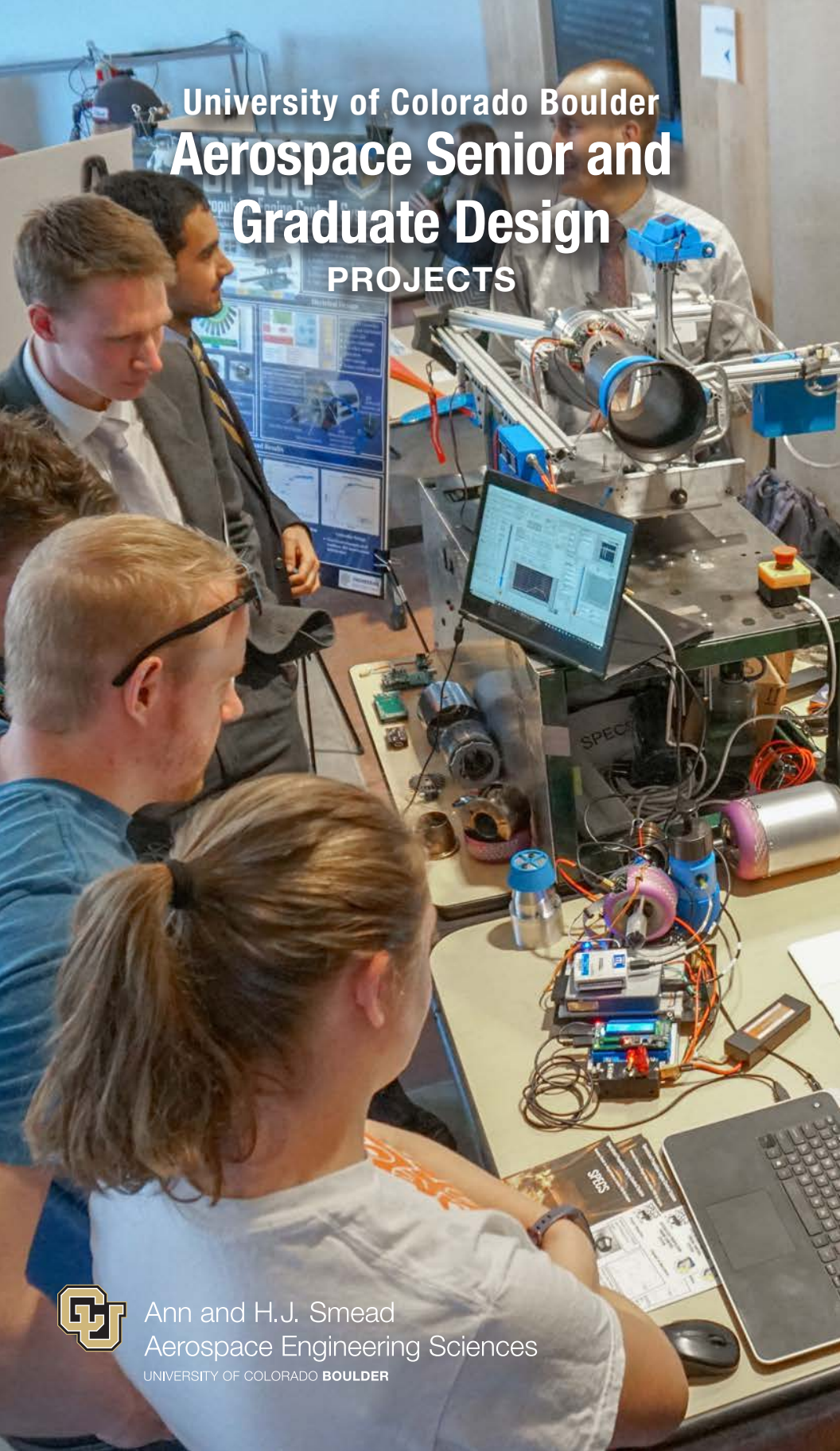

University of Colorado Boulder

Aerospace Senior and Graduate Design PROJECTS

Ann and H.J. Smead
Aerospace Engineering Sciences
UNIVERSITY OF COLORADO **BOULDER**

"If you look across Lockheed Martin you will find Smead Aerospace graduates working in critical technical and leadership roles in the country's most important programs. Their extraordinary technical competence, combined with visionary leadership and an entrepreneurial spirit, are the reasons we hire them."

Steve Jolly
Director and Chief Engineer, Commercial Civil Space
Lockheed Martin Space

Aerospace Senior and Graduate Design
PROGRAMS

The University of Colorado Boulder Smead Aerospace Engineering Sciences Senior and Graduate Design Programs provide an innovative educational opportunity for students to gain team-based experience on real-world aerospace projects.

In the required two semester AES senior projects course, student teams utilize systems engineering principles to tackle an open-ended design problem which requires integration of multiple sub-systems. Throughout this process students apply fundamental engineering principals they have learned in the AES curriculum to design, fabricate, integrate, and test an aerospace system.

At the graduate level, Master's and PhD students have the option to enroll in an advanced projects course that builds upon senior design and offers sponsors additional flexibility in project structure, duration, and complexity.

Senior Design How it Works

- 10-12 students per team.
- Projects are developed and scoped by AES faculty members to tackle an aerospace problem of national interest.
- All projects have open-ended design space, multiple key performance parameters, require integration across sub-systems, and include both software and hardware design.
- Teams elect a program manager and systems engineer and develop a work breakdown structure with sub-teams.
- Teams are advised weekly by their faculty advisor.
- Teams present two design reviews per semester to a project advisory board, which is comprised of AES faculty members.
- 1st semester: Teams scope the project mission/CONOPs, define requirements, conduct trade studies, and utilize modeling and prototyping techniques to develop a detailed design.
- 2nd semester: Teams focus on manufacturing, integration, and test of their design. At the end of the semester during the AES Projects Symposium, teams present hardware demonstrations and verification and validation results to sponsors and department stakeholders.
- Resources: Teams have access to a machine shop, electronics shop, composites shop, 3D printing and prototyping shop, engine test cell, and static and vibrational testing equipment. In addition to AES faculty, machining, safety, electronics, testing, and software technicians support student teams.

Sample Projects

Build a high-fidelity hybrid reality simulation incorporating tactile and visual immersion to provide accurate astronaut training for geology-focused extravehicluar activities (EVAs) at the lunar South Pole.
Develop a communications system of uncrewed aerial vehicles with enhanced automation of aircraft energy and mission management to aid first responders in RF denied environments.
Design a cislunar space transportation infrastructure at a systems-of-systems level and mitigate risk through multi-objective optimization and a hardware demonstration.


KURT

Award Winning Senior Projects

AIAA SciTech Forun International Student Conference - Team Category
1st Place: 2023 & 2017

AIAA Region Five Student Paper Conference - Team Category 1st Place: 2022, 2020, 2019, 2017, 2016

Society of Allied Weight Engineers International Paper Conference 1st Place: 2019

Sponsor a Senior Project

- Interested parties should email **AESSeniorProjects@colorado.edu** to receive a Notice of Intent Form and additional information on becoming a sponsor.
- A sponsorship contract and fee are finalized in spring and early summer. The sponsorship fee is allocated to a senior project funds pool that covers materials, parts, software, senior projects support staffing, and labor fees for all projects.
- All sponsor funding directly supports the senior projects program.

Sponsor Benefits

- **Workforce development through direct support of hands-on, project-based education with a top aerospace department.**
  - Faculty-advised student teams work on exciting aerospace problems of national interest.
- **Have the option to mentor a student team.**
  - Mentors meet with teams weekly or monthly to give technical, program management, and career guidance. Mentors can interact with students and closely assess potential future employees.
- **Attend the design reviews of any student team and gain exclusive and early access to top talent.**
  - All sponsors receive a senior projects dossier in early September with information on project teams and the review schedule. The first design review occurs in late September.
  - Attend the Senior Projects kick off night (early September) and the AES Projects Symposium (April).
- **Promote and elevate your company brand -** sponsors are highlighted on AES Senior Projects Website and at the spring projects symposium.


LOCKHEED MARTIN
NASA

Graduate Design How it Works

The Graduate Projects program expands and builds upon the possibilities of senior design and offers sponsors additional flexibility in project structure, duration, and complexity.

It exposes graduate students to engineering project work, project management, systems engineering, and subsystem-level design and testing. Projects must be related to one (or more) of five graduate research focus areas:

- Astrodynamics and Satellite Navigation Systems
- Autonomous Systems
- Bioastronautics
- Fluids, Structures and Materials
- Remote Sensing, Earth and Space Science

Differences from Senior Design

- Timeline - Can vary significantly, from one semester for a human spaceflight mockup to 3 to 4 years for a flight-ready CubeSat.
- Team Size - 5 to 15 students, based on project needs.
- Must align with faculty research.
- Exploratory, proof-of-concept, and design-ready products can all be quite successful as Graduate Projects.

Sponsoring a Project

- Interested in sponsoring a graduate design project? Contact Chris Koehler, Graduate Projects Coordinator at Koehler@colorado.edu.

Sample Graduate Projects

GROUP	SPONSOR	PROJECT	SPECIFICATIONS/GOALS
TALOS	Lockheed Martin	Lunar Lander Mockup	Build a mockup of a two person lunar lander and provide human factors testing results.
MLI	L3Harris	Deployable Multi-Layer Insulation	Design collapsible insulation for a deployable boom and test in a thermal vacuum chamber.
MAXWELL	Air Force Research Laboratory	Enhanced RF Communications and Navigation CubeSat	Build and launch the first cubesat to utilize CDMA radio communication.

The Ann and H.J. Smead Department of Aerospace Engineering Sciences is pushing the limits of aeronautics and astronautics research, designing next generation uncrewed aircraft, expanding the possibilities of remote sensing, bioastronautics, and building space instruments and satellites for orbit around Earth and beyond. We are home to 56-tenure track, research, and instructional faculty, over 500 graduate students and 1,000 undergraduates.

The department houses four research centers and receives over $40 million annually in sponsored research awards. Leading research centers are in astrodynamics, structures and materials, bioastronautics, and uncrewed aerial vehicles.

Prof. Kathryn Wingate, Senior Projects Course Coordinator
303-735-7631
Kathryn.Wingate@colorado.edu

Prof. Chris Koehler, Graduate Projects Course Coordinator
303-492-7814
Koehler@colorado.edu

Prof. Hanspeter Schaub, Department Chair
303-492-2767
Hanspeter.Schaub@colorado.edu

Claire Yang, Industry and Alumni Relations Manager
303-492-2940
Claire.Yang@colorado.edu

colorado.edu/**aerospace**

The MinXSS CubeSat graduate project (center) flies free after leaving the CubeSat Deployer on the International Space Station (upper right).

MinXSS was designed and built by students and flew a successful, year-long mission studying solar flares and their impact on Earth's upper atmosphere.