

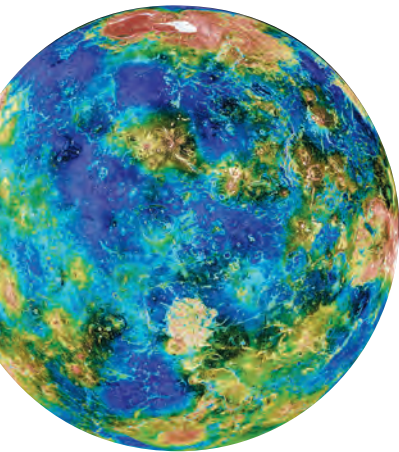
UNIVERSITY of WASHINGTON

WILLIAM E. BOEING

# DEPARTMENT OF AERONAUTICS & ASTRONAUTICS



**From the development of advanced autonomous vehicles and systems to new aerodynamic techniques, novel space propulsion concepts, and lightweight aerostructures and materials, the faculty and students of the William E. Boeing Department of Aeronautics & Astronautics are shaping the technologies that will drive air and space flight in the 21st century.**



## OUR MISSIONS



### LAUNCHING CAREERS

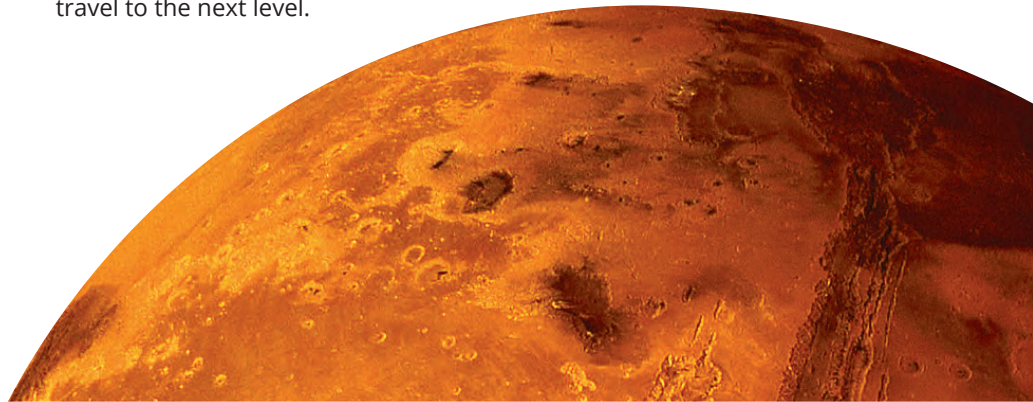
Educating tomorrow's aerospace leaders is our highest priority. Our graduates find employment throughout the aerospace industry. From Boeing to NASA our alumni pursue successful careers in diverse sectors of the economy.

### HARNESSING THE POWER OF INVENTION

Our students and faculty push the boundaries of air and space flight every day. From exploring the mechanics of biological flight to testing new designs for more durable, lightweight structures, research in our department is opening doors to cutting-edge technology that will define the future of air and space travel. Our faculty members are leaders in education, economic development, and industry collaboration, and our students routinely show themselves to be the future leaders in both industry and academia—making our department and the University of Washington proud.

### CROSSING BOUNDARIES

The history of air and space flight is filled with contributions from our faculty and students. Established as a department in 1929 and offering instructional classes in aeronautics as early as 1918, the William E. Boeing Department of Aeronautics & Astronautics was one of the first of its kind in the nation. Interdisciplinary work is the key to our department's continued growth. Our students and faculty foster a collaborative environment with partnerships across campus, with other universities, and with industry to take air and space travel to the next level.



# DEGREE PROGRAMS ///////////////

**Bachelor of Science (BSAAE)** - prepares students for graduate work or careers in the aerospace industry

**Master of Science (MSAA)** - research-oriented program prepares students for careers in industry and government, or for further graduate studies toward a PhD

**Master of Aerospace Engineering (MAE)** - multidisciplinary, professionally oriented part-time degree program prepares students for advanced careers in industry

**Doctor of Philosophy (PhD)** - trains engineers for research leadership roles in academia, industry, and research institutions

## UNDERGRADUATE EDUCATION

### PROGRAM FEATURES

- Strength in core fundamentals
- Knowledge integration and application through hands-on laboratory experience and world-class senior design capstone
- Real-world focus on teamwork, communication and problem solving, systems analysis, interdisciplinary collaboration, leadership, and creativity

### STUDENT DEMOGRAPHICS

- 56 BSAAEs awarded in 2014
- 147 current undergraduates, 15% women, 18% underrepresented minorities

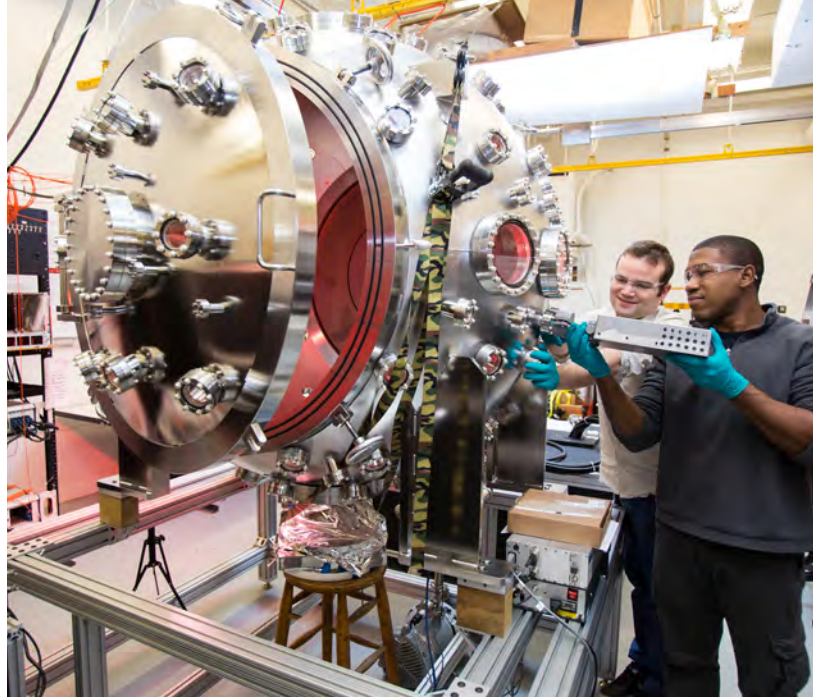
## GRADUATE EDUCATION

### PROGRAM FEATURES

- Graduate concentrations available in: Controls, Fluids, Plasmas, Structures, and Composites
- Thesis and dissertation research opportunities for cutting edge, interdisciplinary work
- Available research and teaching assistantships, supplementary stipends

### STUDENT DEMOGRAPHICS

- 52 graduate degrees awarded in 2014 (11 MAE, 34 MSAA, and 7 PhD)
- 2014 graduate enrollment included 16% women, 10% underrepresented minorities, and 12% international students
- 250 graduate students enrolled in 2014



## STUDENT EXCELLENCE

- Department of Energy Office of Science Graduate Research Fellow
- National Defense Science and Engineering Graduate Fellow
- Air Force Research Laboratory Space Scholar
- Department of Defense SMART Scholar
- 3 College of Engineering Dean's Fellows
- Amelia Earhart Zonta International Fellow
- National Science Foundation Graduate Research Fellows

## FACULTY

### COMPOSITION

- 20 core tenured and tenure-track faculty and 4 research faculty
- 7 faculty adjunct with other UW engineering and science departments
- 25 affiliate faculty representing industry and outside research institutions
- 9 post-doctoral research associates

### EXCELLENCE & LEADERSHIP

- More than \$6.8M in Research Awards in 2014-2015
- Executive Director: Washington State Joint Center for Aerospace Technology Innovation (JCATI)
- President: University Fusion Association
- Editor-in-Chief: AIAA Journal of Aircraft
- Multiple Early Career Awards from NSF and Dept. of Energy

# RESEARCH AND INNOVATION

## TECHNOLOGICAL CONTRIBUTIONS

- **Autonomous Vehicles and Systems** – An A&A team helped develop the Aerosonde, the first UAV to cross the Atlantic (1998), and continues to work on designs for mini-UAV systems and vehicles for a multitude of applications.
- **Aerospace and Energetics** – World-renowned research developed key elements of high-power gas-dynamic lasers and advanced technologies for generating space and terrestrial energy.
- **Fluid Dynamics** – Innovations in novel 2D/3D velocimetry methods, multi-phase flow research, supersonic fuel injection, microgravity, shock-induced cooling in supersonic jets, vortex dynamics, turbulent mixing, computational fluid dynamics and combustion.
- **Composite Aerostructures** – Pioneering research in aerospace applications concerning smart materials and structures, structural health monitoring, damage tolerance and durability of composite structures, computational modeling of progressive damage and failure of composite structures, structural stability, aerothermoelasticity, multi-disciplinary optimization and nano-composites.
- **Plasma Science and Controlled Fusion** – Experimental and computational research on plasma science and controlled fusion, with particular emphasis on advanced alternative fusion concepts has applications in fusion energy and advance space propulsion.
- **Propulsion** – Contributions include the development of the ram accelerator, a chemically-propelled hypervelocity mass launcher based on the ramjet principle, and development of advanced plasma propulsion technologies for space exploration.

## AREAS OF IMPACT

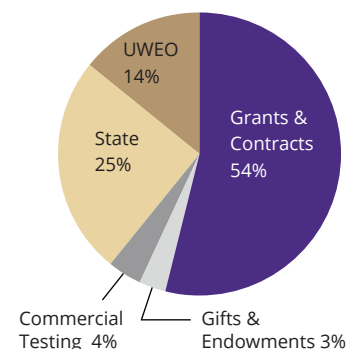
- Guidance and control systems
- Advanced composite materials and structures
- Aerodynamics and fluid mechanics
- Computational fluid dynamics
- Combustion and hypervelocity accelerators
- Microgravity science
- Autonomous vehicles and systems
- Space and terrestrial energy systems
- Plasma dynamics and fusion reactors
- Air breathing and space propulsion
- Multidisciplinary design optimization
- Flight systems integration
- Planetary science
- Damage and failure theories for composites
- Aeronautical design and testing

## MAJOR FACILITIES

- **Kirsten Wind Tunnel** – World-renowned subsonic facility with an 8-foot by 12-foot test section that produces highly accurate results.
- **Computational Fluid Mechanics Laboratory** – Fundamental research in single and multi-phase as well as multi-species turbulent flows, with applications to internal and external aerodynamics and propulsion.
- **Autonomous Flight Systems Laboratory** – Research in guidance, navigation, and control (GN&C) of UAVs, with integration into the department’s flight mechanics and controls courses, providing students with the experience of realistic GN&C systems.
- **Plasma Science and Innovation (PSI) Center** – Theoretical support for plasma research including extended magnetohydrodynamic (MHD) numerical codes to predict capabilities for fusion power experiments.
- **Robotics, Aerospace, and Information Networks (RAIN) Laboratory** – Multi-faceted research in the areas of guidance, control, and estimation for single and distributed systems; theoretical underpinnings of networked systems; and optimization and control.
- **Nonlinear Dynamics and Control Laboratory** – Research focuses on nonlinear, single and multi-vehicle autonomous systems, with particular focus on bio-inspired, underwater and air vehicles.
- **3D Printing Laboratory** – Research on the performance of 3D printed structures for aerospace applications.
- **Composite Structures Laboratory** – Fundamental research on the progressive damage and failure of advanced composite aerostructures including the characterization of high rate response, multi-axial load states and blast response.
- **Advanced Dynamics, Validation & Control Research Laboratory** Investigating dynamical modeling and analysis tools to address the multiple temporal, spatial and nonlinear nature of increasingly autonomous systems.

## ANNUAL OPERATING BUDGET FY15 (\$12.5M)

SOURCE	AMOUNT
Grants & Contracts	\$6,768,688
Gifts & Endowments	\$344,078
Commercial Testing	\$475,254
State	\$3,149,442
UWEO	\$1,764,369
<b>TOTAL</b>	<b>\$12,501,831</b>



## RECENT A&A DISTINGUISHED ALUMNUS HONOREES



### **Dennis Muilenburg, MS 1990**

Dennis Muilenburg is president and chief executive officer of The Boeing Company. Muilenburg joined Boeing in 1985, previously serving as president and chief executive officer of Boeing Defense, Space & Security. Prior to this, he held a progression of program management and engineering positions on a broad range of large-scale programs, including JAST/ASTOVL, F-22, AFX, EX surveillance platform, 747 Airborne Laser,

Advanced Tactical Fighter, High Speed Civil Transport, and the Condor reconnaissance aircraft and a number of proprietary programs. He also is a Fellow of the American Institute of Aeronautics and Astronautics (AIAA) and a Fellow of the Royal Aeronautical Society.



### **Gregory Johnson (Captain US Navy Ret.), BS 1977**

Gregory Johnson ("Ray J") attended the U.S. Air Force Test Pilot School after graduating from UW A&A. In 1990, Johnson accepted a position as an aerospace engineer and research pilot with NASA's Johnson Space Center Aircraft Operations division. Johnson was selected by NASA as an astronaut in June 1998. He served as the pilot for the final space shuttle mission to the Hubble Space Telescope in 2009.

Johnson is currently a management astronaut assigned as the acting chief, aircraft operations and is a qualified T-38 instructor pilot, T-38 examiner pilot, T-38 functional check flight pilot, WB-57F high altitude research pilot and KC-97 Super Guppy instructor pilot.



### **Dana Andrews, BS 1966**

After graduating from the UW, Dana Andrews attended California Institute of Technology where he received an MS in Aeronautics & Astronautics. He later received a PhD in Aeronautics & Astronautics from Stanford University. Andrews spent 34 years at The Boeing Company, serving on projects such as the X-33/RLV program, Boeing habitation module for the International Space Station and the aero-assisted orbital transfer vehicle.

After retiring from Boeing, Andrews became chief technology officer of Spaceflight (formerly Andrews Space). He is an affiliate professor in the William E. Boeing Department of Aeronautics & Astronautics.



### **Lars Andersen, BS 1968**

After working at Pratt and Whitney Aircraft Engines, Lars Andersen began his career at Boeing in 1973 where he worked on the 7X7, 707/CFM-56 re-engine, 757, and the 7J7 programs, and received a U.S. patent for a noise-suppression engine exhaust mixer. In 1989, Andersen joined the 777 program as chief engineer for the Extended Range Twin Operations (ETOPS). In 2000, he became vice president of the 777 program. After retiring in

2007, he was called back to serve as the vice president of 777 Product Development, where he works closely with the CEO. He is an active participant on the Boeing Senior Advisory Group.

## A&A STUDENTS IN THE SPOTLIGHT



**Saghar Hosseini** entered the doctoral program in 2011 after receiving her MS from the University of California-Irvine. She has made significant contributions in the area of energy optimized aerospace systems that improve civilian applications such as search and rescue missions, forest fire containment and environmental monitoring. Hosseini is the recipient of the 2014 Zonta International Amelia Earhart Fellowship.



**Derek Sutherland** is a PhD student in plasma physics and fusion energy, working in the steady inductive helicity injected torus (HIT-SI) research group. Sutherland joined A&A in 2012 after completing his BS in nuclear science and engineering and physics from MIT. He plans to develop fusion energy into a feasible energy source and fossil fuel alternative. He was recently named as one of *Forbes Magazine's* "30 under 30" for his contributions to energy research.



**Navdeep Sandhu** has been on the Dean's List since his freshman year at the UW. As a senior, he is the recipient of the Dale & Marjorie Myers Scholarship and serves as the outreach coordinator for the UW AIAA Student Chapter. He is interested in fluid mechanics, and has worked in our Ram and Shockwave labs and interned in the Boeing Flight Test Instrumentation group. Sandhu plans to attend graduate school before pursuing an engineering career.



**Melanie Clark** works on unmanned systems in the Autonomous Flight Systems Lab and is on the recovery team for the student chapter of the Society for Advanced Rocket Propulsion. She has interned at an aeroacoustics company where she worked on a NASA SBIR project to design and manufacture wind tunnel models. Clark is the recipient of the Peter S. Christie Endowed Scholarship and plans to pursue both design and systems engineering after graduation.

