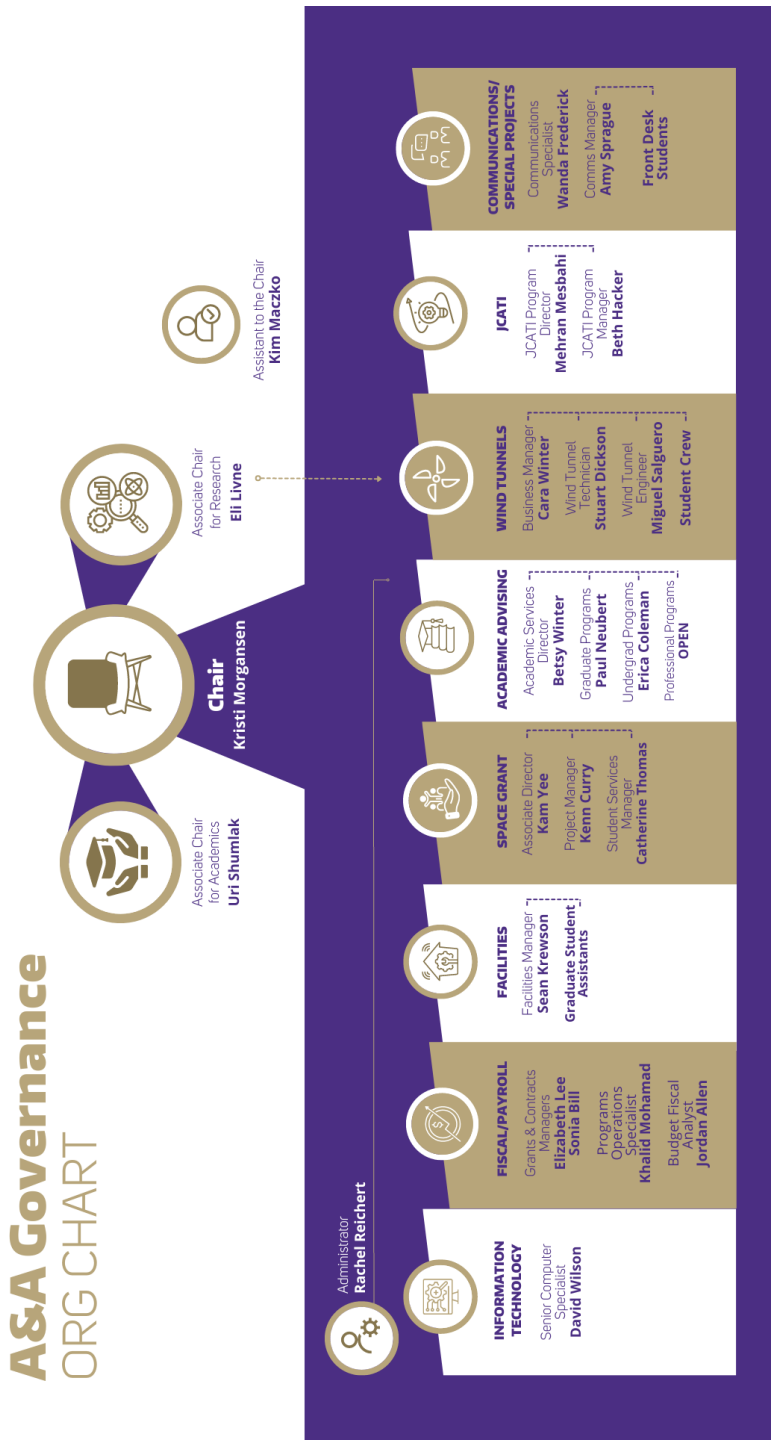
Given our list of activities, what best practices could we leverage from other schools?

One route our university is pursuing which has demonstrated appeal to our industry partners is building a Secure Compartmentalized Information Facility (SCIF) for classified work in areas such as data science and hypersonics. We are looking at incorporating classified work for masters students with industry support of their projects.

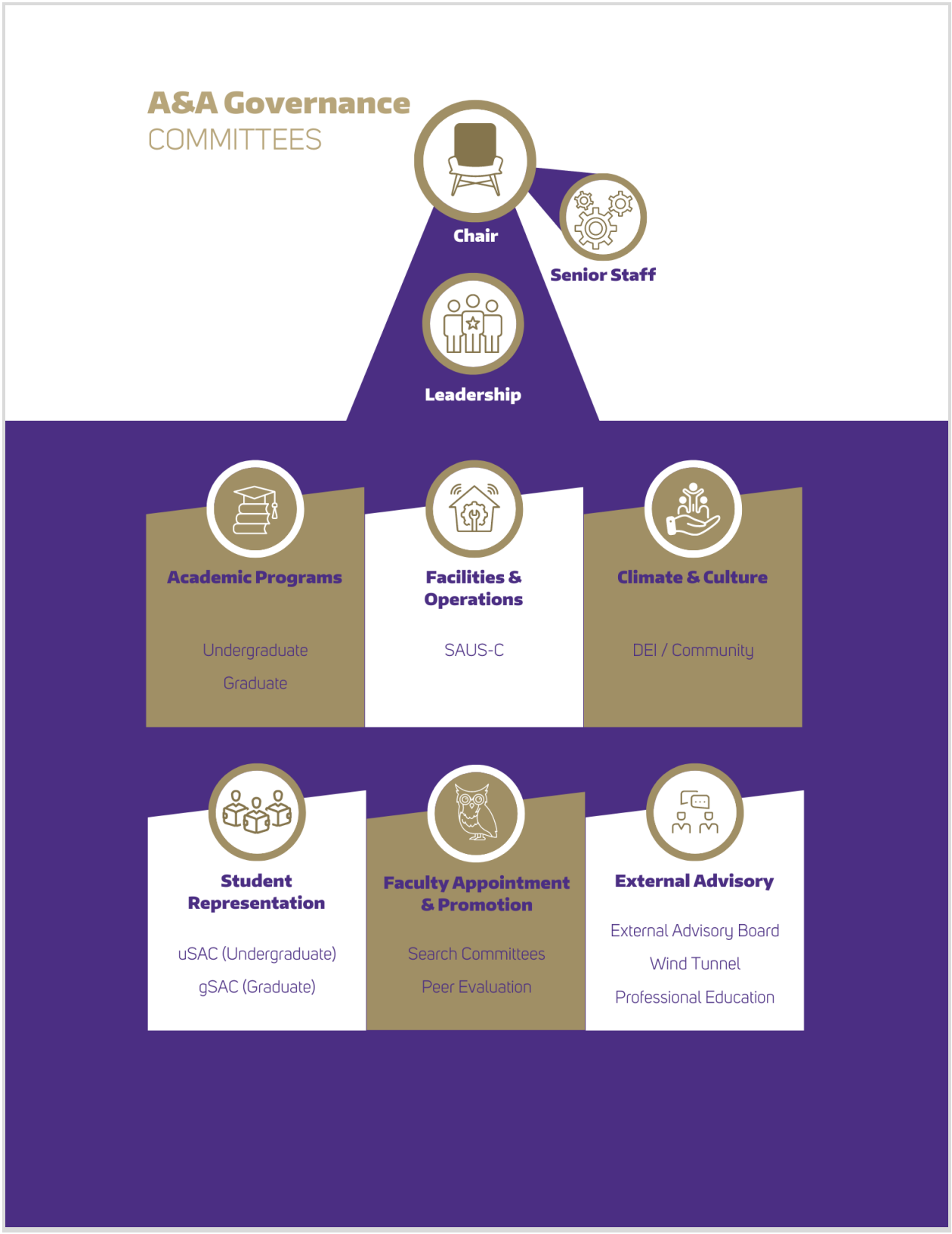
Incorporating teaching faculty into our department has been a great benefit. These faculty are dedicated to particular areas such as early undergraduate education or project-based learning.

PART C: APPENDICES

Appendix A: Organization and Governance



The Administrator directly supervises the following staff positions: Senior Computing Specialist, Grants & Contracts Managers, Space Grant Associate Director, and the Director of Academic Services. The Business Manager of the Wind Tunnels, JCATI Program Manager, Communications Specialist and Communications Manager report directly to the Chair.


A&A Governance
COMMITTEES
Chair
Senior Staff
Leadership
Academic Programs
Undergraduate
Graduate
Facilities & Operations
SAUS-C
Climate & Culture
DEI / Community
Student Representation
uSAC (Undergraduate)
gSAC (Graduate)
Faculty Appointment & Promotion
Search Committees
Peer Evaluation
External Advisory
External Advisory Board
Wind Tunnel
Professional Education

Appendix B: Budget Summary

A&A Department Budget Summary														
									Projections					
as of	9/1/2023	FY17	FY18	FY19	FY20	FY21	FY22	FY23	FY24	FY25	FY26	FY27	FY28	FY29
Beginning Balance (Deficit)		**304,472**	**65,099**	**392,846**	**689,371**	**1,082,970**	**938,859**	**1,307,319**	**696,161**	**307,142**	**329,029**	**561,793**	**387,898**	**531,097**
	Core Funds													
	Reserves													
Core		**4,499,471**	**4,792,390**	**5,150,609**	**5,307,180**	**4,975,984**	**5,585,836**	**5,059,170**	**5,561,017**	**5,955,762**	**6,427,150**	**6,597,934**	**6,895,140**	**7,078,964**
	GOF_Permanent Budget								4,434,084	4,529,244	4,648,592	4,770,327	4,894,497	5,021,151
	GOF_New Funds								95,160	119,348	121,735	124,170	126,653	129,187
	ICR	$376,923	$349,019	$446,646	$433,376	$401,773	$402,263	364706	364,706	372,000	379,440	387,029	394,770	402,665
	PMP (Tuition Based MS & Cert.)	$693,066	$625,475	$600,359	$521,618	$663,434	$918,850	$872,908	383,644	912,587	1,254,800	1,293,824	1,456,637	1,503,379
	Other- Summer/Course Fees								283,423	22,583	22,583	22,583	22,583	22,583
Reserves		**303,882**	**269,962**	**269,269**	**244,636**	**244,022**	**237,544**	**144,439**	**239,020**	**239,020**	**239,020**	**239,020**	**239,020**	**239,020**
	Discretionary Gifts								208,200	208,200	208,200	208,200	208,200	208,200
	Other Gifts								30,820	30,820	30,820	30,820	30,820	30,820
	Other Resources								0	0	0	0	0	0
Revenue Transfers									79,059	278,840	78,617	-11,611	-11,843	-12,080
TOTAL Resources (Authority To Spend)		**4,803,353**	**5,062,352**	**5,419,878**	**5,551,816**	**5,220,006**	**5,823,380**	**5,203,609**	**6,575,257**	**6,780,764**	**7,073,816**	**7,387,135**	**7,510,215**	**7,837,001**
Expenditures		**FY17**	**FY18**	**FY19**	**FY20**	**FY21**	**FY22**	**FY23**	**FY24**	**FY25**	**FY26**	**FY27**	**FY28**	**FY29**
Salaries		3,359,471	2,930,310	2,828,513	3,014,980	2,837,709	3,877,865	4,291,908	4,273,218	4,482,313	4,568,478	4,761,264	4,853,009	4,930,550
Fringe Benefits		989,040	902,962	920,611	919,347	888,147	953,007	1,083,212	1,023,144	1,072,351	1,093,001	1,137,771	1,159,730	1,178,503
Non-Salaries (Operations)		91,794	359,195	408,092	557,673	530,905	608,426	439,646	448,106	457,068	466,210	475,534	485,045	494,746
Total Core Expenditures		**$4,440,305**	**$4,192,467**	**$4,157,216**	**$4,492,000**	**$4,256,761**	**$5,439,298**	**$5,814,766**	**$5,744,468**	**$6,011,732**	**$6,127,690**	**$6,374,570**	**$6,497,784**	**$6,603,798**
Actual Startup Owed by Unit							0	0	472,433	390,333	351,333	258,333	115,000	0
Other Commitments (Actual)							0	0	51,214	49,670	33,000	33,000	33,000	33,000
Planned (New) Initiatives							0	0	0	0	0	333,334	333,334	0
COMBINED TOTAL		**$4,440,305**	**$4,192,467**	**$4,157,216**	**$4,492,000**	**$4,256,761**	**$5,439,298**	**$5,814,766**	**$6,268,115**	**$6,451,735**	**$6,512,023**	**$6,999,237**	**$6,979,118**	**$6,636,798**
							-	-	-	-	-	-		-
	Projected Balance	65,099	392,846	1,139,780	1,082,970	$1,425,261	$1,307,319	$696,161	$307,142	$329,029	$561,793	$387,898	$531,097	$1,200,203

Fiscal Year	Total ICR	Avg Grant Units
2018	$453,499	1.51
2019	$447,268	1.36
2020	$393,758	1.19
2021	$407,666	1.29
2022	$383,694	1.22
2023	$386,266	1.17
GOAL	$600,000	2

Appendix C: Faculty Information

ACCESS ALL OF OUR FACULTY CVs

FACULTY BY RANK AND DISCIPLINE

Note: Emeritus faculty are not listed

Tenure Track

- 10 Professors
    - Behcet Acikmese, Controls
    - Robert Breidenthal, Fluids
    - Dana Dabiri, Fluids
    - Antonino Ferrante, Fluids
    - Jim Hermanson, Fluids
    - Eli Livne, Fluids, Structures
    - Mehran Mesbahi, Controls
    - Kristi Morgansen, Controls
    - Uri Shumlak, Plasma Science
    - Jinkyu Yang, Structures
- 2 Associate Professors
    - Marco Salviato, Structures
    - Bhuvana Srinivasan, Plasma Science
- 4 Assistant Professors
    - Ed Habtour, Structures
    - Karen Leung, Controls
    - Justin Little, Plasma Science
    - Amir Taghvaei, Controls
- 7 of these faculty are adjuncts in the other departments
    - Electrical & Computer Engineering: Behcet Acikmese, Mehran Mesbahi, Kristi Morgansen
    - Materials Science & Engineering: Marco Salviato
    - Mechanical Engineering: Dana Dabiri, Jim Hermanson
    - Mathematics: Mehran Mesbahi
    - Applied Mathematics: Antonino Ferrante
    - eScience Institute: Antonino Ferrante

Non-Tenure Track

- 1 Associate Research Professor: Carl Knowlen, Fluids
- 1 Assistant Research Professor: Owen Williams, Fluids
- 1 Associate Teaching Professor: Erik Hurlen

- 1 Assistant Teaching Professor: Alvar Saenz Otero

Adjunct Faculty

- Alberto Aliseda, Professor, Mechanical Engineering
- Jingwei Hu, Associate Professor, AMATH
- Santosh Devasia, Professor, Mechanical Engineering
- Radha Poovendran, Professor, Electrical & Computer Engineering
- Lillian Ratliff, Assistant Professor, Electrical & Computer Engineering
- David Shean, Assistant Professor, Civil & Environmental Engineering
- Richard Wiebe, Associate Professor, Civil & Environmental Engineering.

Affiliate Faculty from industry, government and outside academic institutions

- Dan Almosino, Affiliate Professor, Independent Consultant
- Pascal Bauer, Affiliate Professor, Ecole National Superieure de Mecanique et d'Aerotechnique, France
- Douglas Chappelle, Affiliate Associate Professor, Boeing
- Mary Cummings, Affiliate Professor, Department of Mechanical Engineering and Materials Science, Duke University
- Robert Dougherty, Affiliate Professor, OptiNav
- Chris Hansen, Affiliate Associate Professor, Columbia University
- Kevin Housen, Affiliate Professor, Boeing
- Chris Lum, Affiliate Associate Professor, Boeing
- Brian McGeer, Affiliate Associate Professor, Aerovel
- Harry McLean, Affiliate Professor, Lawrence Livermore National Laboratory
- Michael Mohaghegh, Affiliate Associate Professor, Boeing
- Marat Mor, Affiliate Associate Professor
- Robert Moses, Affiliate Professor, NASA
- Eric Muir, Affiliate Professor, Boeing
- Kioumars Najmabadi, Affiliate Professor, Boeing
- Chester Nelson, Affiliate Associate Professor, Boeing (retired)
- Mostafa Rassaian, Affiliate Professor, Boeing
- Eckart Schmidt, Affiliate Associate Professor, Consultant
- Steven Stanley, Affiliate Professor, Blue Origin
- Jeffrey Wollschlager, Affiliate Assistant Professor, Altair Engineering
- Rao Varanasi, Affiliate Professor, Boeing (Retired)
- Tony Waas, Affiliate Professor, University of Michigan

MAJOR FACULTY HONORS

Our award-winning faculty include eleven AIAA Fellows and Associate Fellows, an American

Physical Society Fellow, an American Society of Composites Fellow, an American Society of Mechanical Engineers Fellow, three Institute of Electrical and Electronics Engineers Fellows, two elected members of the Washington State Academy of Sciences and five holders of endowed professorships, among other awards.

Air Force Office of Scientific Research (AFOSR)

Young Investigator Research Award (2019)

Justin Little

American Institute of Aeronautics and Astronautics (AIAA)

Fellows

- Behcet Acikmese
- Eli Livne
- Kristi Morgansen

Associate Fellows

- Robert Breidenthal
- Dana Dabiri
- Antonino Ferrante
- Jim Hermanson
- Carl Knowlen
- Mehran Mesbashi
- Uri Shumlak
- Jinkyu Yang

Holt Ashley Award for Aeroelasticity

Eli LIvne (2021)

American Physical Society

Fellow

Uri Shumlak

American Society for Composites

DEStech Young Composites Researcher Award

Marco Salviato (2020)

American Society of Mechanical Engineers

Fellow

Jim Hermanson

Institute of Electrical and Electronics Engineers

Fellows

- Behçet Açıkmeşe

- Mehran Mesbahi
- Uri Shumlak

Controls Systems Society's Award for Technical Excellence
Behçet Açıkmeşe (2019)

International Council for Aeronautical Sciences (ICAS)
Enoch Thulin ICAS Innovation in Aeronautics Award
Eli Livne (2022)

Washington State Academy of Sciences
Elected Members
- Mehran Mesbahi (2023)
- Kristi Morgansen (2021)

Endowed Professorships
- Behcet Acikmese: Professor in Aerospace Optimization and Control
- Karen Leung: Juris Vagners and Linda Christianson Endowed Faculty Fellow
- Eli Livne: Boeing Endowed Professor
- Mehran Mesbahi: J. Ray Bowen Professor for Innovation in Engineering Education
- Kristi Morgansen: Boeing-Egtvedt Endowed Professor

FACULTY HONORS - FULL LIST 2012-2023

UW COE FACET Award	Salviato, Marco	2023
UW COE FACET Award	Yang, JK	2020
US Department of the Army Engineers-Scientist Exchange Program	Habtour, Ed	2018
UW Leadership Excellence Program	Morgansen, Kristi	2017
Computational Science and Engineering (CSE) Fellowship University of Illinois at Urbana-Champaign	Taghvaei, Amir	2017
US Department of the Army Achievement Award, 2015	Habtour, Ed	2015
AIAA Fellow	Acikmese, Behcet	2023
Elected Member, Washington State Academy of Science	Mesbahi, Mehran	2023
AIAA Foundation Board of Trustees Member	Morgansen, Kristi	2023
IEEE Fellow	Shumlak, Uri	2023
AIAA Associate Fellow	Ferrante, Antonino	2022

Juris Vagners and Linda Christianson Endowed Faculty Fellow in Aeronautics & Astronautics	Leung, Karen	2022
The UW + Amazon Science Hub Inaugural Research-Award	Leung, Karen	2022
William F. Ballhaus Prize for Best PhD Thesis	Leung, Karen	2022
Enoch Thulin ICAS Award for Innovation in Aeronautics	Livne, Eli	2022
Boeing Egvedt Endowed Chair for Excellence in Engineering	Morgansen, Kristi	2022
ISS Ntl. Laboratory R&D Innovation Award for STEM Engagement (Zero Robotics)	Saenz-Otero, Alvar	2022
Director of Center of Excellence for Advanced Materials in Transport Aircraft Structures (AMTAS)	Salviato, Marco	2022
NAE Grainger Foundation Frontiers of Engineering Grant for Advancement of Interdisciplinary Research	Salviato, Marco	2022
NSF Planning Grant, Center for Data-driven High-rate Composites Manufacturing	Salviato, Marco	2022
Excellent Reviewer for the Journal of Guidance, Control, and Dynamics	Acikmese, Behcet	2021
IEEE Fellow	Acikmese, Behcet	2021
Early Career Award, Michigan Institute for Plasma Science and Engineering	Little, Justin	2021
AIAA Holt Ashley Award for Aeroelasticity	Livne, Eli	2021
J. Ray Bowen Endowed Professor in Engineering Education	Mesbahi, Mehran	2021
AIAA Fellow	Morgansen, Kristi	2021
Elected Member, Washington State Academy of Sciences	Morgansen, Kristi	2021
National Academy of Engineering U.S. Frontiers of Engineering Symposium Attendee	Salviato, Marco	2021
UW COE FACET Award	Ferrante, Antonino	2020
Member, Sigma Xi Scientific Research Honor Society	Morgansen, Kristi	2020
American Society for Composites 2020 ASC/DEStech Young Composites Researcher Award	Salviato, Marco	2020
AIAA Associate Fellow	Yang, JK	2020
Brain Pool Fellowship, Korea's National Research Foundation	Yang, JK	2020
IEEE Control Systems Society Technical Excellence Award in Aerospace Control	Acikmese, Behcet	2019

UW COE FACET Award	Acikmese, Behcet	2019
UW COE FACET Award	Breidenthal, Robert	2019
AFOSR Young Investigator Program Award	Little, Justin	2019
UW COE FACET Award	Mesbahi, Mehran	2019
Distinguished Speaker, Chinese Control and Decision Conference	Mesbahi, Mehran	2019
Defense Sciences Study Group, Inst. For Defense Analyses	Morgansen, Kristi	2019
American Physical Society Fellow	Shumlak, Uri	2019
Erna and Jakob Michael Visiting Professorship Weizmann Institute of Science	Shumlak, Uri	2019
Plenary Speaker for IEEE International Pulsed Power and Plasma Science Conference	Shumlak, Uri	2019
UW COE FACET Award	Williams, Owen	2019
Inaugural LSAMP Faculty of the Year Award by Louis Stokes Alliance for Minority Participation in STEM (LSAMP)	Yang, JK	2019
Outstanding Paper Award, Sym. NW Chapter of the Society of Flight Test Engineers	Breidenthal, Robert	2018
Robert H. Cannon, Jr., Summer Fellowship Stanford University	Leung, Karen	2018
Qualcomm Innovation Fellowship	Leung, Karen	2018
Faculty Scholar, Lawrence Livermore National Laboratory	Shumlak, Uri	2018
Acoustic Hub Fellowship, Laboratoire d'Acoustique de l'Universite du Maine (LAUM), CNRS, France	Yang, JK	2018
AIAA Associate Fellow	Breidenthal, Robert	2017
US Department of the Army Commander's Award for Civilian Service Medal	Habtour, Ed	2017
Endowed Professorship in Control Systems and Networks.	Mesbahi, Mehran	2017
UW COE Strategic Instruction Initiative Award	Morgansen (Team lead), Dabiri, Hermanson, Lum	2017
ASME Haythornthwaite Young Investigator Award	Salviato, Marco	2017
U.S. Burning Plasma Organization Advisory Council Member to Department of Energy	Shumlak, Uri	2017
AIAA/ASC James H. Starnes, Jr. Award	Waas, Tony	2017
Elected Member, Washington State Academy of Sciences	Waas, Tony	2017
eScience Incubator Program Participant	Williams, Owen	2017
Hangai Prize	Yang, JK	2017

Vehicle Tech Directorate Science Award	Habtour, Ed	2016
Fulbright Program Fellowship	Hermanson, Jim	2016
Meteoritical Society Barringer Medal	Holsapple, Keith	2016
AIAA/ASME Best Propulsion Paper	Knowlen, Carl	2016
Eleanor Sophia Wood Postgraduate Research Traveling Scholarship	Leung, Karen	2016
AIAA Associate Fellow	Mesbahi, Mehran	2016
AIAA Associate Fellow	Morgansen, Kristi	2016
NSF CAREER Award	Narang, Anshu	2016
AIAA Associate Fellow	Shumlak, Uri	2016
UW Greenest Lab Award: ZaP Flow Z-Pinch Lab	Shumlak, Uri	2016
AIAA Structures, Structural Dynamics and Materials Award	Waas, Tony	2016
NSF CAREER Award	Yang, JK	2016
NSF CAREER Award	Acikmese, Behcet	2015
Asian Journal of Control Best Paper Award, US Army Research Laboratory	Acikmese, Behcet	2015
NASA Group Achievement Award for “Successfully demonstrating real-time terrain relative navigation and fuel-optimal trajectory planning on Masten’s Xombie rocket vehicle	Acikmese, Behcet	2015
Arcus Traveling Scholarship, University of Sydney	Leung, Karen	2015
AIAA Fellow	Livne, Eli	2015
IEEE Fellow	Mesbahi, Mehran	2015
AFRL Summer Faculty Fellowship	Acikmese, Behcet	2014
AIAA Associate Fellow	Acikmese, Behcet	2014
NASA Group Achievement Award for “Exceptional performance in two successful test flights on Masten’s rocket vehicle, demonstrating in-flight fuel-optimal trajectory planning and execution capabilities,”	Acikmese, Behcet	2014
Mrs. Elva Rae Talented Mathematics Student Award University of Sydney	Leung, Karen	2014
AIAA PNW Educator of the Year	Morgansen, Kristi	2014
ISS Ntl. Laboratory R&D Space Station Top Results for Biotechnology, Health and Education	Saenz-Otero, Alvar	2014
Samsung Think Tank Team Award, Samsung Research America	Yang, JK	2014
DOE Career Research Program Award	You, Sett	2014
JPL Summer Faculty Award	Acikmese, Behcet	2013
NASA Group Achievement Award for “Exceptional performance in the design, development, fabrication, test, and operation of the Mars Science Laboratory GN&C system	Acikmese, Behcet	2013

UW - University of Ljubljana Scholar	Breidenthal, Robert	2013
Dean of Science Undergraduate Exchange Scholarship, University of Sydney	Leung, Karen	2013
Boeing Endowed Professorship in Aeronautics and Astronautics,	Livne, Eli	2013
Wu Prize for Excellence in Research	Willams, Owen	2013
Best Paper Award, 7th World Congress on BAMN (Biomimetics, Artificial Muscles and Nano-Bio) Conference (2013)	Yang, JK	2013
Royalty Research Fund Award	Ferrante, Antonino	2012
Juniores Prize, Italian Association for Strain Analysis (IASA) for the best conference paper by a single author 35 years old and younger	Salviato, Marco	2012
McGraw Teaching Fellow, Princeton	Willams, Owen	2012
Editors' Choice, Best Paper of the Year, Journal of Biomechanical Engineering, ASME	Yang, JK	2012

Appendix D: Equity & Inclusion Plan

Our Equity & Inclusion Plan and implementation is contained in our

- Diversity, Equity & Inclusion Rubric and Roadmap document
- The DEI Section of our Strategic Plan
- The DEI Tab of our Strategic Plan dashboard

Appendix E: Enrollment and Graduation Statistics

Enrollment during the 1980s was at capacity levels for that time, with 120-140 undergraduates and 120-140 graduate students, with many qualified students turned away. Those levels dropped considerably by the mid-1990s, as a result of the recession the aerospace industry experienced at the end of the cold war. Enrollment in the undergraduate program began to recover in the late 1990s, and enrollment in the graduate programs stabilized in 2000, with significant growth in recent years.

The undergraduate population was roughly constant between 2000 and 2007. Since 2008 enrollment has steadily increased, and in 2011 it is now approximately 29% higher than the 2000-2007 average. Historically, the BSAAE degree program has been an upper-division only (i.e., junior and senior) program. Beginning in the late 1990s, the Department began a process of inviting high-achieving lower-division students to join the Department at the start of their sophomore year as Early Admission students. The number of Early Admits entering the Department increased significantly in 2006, but has been roughly constant since that time.

The College has implemented several advanced admissions processes. The most recent being the Direct to College process which was implemented in Autumn 2018.
This process brings Freshmen into the College of Engineering and places them into departments for their sophomore year. Currently, about 80% of students in the junior class are those who were originally admitted through the Direct to College program and placed into the Department. This program has resulted in an increase in undergraduate enrollment. A similar increase was seen during the experimental admission process, called Advanced Admission, which was initiated by the College of Engineering in 2008 but discontinued in 2011. This process allowed selected students to enter an engineering program of their choice at the end of their freshman year. In 2011 the Department admitted freshmen at the start of their freshman year, this program was discontinued with the start of the Direct to College process.. These various admission data are summarized below.

The fraction of underrepresented (URM) minorities in the A&A undergraduate program, shown in Fig. E-4, fluctuated between 3% and 8% between 2002 and 2007, but decreased beginning in 2008, possibly due to the unfavorable state and national economic conditions. Currently, URM enrollment comprises 16% of the undergraduate enrollment. The enrollment of women increased steadily beginning in the 1990s, and grew to represent about 23% of the undergraduate program in 2004 and 2005. IThen declined from 2005 to 2011 but has grown steadily since to the current level of 23%.

The graduate programs in the department have doubled in size from 150 students in 2011-2012 to an anticipated 311 in Autumn Quarter 2023. The master’s programs have also

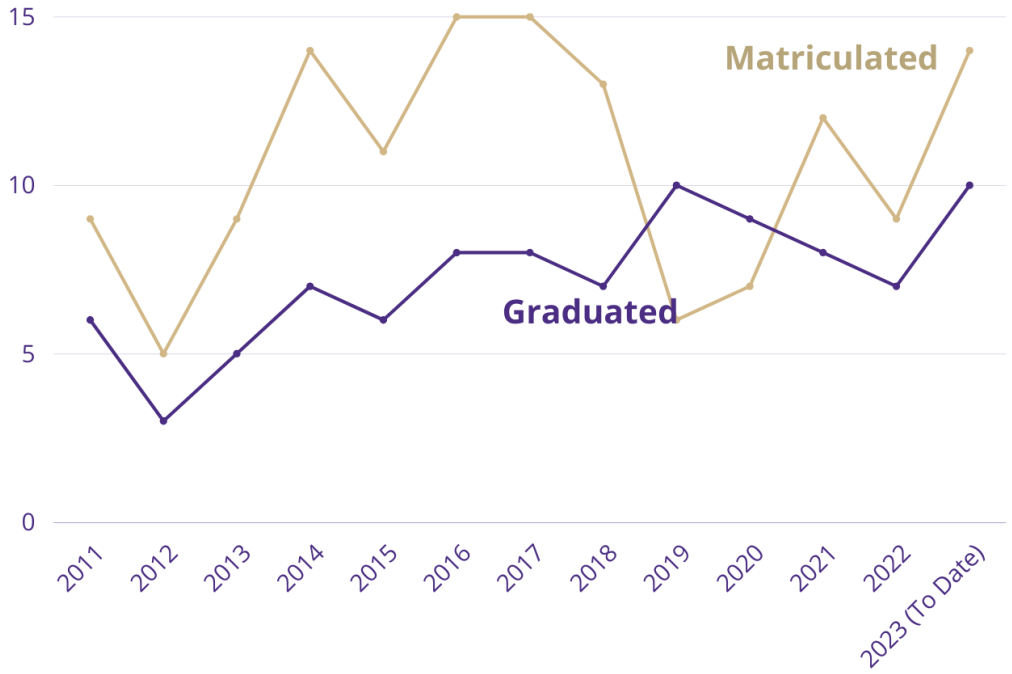
doubled from an enrollment of 107 in 2011-2012 to an anticipated 233 in Autumn Quarter 2023. Much of this growth is due to the large increase in participation in our Professional Masters program (the Masters of Aerospace Engineering), which as of Autumn Quarter 2023 will comprise 74% of all graduate enrollment. The number of PhD students in the Department was 47 in 2011, and has steadily increased in subsequent years. Over the past 5 year period, the PhD program averaged 66 active PhD students. We anticipate this number to be 78 active PhD students as of Autumn Quarter 2023.

Underrepresented minorities in the A&A graduate programs have increased from 10.3% in Autumn 2014 to 12.3% in Autumn 2022. These percentages are higher than the average percentage of URM students across all UW College of Engineering graduate programs during the same time range, which fluctuated between 6.3% and 8.6%. The number of students who self-identify as female in the graduate program increased from 17.4% in Autumn 2014 to 18.1% in Autumn 2022. These percentages are lower than the average percentage of self-identified female students across all UW College of Engineering graduate programs during the same time range, which fluctuated between 28.3% and 35.4%.

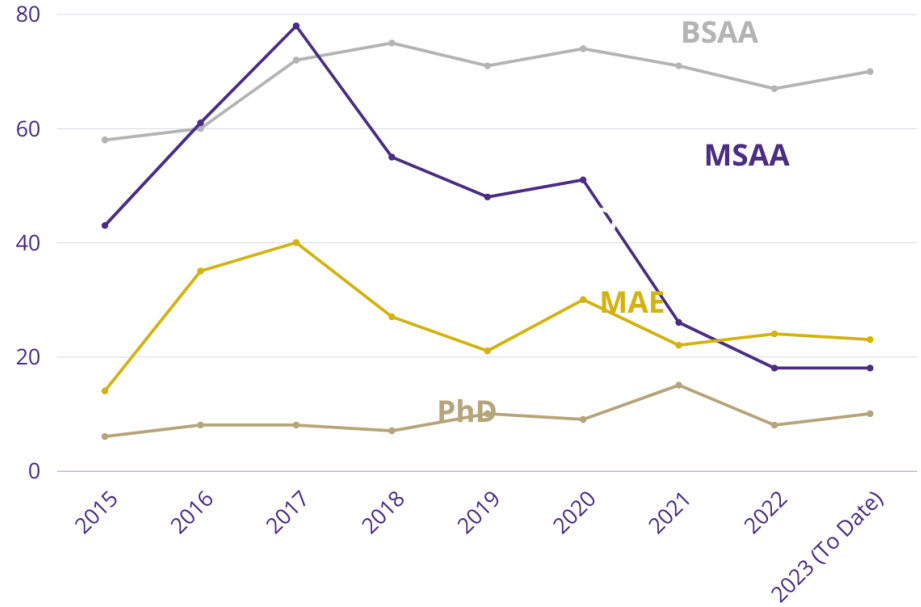
For the admissions cycles 2014-2015 thru 2022-2023, the graduate programs had 284 URM applicants. The Department offered admission to 52% of those applicants (148). 53% (79) of those URM applicants accepted the offer, while 47% (69) declined.

Examining anticipated Autumn 2023 enrollment, as of 9-5-23, 24.25% of our incoming professional masters cohort are URM students, a significantly higher percentage than seen on average for peer disciplines. Across our graduate programs, 18% of our incoming cohort are URM students. 17% of our incoming professional masters cohort self-identify as female, while the percentage is 16% across our graduate programs.

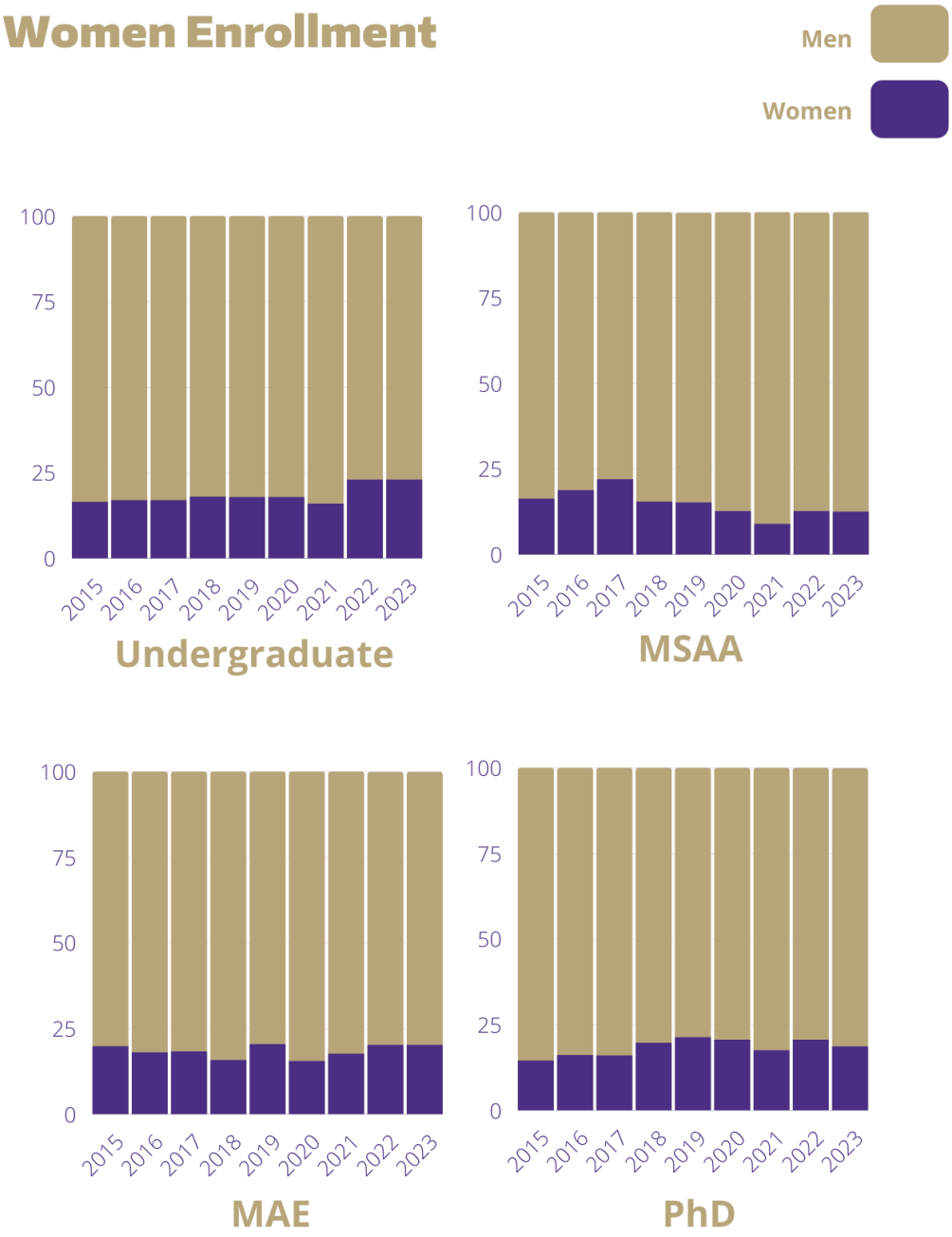
PhD Matriculation / Graduation

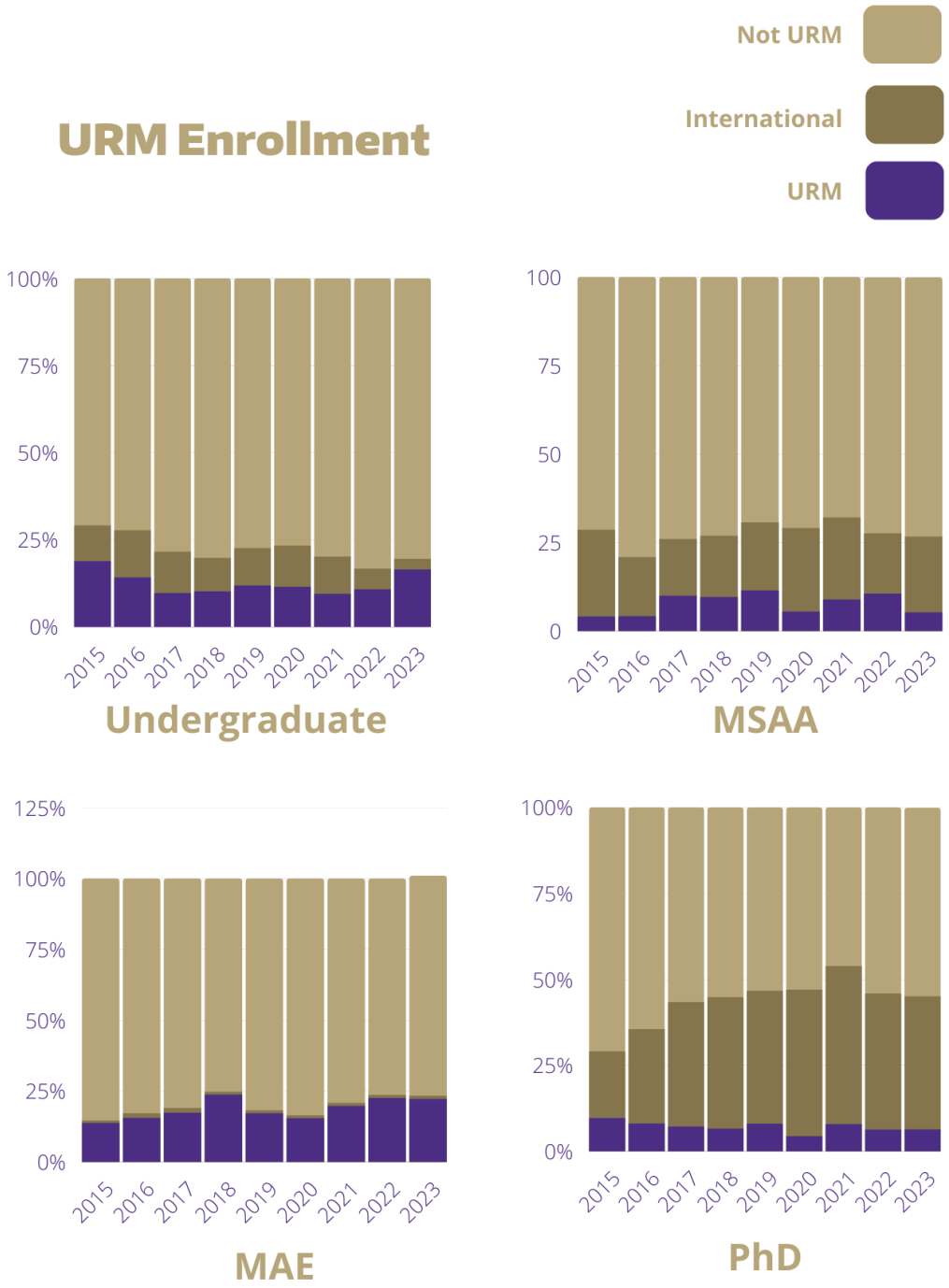


Total Degrees Granted

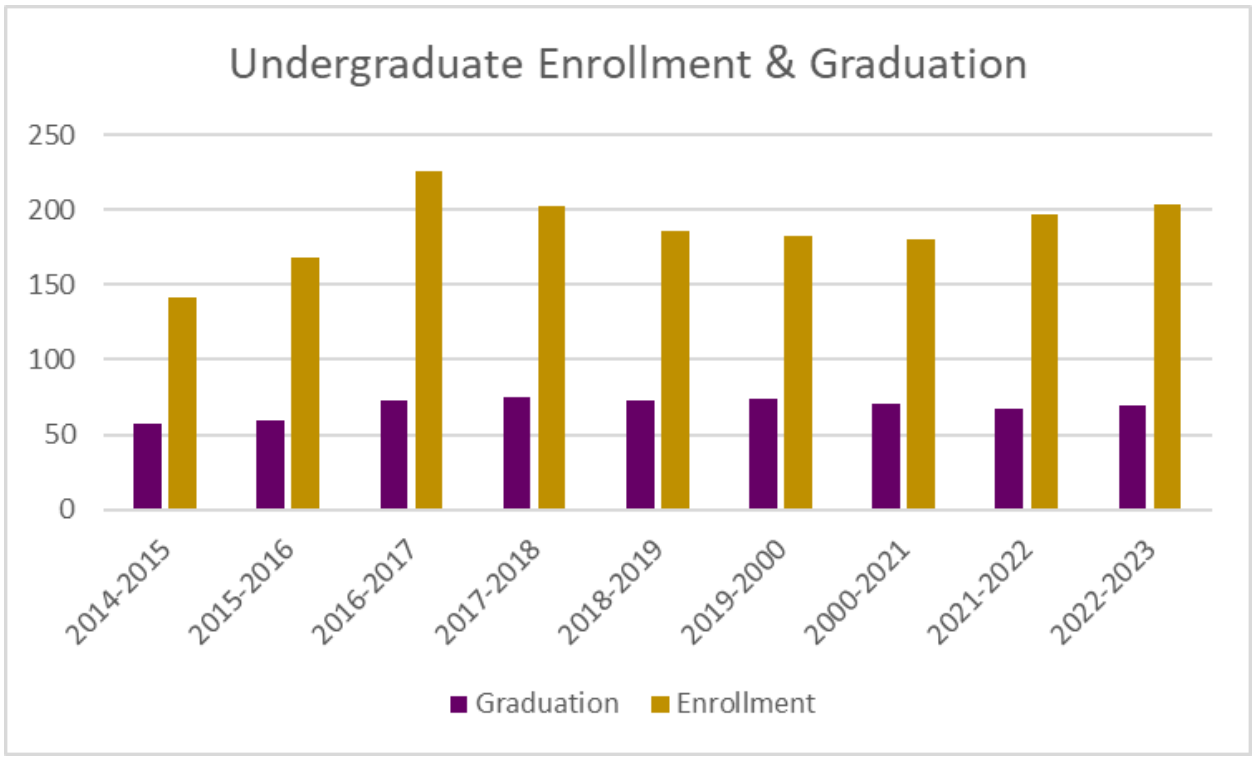


Women Enrollment

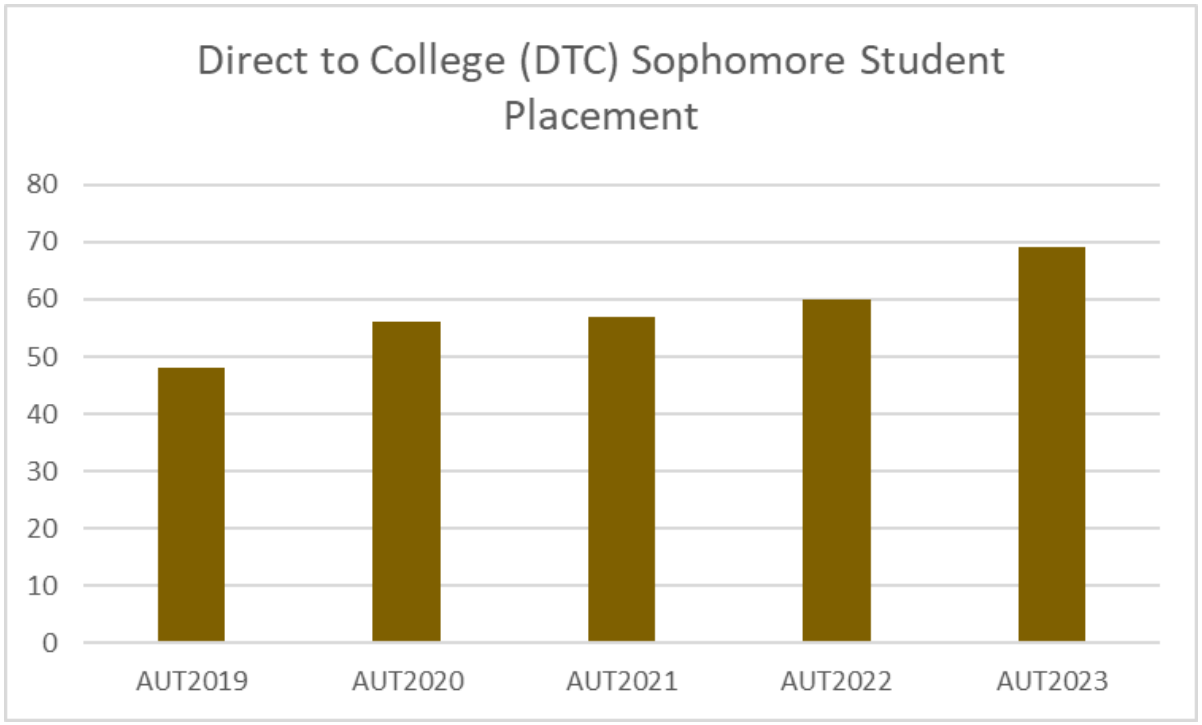




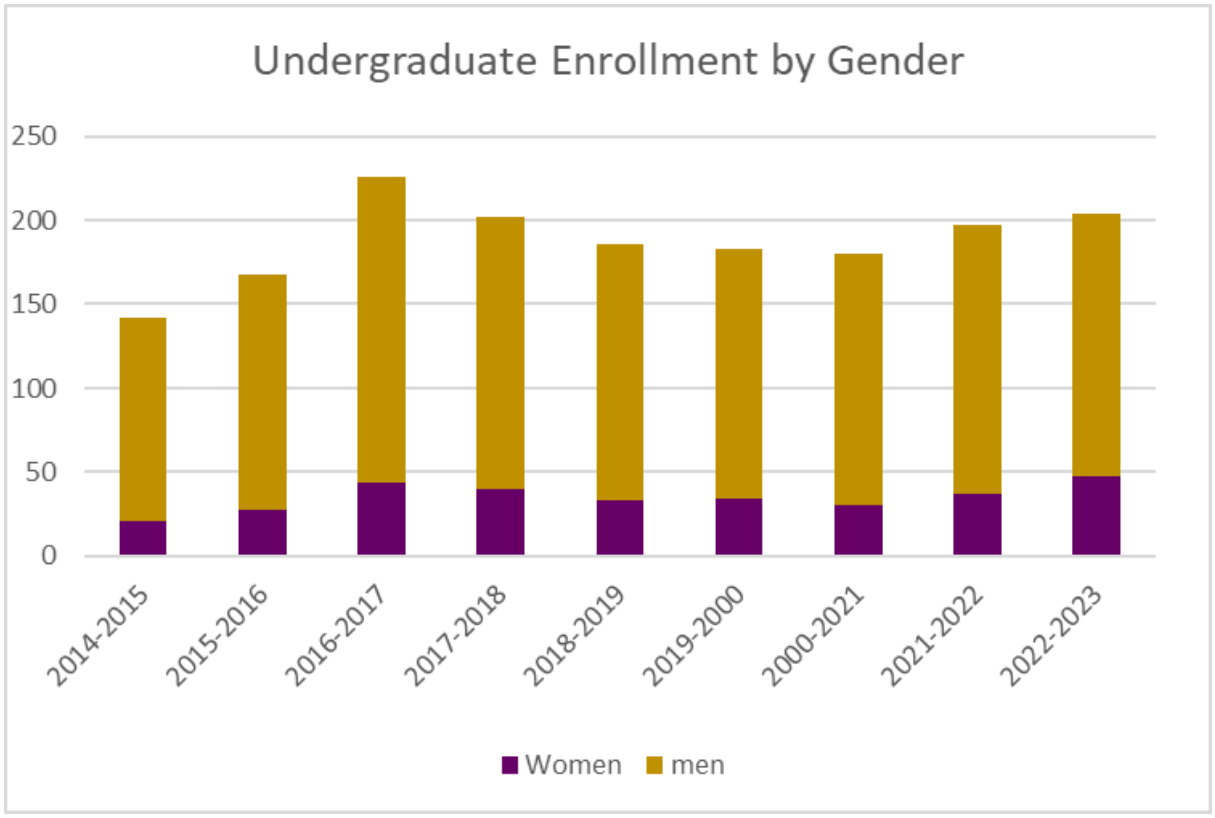
A student at the University of Washington is classified as having Underrepresented Minority (URM) Status if that student identifies with either: a Hispanic/Latino ethnicity, OR one or more of the following racial groups: Hawaiian/Pacific Islander, American Indian/ Alaskan Native, or African-American. This is the same definition that the National Science Foundation uses as well.



Undergraduate Enrollment and Graduation 2014-2023



Sophomore Admissions via Direct to College (DTC) placement, Autumn 2019-2023



Undergraduate Female Enrollment 2014-2023

Appendix F: External Advisory Board Membership

Lars Q. Andersen (BSAAE '68)
Vice President, Advanced 777 Product Development
Boeing Commercial Airplanes (Ret.)

Jason Andrews (BSAAE '94)
President
Spaceflight Industries

Emilio Beltran (BSAAE '99)
Principal Software Engineer
Microsoft

Paul Bevilaqua
Chief Scientist
Lockheed Martin Skunk Works (Ret.)

Suzanna Darcy-Hennemann (BSAAE '81)
Chief Pilot - Director, Flight Training
The Boeing Company (Ret.)

Laila Elias (BSAAE ' 98)
Director, Propulsion Systems Engineering
Boeing Commercial Airplanes

Gary Lai (BSAAE '99)
Senior Director, Program Management
Blue Origin LLC

Andrew Madar
CEO
Aerozon Aviation

Laura McGill (BSAAE '83)
Deputy Laboratories Director - Nuclear Deterrence & CTO
Sandia National Laboratories

Nujoud Merancy (BSAAE '01)
Chief, Exploration Mission Planning Office
NASA

Roger Myers
Chair
Washington State Joint Center for Aerospace Technology

Alex Pietsch
Associate Vice President for Corporate Relations
Washington State University

Alton Romig Jr.
Executive Officer, National Academy of Engineering
Vice President, Advanced Development
Programs Engineering and Advanced Systems
Lockheed Martin (Ret.)

Khaled Shahwan
Sr. Technology Leader – Composites, Methods & Strategies
Global Innovations – Advanced Development Engineering
Fiat Chrysler Automobiles

Rao Varanasi (AA PhD '68)
Chief Engineer, In-Service Structures and Aging Fleet
The Boeing Company (Ret.)

Appendix G: Peer Evaluation Process

A&A's Peer Teaching Evaluation Committee ensures that Section 24-57A of the Faculty Code is followed to ensure peer evaluations are performed on the following schedule:

- Assistant professor, or associate professor or professor "without tenure" shall be conducted every year.
- Associate professor or professor shall be conducted at least every three years.
- Faculty members up for promotion shall be evaluated the quarter before they are reviewed for promotion.

The committee reviews the annual student evaluations, both numerical and written comments, and provides a report with their assessment of teaching effectiveness to each faculty member in the Department. A copy of the evaluation is shared with the Assistant to the Chair to add to the faculty member's official file. The A&A Department Chair receives a quarterly report of progress which will be due the last day of each quarter.

Membership on this committee includes three faculty members of full professor rank as well as the assistant to the Chair to assist with regards to academic human resources and staffing the committee meetings.

The Peer Evaluation Committee requires faculty members up for review to submit the following in advance:

1. Course Content: For all courses taught in the three quarters prior to the evaluation, please, provide for each course
    - A list of prerequisites for the course and:
        - Instructor assessment of whether the pre-requisites as stated in the course catalog are appropriate and sufficient (or not needed) for the course
        - Instructor assessment of whether the students had suitably mastered the prerequisites on entry to the course.
        - Note: 1a and 1b are for Department information only and are not a part of instructor evaluations.
    - Outline of topics covered/mastered by the students in the course
    - The course outline provided at the start of the course
    - Summary chart of which weeks the topics were covered (if not included in the course outline). Include description of significant deviations, if any, from the planned course outline and/or catalog description
    - A description of the homework assigned, including how frequently, and what topics were covered

    - A listing and brief description of the content of assessments (exam, project, etc.) in which the students' mastery was assessed.
    - Course instructional materials such as textbooks, other references or materials
    - Sample lectures, if available (2 for each course), at least two homework assignments; the final exam / project report
    - Examples of graded homework and final exams/project reports (low grades, high grades).
2. Students' Course Evaluations: Attach end-of-quarter student evaluations of all courses covered, conducted according to University guidelines. Student evaluations should consist of Course Summary Reports. What techniques did you use, if any, to obtain high participation by the students in the end of quarter student evaluation of your courses?
3. Taped Lectures: Provide links to one or two representative lectures in at least two of the courses covered.
4. New Courses: Have you developed any new course or educational program in the last three years? If so, please, provide information.
5. Additional Questions
    - What special teaching techniques, other than lecturing at the board, have you tried or are you using in your classroom?
    - What are your strengths and weaknesses as a classroom teacher?
    - What are your strengths and weaknesses in course design, and in course organization and management, including supervising TAs/graders?
    - Have you participated in teaching workshops or used university/college professional teaching improvement services in these courses?
    - Who are the PhD and Master students that you supervised to graduation in the past three years (their stage in the graduate program, research topics, and the titles of completed dissertations)?
    - How many PhD and Master graduate students are you currently supervising (their stage in the graduate program, research topic)?
    - How many undergraduate special projects (like AA499) have you supervised in the past three years?

Appendix H: Alumni Achievements and Awards

Please see the separate appendix document, as this Appendix includes A&A alumni identifying information.

Appendix I: Student Awards 2012-2023

Please see the separate appendix document, as this Appendix includes A&A student identifying information.

Appendix J: Course Changes 2011-2023

Undergraduate major
First and second year courses did not change. These courses are general education and foundational engineering courses.

Junior year courses:

- AA 395 expanded on professional development, works with Advancement to connect with industry
- AA 301 and AA 302 sequence was switched to AA 302, AA 301 sequence
- AA 312 now includes more preparation for AA 447
- AA 447 and AA 460 were flipped between junior year spring and senior year autumn based on industry and student feedback
- AA 331 AA 332 have not changed
- AA 310 and AA 311 have not changed, but content has been reviewed to ensure relevancy
- AA 320 was updated to be arduino compatible during the pandemic, and AA 320, AA 321, and AA 322 are currently under review and waiting to be approved by the faculty.

Senior year courses:

- Capstone preparation course: AA 470 now offered in Autumn rather than Spring
- AA 410/411 shift from one large project for space and one large project for flight to many more projects - now have industry sponsored projects and RSO projects
    - Strong design review process
    - All intended to have hands on product with testing now
    - Increased industry engagement
    - Already set up to scale to increased cohort size

Various tech electives options added for seniors:UGs capable of the material and streamlined teaching resources (better resource management overall)

- AA 430 and AA 516
- AA 406 in response to industry and student interest

Master of Aerospace Engineering

- Shifted classes to evening offerings
- Current courses and content for working professionals based on student and industry feedback (always courses only program)
- Continued evolution of AA 598 MAE Colloquium to address professional development needs and based on student and industry feedback

Master of Science in Aeronautics & Astronautics

- Moved to thesis only from having it be thesis or coursework only (course requirements the same)
- Added Integrated Flight Sciences & Control track

Doctor of Philosophy

- Voted to add a Data Science option within the PhD

Appendix K: Degree Requirements

Bachelor of Science:

To earn a Bachelor of Science in Aeronautical & Astronautical Engineering, you must complete the following requirements. A minimum of 180 credits is required to complete the degree. Completing A&A Core Courses and A&A Capstone Courses out of sequence must be pre-approved by the A&A Undergraduate Committee.

Mathematics (24 credits)

- **MATH 124** Calculus with Analytic Geometry I (5)
- **MATH 125** Calculus with Analytic Geometry II (5)
- **MATH 126** Calculus with Analytic Geometry III (5)
- **MATH 207** ***(formerly MATH 307)*** Introduction to Differential Equations (3)
- **MATH 208** ***(formerly MATH 308)*** Matrix Algebra with Applications (3)
- **MATH 224** ***(formerly MATH 324)*** Advanced Multivariable Calculus (3)

Sciences (25 credits)

- **CHEM 142** General Chemistry (5)
- **CHEM 152** General Chemistry (5) *or* **other Natural Science (*formerly Natural World*) - NSc (5)**
- **PHYS 121** Mechanics (5)
- **PHYS 122** Electromagnetism (5)
- **PHYS 123** Waves (5)

Engineering Fundamentals (20 credits)

- **A A 210** Engineering Statics (4)
- **CEE 220** Introduction to Mechanics of Materials (4)
- **M E 230** Kinematics and Dynamics (4)
- **A A 260** Thermodynamics (4)
- **AMATH 301** Beginning Scientific Computing (4)

Written & Oral Communication (5 credits)

- **English Composition - C (5)**
- *7 additional writing credits are built into A&A core courses* **- W**

Areas of Knowledge Requirements (24 credits)

- **Arts & Humanities (*formerly Visual, Literary and Performing Arts)* - A&H (10)**
- **Social Sciences *(formerly Individuals and Societies)* - SSc (10)**
- **Additional A&H or SSc (4)**
- *3 additional diversity credits are required and can overlap with another areas of knowledge requirements* ***- DIV***
  (*5 diversity credits will be required for students entering the University Autumn quarter 2023)*

A&A Core Courses (46 credits)

- **A A 301** Compressible Aerodynamics (4)
- **A A 302** Incompressible Aerodynamics (4)
- **A A 310** Orbital and Space Flight Mechanics (4)
- **A A 311** Atmospheric Flight Mechanics (4)
- **A A 312** Structural Vibrations (4)
- **A A 320** Aerospace Instrumentation (3) **- W**
- **A A 321** Aerospace Laboratory I (3) **- W**
- **A A 322** Aerospace Laboratory II (3) **- W**
- **A A 331** Aerospace Structures I (4)
- **A A 332** Aerospace Structures II (4)
- **A A 395** Undergraduate Seminar (1)
- **A A 447** Control in Aerospace Systems (4)
- **A A 460** Propulsion (4)

A&A Capstone Design Courses (8 credits)

Select one sequence:

- **A A 410** Aircraft Design I (4)
- **A A 411** Aircraft Design II (4)

OR

- **A A 420** Spacecraft and Space Systems Design I (4)
- **A A 421** Spacecraft and Space Systems Design II (4)

A&A Technical Electives (15 credits)

Choose from the following:

- **A A 402** Viscous Fluid Mechanics (3)
- **A A 405** Introduction to Aerospace Plasmas (3)
- **A A 406** Electric Propulsion (3)
- **A A 419** Aerospace Heat Transfer (3)
- **A A 448** Control Systems Sensors and Actuators (3)
- **A A 461** Air Breathing Propulsion (3)
- **A A 462** Rocket Propulsion (3)
- **A A 470** System Engineering (4)
- **A A 516** Stability and Control of Flight Vehicles (3)
- **A A 532** Mechanics of Composite Materials (3)
- **A A 540** Finite Element Analysis I (3)
- **A A 498** Special Topics (may only be used when pre-approved by the department)
- **A A 499** Undergraduate Research (up to 6 credits of A A 499 & ENGR 321 may be used)
- **ENGR 321** Engineering Internship Education (up to 6 credits of A A 499 & ENGR 321 may be used)

Free Electives (13 credits)

Choose from the following:

- Additional coursework in any subject area not used elsewhere in degree.

Minor in Aeronautics and Astronautics:

Minor Requirements (32 credits minimum)

- A A 210 Statics (4)
- CEE 220 Mechanics of Materials (4)
- M E 230 Kinematics and Dynamics (4)
- A A 260 Thermodynamics (4)
- A A 310 Orbital and Space Flight Mechanics (4)*
- A A 311 Atmospheric Flight Mechanics (4)*
- Approved Electives (8)

Approved Electives

- A A 301 Compressible Aerodynamics (4)*
- A A 302 Incompressible Aerodynamics (4)*
- A A 312 Structural Vibrations (4)*
- A A 331 Aerospace Structures I (4)*
- A A 332 Aerospace Structures II (4)*
- A A 402 Fluid Mechanics (3)*
- A A 405 Introduction to Aerospace Plasmas (3)*
- A A 406 Electric Propulsion (3)*
- A A 419 Aerospace Heat Transfer (3)*
- A A 430 Finite Element Analysis I (3)*
- A A 447 Control in Aerospace Systems (4)*
- A A 448 Control Systems Sensors and Actuators (3)*
- A A 460 Propulsion (4)*
- A A 461 Advanced Air Breathing Propulsion (3)*
- A A 462 Rocket Propulsion (3)*
- A A 470 Systems Engineering (4)*
- A A 516 Stability and Control of Flight Vehicles (3)*
- A A 532 Mechanics of Composite Materials (3)*
- ESS 471 Introduction to Space Physics (3)
- ESS 472 Rockets and Instrumentation (2-4)

Master of Aerospace Engineering:

The 45 required MAE credits are distributed among an analytical methods course, prescribed core area courses, technical breadth electives, and a weekly professional development colloquium.

Analytical Methods (4 credits): All MAE students are required to take A E 501 Analytical Methods for Aerospace Engineering in their first quarter in the MAE program.

Core Area (20 credits): Students must formally declare a concentration by the end of their first year in the program. Each concentration corresponds to a set of five required core courses. (see below)

Technical Breadth (12 credits): Students must complete three breadth electives outside their concentration. Students may choose to complete all three breadth requirements within a single area or may choose to take breadth electives in multiple areas.

Professional Development (9 credits): Every quarter, the department will offer a weekly professional development seminar: A E 598 Aerospace Engineering Colloquium. MAE students are required to enroll in the colloquium every quarter.

CONCENTRATION REQUIRED COURSES

Controls

- AE 510 Linear Systems Theory (4)
- AE 511 Classical Control Theory (4)
- AE 512 Dynamics, Stability, & Control of Vehicles (4)
- AE 513 Multivariable Control (4)
- AE 514 Estimation Theory (4)

Fluids

- AE 520 Fluid Dynamics (4)
- AE 521 Aircraft Propulsion (4)
- AE 522 Rocket Propulsion (4)
- AE 523 Aircraft Noise (4)
- AE 524 Computational Methods in Aerodynamics (4)

Structures

AE 540 Mechanics of Solids (4) (required)

Take 4 out of the 5 following classes:

- AE 541 Finite Element Methods (4)
- AE 542 Fatigue & Fracture (4)

- AE 543 Structural Vibrations (4)
- AE 544 Additive Manufacturing (4)
- AE 550 Mechanics of Composites (4)

Composites

- AE 550 Mechanics of Composites (4)
- AE 551 Aerospace Composite Design I (4)
- AE 552 Aerospace Composite Design II (4)
- AE 553 Advanced Composite Structural Analysis (4)
- AE 554 Manufacturing of Aerospace Composites (4)

Master of Science in Aeronautics and Astronautics:

The MSAA degree requirements are distributed among the following categories.

1. Analytical: An approved sequence consisting of 3 graduate-level analytical/math courses. (~15 credits)

2. Core Coursework: A minimum of 5 graduate-level aerospace courses appropriate to their area of concentration. (~15 credits)

3. Breadth Electives: 2 courses outside their area of concentration. These courses must come from two different areas. (~6 credits)

4. Master's Thesis: While completing a thesis, students must enroll in AA 700, "Master's Thesis." (9 credits minimum)

Recommended Breadth Electives (not an exhaustive or complete list)

Controls Courses (for non-Controls students)
AA 447-Controls in Aerospace Systems
AA 516-Stability and Control of Flight Vehicles
AA 528-Spacecraft Dynamics and Control

Fluids Courses (for non-Fluids students)
AA 504-Compressible Fluid Mechanics
AA 507-Incompressible Fluid Mechanics
AA 543- Computational Fluid Dynamics of Compressible Flows

Plasma Courses (for non-Plasmas students)
AA 405-Intro to Aerospace Plasmas
AA 529-Space Propulsion

Structures Courses (for non-Structures students)
AA 530-Mechanics of Solids

AA 532-Mechanics of Composite Materials
AA 540-Finite Element Analysis I

Interdisciplinary Course (for non-IFSC students)
AA 527-Space Power Systems

Controls analytical and core:

Core Courses

- AA 516 Stability and Control of Flight Vehicles
- AA 547 Linear Systems Theory
- AA 548 Linear Multivariable Control
- AA 583 Nonlinear Control Systems

Selective Courses (choose one)

- AA 528 Spacecraft Dynamics and Control
- AA 549 Estimation and System Identification
- AA 550 Nonlinear Optimal Control
- AA 580 Geometric Methods for Nonlinear Control Systems
- AA 581 Digital Control System Design
- AA 582 Introduction to Discrete Event Systems
- AA 585 System Identification and Adaptive Control
- AA 593 Feedforward Control
- AA 594 Robust Control
- AA 597 Networked Dynamic Systems

Analytical Courses

- AA 510 Mathematical Foundations of Systems Theory
- AMATH 561 Introduction to Probability and Random Processes
- AMATH 582 Computational Methods for Data Analysis

Fluids analytical and core:

Core Courses

- AA 504 Compressible Fluid Mechanics
- AA 507 Incompressible Fluid Mechanics
- AA 543 Computational Fluid Dynamics of Compressible Flows

Selective Courses (choose two)

- AA 501 Advanced Gas Dynamics
- AA 503 Continuum Mechanics

- AA 506 Vortex-dominated Flows
- AA 508 Turbulence
- AA 524 Aeroacoustics
- AA 525 Advanced Airbreathing Propulsion
- AA 544 Computational Fluid Dynamics of Incompressible Flows

Analytical Courses

- AMATH 501 Vector Calculus and Complex Variables
- AMATH 503 Methods for Partial Differential Equations

AND ONE OF

- AMATH 581 Scientific Computing
- AMATH 582 Computational Methods for Data Analysis
- AMATH 584 Applied Linear Algebra and Introductory Numerical Analysis

Integrated Flight Sciences and Control analytical and core:

Aerodynamics Core Courses

- AA 507 Incompressible Fluid Mechanics
- AA 598 Applied Aerodynamics

Structures Core Courses

- AA 538 Introduction to Structural Optimization
- AA 554 Aeroelasticity
- M E 588 Dynamics and Vibrations

Controls Core Courses

- AA 516 Stability and Control of Flight Vehicles
- AA 547 Linear Systems Theory
- AA 548 Linear Multivariable Control

Analytical Core Courses

- AA 510 Mathematical Foundations of Systems Theory
- AMATH 503 Methods for Partial Differential Equations
- AMATH 561 Introduction to Probability and Random Processes

Plasmas analytical and core:

Core Courses

- AA 405 Introduction to Aerospace Plasma
- AA 556 Space and Laboratory Plasma Physics
- AA 557 Physics of Fusion Plasmas
- AA 558 Plasma Theory
- PHYS 543 Electromagnetic Theory

Analytical Courses

- AMATH 501 Vector Calculus and Complex Variables
- AMATH 502 Introduction to Dynamical Systems and Chaos
- AMATH 503 Methods for Partial Differential Equations

OR

- AMATH 581 Scientific Computing
- AMATH 582 Computational Methods for Data Analysis
- AMATH 584 Applied Linear Algebra and Introductory Numerical Analysis

Structures analytical and core:

Core Courses

- AA 530 Mechanics of Solids
- AA 532 Mechanics of Composite Materials
- AA 540 Finite Elements Analysis I
- AA 553 / ME 588 Vibrations of Aerospace Systems

Selectives Courses (choose one)

- AA 531 Quasi-Brittle Fracture Mechanics and Scaling
- AA 535 Advanced Composite Structural Analysis
- AA 538 Introduction to Structural Optimization
- AA 541 Finite Element Analysis II
- AA 554 Aeroelasticity
- AA 598 Structural Health

Analytical Courses

- AMATH 501 Vector Calculus and Complex Variables
- AMATH 502 Introduction to Dynamical System and Chaos
- AMATH 503 Methods for Partial Differential Equations

Doctor of Philosophy (PhD):

The Doctor of Philosophy (PhD) requires a minimum of 90 credits.

Graduate Fundamentals, MSAA, or Post-Master's "Doctoral Residency" Credits: The first one to two years of the PhD program will be organized based on the degree pathway a student chooses, with guidance from their research advisor. Each student will choose one of the following pathways:

1. **MSAA**

- Many students choose to complete the MSAA en route to their PhD. With appropriate planning and progress, completing an MSAA en route to a PhD does not usually extend a student's time-to-degree.
- To pursue this option, students should plan to complete all MSAA degree requirements. PhD students completing an MSAA are encouraged to complete a master's thesis and to complete most (if not all) of their MSAA coursework before taking the Qualifying Exam.

2. **Graduate Fundamentals**

- Students who do not wish to complete a master's degree en route to the PhD will complete the same graduate fundamental coursework as MSAA students. However, they will not complete a thesis and will not receive a Master's degree from our department.
- Students are advised to refer to the pre-approved MSAA concentration courses for guidance when choosing depth courses. However, doctoral students should work directly with their faculty advisor to identify the depth coursework that is most appropriate for their field of study and research.

3. **Post-Master's Doctoral Residency Credits**

- If you enter the PhD program after previously earning a related master's degree then you may be eligible for post-master's status. You will need to submit a Petition for Post-Master's Status.
- If your petition is approved then the Graduate Fundamental coursework is waived and you will complete a minimum of 9 doctoral residency credits before taking the Qualifying Exam. Please consult with your faculty advisor regarding which courses to take.

2. **Qualifying Exam:** The Qualifying exam should be taken as soon as possible after completing pathway option 1, 2, or 3. Students are generally expected to take the Qualifying Exam during their second year in the PhD program. Doctoral students who do not pass the qualifying exam by the end of their third year of graduate study will be subject to unsatisfactory progress policies.

3. **Establish Doctoral Supervisory Committee**: Doctoral Supervisory Committees should be established as soon as possible after the Qualifying Exam. At the latest, the committee must be in place *the quarter before* the General Exam may be scheduled. The Chair of a student's Doctoral Supervisory Committee must hold an appointment in the A&A Department. (Adjunct faculty appointments are

sufficient.) Students must notify the department's graduate program advisors as soon as they have their committee membership finalized.

4. **Doctoral Coursework:** After successfully passing the Qualifying Exam and establishing a Supervisory Committee, PhD students must complete additional coursework (9 credits minimum) to prepare for the remainder of the PhD.

   Students should consult directly with their faculty advisor to determine which courses to take. These courses should serve to prepare the student for passing the General Exam as well as developing and completing a doctoral dissertation.

5. **General Exam:** When ready to focus primarily on dissertation research, students must undertake (and pass) the General Examination under the supervision of their Doctoral Supervisory Committee. General Exams are to be taken *at least one year after the Qualifying Exam* and *at least one year before the Final Exam*. Students must also complete a minimum of 60 credits of graduate-level work (including a minimum of 18 numerically graded 500-level credits) before a General Exam may be scheduled.

6. **Dissertation:** After passing the General Exam, students become PhD Candidates and are expected to focus primarily on completing their doctoral dissertation. While completing a dissertation, students must enroll in A A 800, "Doctoral Dissertation" (27 credits minimum). Final completion of the dissertation will require identifying a Doctoral Dissertation Reading Committee.

7. **Final Exam:** When a student and their committee are satisfied that the dissertation has been successfully completed, the student must schedule and pass the Final Exam. Final Exams should be scheduled *at least one year after the General Exam*

Graduate Certificates:

Graduate Certificate in Dynamics and Control:
This certificate requires 16 Credits

- AE 501 Analytical Methods for Aerospace Engineering (4)
- AE 511 Classical Control Theory (4)
- AE 512 Dynamics, Stability, and Control of Vehicles (4)
- AE 597 Introduction to Systems Engineering (4) (pending final approval)

Graduate Certificate in Modern Aircraft Structures (pending):
This certificate requires 16 Credits

- AE 501 Analytical Methods for Aerospace Engineering (4)
- AE 540 Mechanics of Solids (4)

- AE 544 Additive Manufacturing (4)
- AE 550 Mechanics of Composite Materials (4)

Graduate Certificate in Aircraft and Aerospace Composite Structures (pending):
This certificate requires 16 Credits

- AE 501 Analytical Methods for Aerospace Engineering (4)
- AE 554 Manufacture of Aerospace Composites (4)
- AE 544 AE 544 Additive Manufacturing (4)
- AE 5## Experiential course (pending)

Appendix L: Facilities, Equipment & Other Resources

General Resources

The William E. Boeing Department of Aeronautics and Astronautics (A&A) provides and supports a wide variety of state-of-the-art facilities for research and instructional use, housed in four buildings. This includes The Aerospace and Engineering Research Building (AERB) (26,055 sq ft), Guggenheim Hall (40,990 sq ft), Aerodynamics Laboratory (1,794 sq ft) and Kirsten Wind Tunnel (14,577 sq ft). These four buildings provide 83,416 sq feet of net assignable space. Guggenheim and AERB provide significant laboratory space to support new and ongoing research initiatives and interdisciplinary efforts. Both buildings were designed to facilitate interaction—both purposeful and serendipitous. The design provides for plentiful breakout areas, reservable meeting spaces big and small, classrooms, and seminar rooms to nurture a sense of community and to foster collaborations among students, faculty, staff and visitors.

Wind Tunnels

The William E. Boeing Department of Aeronautics and Astronautics has two wind tunnels available for instruction and research.

3x3 Low-Speed Wind Tunnel (Aerodynamics Laboratory)

The 3x3 Low Speed Wind Tunnel is an open-loop facility capable of 135 mph (60m/s flows). It is housed within the historic Aerodynamics Laboratory that was built in 1917 to house the first wind tunnel in the northwest that was funded by donations from Boeing Aircraft Company. The current wind tunnel is heavily used by undergraduate students for their laboratory projects throughout the school year.

Tunnel specifications include:

- Wind speeds: 15-60 m/s (34-135 mph)
- Test section: 3’x3’x8’
- 9:1 contraction rate

Kirsten Wind Tunnel

In 1934, Professor F. K. Kirsten promoted the idea of a wind tunnel for aeronautical research tests. He arranged funding for construction from Washington State, the Public Works Administration, and The Boeing Company. The building was designed by Bebb and Gould and was constructed in 1936 for $124,501.

The Kirsten Wind Tunnel is a subsonic wind tunnel located on the central Seattle campus of the University of Washington. It operates as an auxiliary enterprise led by a staff engineer/manager as well as a crew of undergraduate employees who gain practical experience by running tests.

The operating entity that provides services is the University of Washington Aeronautical Lab (UWAL). The UW Board of Regents approved naming the physical facility the Kirsten Aeronautical Laboratory to honor Professor F. K. Kirsten in 1948, although "Kirsten Wind Tunnel" gets more usage than "Kirsten Aeronautical Laboratory."

Tunnel Specification include:

- Air Speeds - 5-200 MPH (90 m/s, 295 ft/s)
- Dynamic Pressures - 0.07-100 psf
- Flow Angularity Upflow = -0.012°, Crossflow = 0.0°
- Turbulence Intensity 0.72%
- Test Section 8'tall, 12'wide, 10'long (2.44x3.66x3.05m)
- External Balance Limits
    - Lift: ±2500 lbs ±11120 N
    - Drag: ±250 lbs ±1112 N
    - Side: ±250 lbs ±1112 N
    - Pitching: ±5000 in-lbs ±564.9 N-m
    - Yawing: ±5000 in-lbs ±564.9 N-m
    - Rolling: ±5000 in-lbs ±564.9 N-m
- Model Positioning -fully automated pitch and yaw accurate to ±0.02°

Instructional Resources

The Aeronautics and Astronautics Department has a number of resources to support instruction including three classroom labs (1,167 sq ft), a machine shop (2,309 sq ft), composite lab (597 sq ft), an antenna for CubeSat related tasks and six additional designated student work/storage spaces for practice- based learning activities both within curriculum and as extracurricular activities.

A&A added an additional ten workbenches for practice-based learning activities to support a growing cohort of students. In addition, the College of Engineering is currently building the Interdisciplinary Engineering Building (IEB) which will relieve pressure on departmental facilities across the College, and provide flexible space to strengthen connections between the UW and industry and expand career opportunities for students.

Composites Lab

The Composites Lab provides a space for students and researchers for layups and composites manufacturing. This space is dedicated to taking the theoretical knowledge learned in a classroom environment and applying it to real-world solutions.

Machine Shop

The A&A Charlie Bossart Machine Shop maintains a variety of fabrication and testing equipment for students and researchers. These resources help students learn by doing, allowing them to put into practice concepts from the classroom.

The Shop is staffed by professional engineers and trained graduate student assistants. The Shop staff train users, keep equipment in working order and consult on projects.

Capabilities include:

- CNC 3-axis milling, CNC 2-axis milling, CNC 2-axis turning, CNC waterjet cutting
- Manual milling and turning
- Traditional rough cutting, grinding and drilling
- Electronics soldering
- FDM 3D printing materials include ABS, PLA, PETG, TPU, PEEK, PC, ULTEM
- 100 kn Load frame testing

- Precision measuring table surface, height gauges, and other traditional precision measuring tools.
- Walk-in freezer composites storage
- Composites curing oven
- Platen heat press
- 4'x8' composites layup table
- 12 student project workbenches
- Fume hood

Computing Resources
A&A also has purchased a share of nodes for Hyak: a shared scalable compute cluster for research. Hyak is part of integrated, scalable, scientific super computing infrastructure developed centrally at the University of Washington. It includes the lolo tapearchive system, a high-performance research network, the Hyak computing infrastructure, the HPC clusters, and any scientific support services to make this useful in research workflow. The network supports fast data transfers among these systems and between them and the rest of campus.

Off Campus Resources
A&A also currently leases space both for a flight arena and at a field in Carnation, Washington for testing.

Flight Arena at Bowman
Bowman is located off-campus near University Village. A&A has a caged flight arena (982 sq ft) available for research and instructional purposes.

Carnation Site
A&A currently rents an outdoor test site (Carnation Farms, 28907 Carnation Farms Rd, Carnation, WA 98104), a large grass field located in Class G airspace providing an ideal environment for safely operating a wide variety of drones.