The AeroSpace Ventures Initiative

Aerospace Engineering Sciences
University of Colorado Boulder

Presentation for CEAS Admin Council
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Aerospace Engineering Sciences Research Areas

- Astrodynamics and satellite navigation (10)
- Structures and materials (7)
- Vehicle systems (UAS) - aerodynamics, systems, controls (9)
- Bioastronautics (5)
- Remote sensing, Earth & space sciences (12)

Many faculty members involved in more than one research area
CU Boulder AS3E Research Initiative

In 2008, CU-Boulder launched a wide-ranging research and education thrust through the AeroSpace Systems Science and Engineering Initiative (AS3E) that seeks to address some of the most challenging and critical problems in earth and space science as well as create stronger connections between engineering and the sciences. The initiative will combine climate and environmental research conducted from Earth orbit with space weather research, planetary exploration astronomy and astrophysics. AS3E brings together scientists from three departments - aerospace engineering sciences, astrophysical and planetary sciences, and atmospheric and oceanic sciences - under one interdisciplinary umbrella.

One of the key elements of the initiative is a planned $40 million Aerospace and Energy Systems Building that will enable student/faculty and engineering/sciences interactions and provide an incubator for small-scale space system development. Graduate fellowship and educational programs in the initiative offer expanded opportunities for interdisciplinary graduate student research. Joint faculty appointments will be placed strategically to enhance cross-discipline interaction. An executive committee of leaders from each of the participating units oversees the development and outcomes of the initiative.

http://www.colorado.edu/research/research-initiatives
AeroSpace Ventures Vision

CU Boulder’s AeroSpace Ventures Initiative creates a collaborative environment where aerospace engineering and earth and space science faculty, students and industrial researchers work together to solve complex problems that lead to new discoveries in space, weather, and climate.
Relevant Core Competencies

Academic Departments

• Aerospace Engineering Sciences (AES) – unmanned aircraft systems, small satellites, dynamics and controls, orbit determination, GNSS, LIDAR, remote sensing, and near space science
• Atmospheric and Oceanic Sciences (ATOC) – weather and climate science, renewable energy, oceanography, satellite remote sensing, atmospheric chemistry, boundary layer dynamics, clouds and aerosols
• Astrophysical and Planetary Sciences (APS) – space and planetary science, plasma science

Research Institutes

• Laboratory for Atmospheric and Space Physics (LASP) – Solar, planetary, atmospheric, and space plasma science; satellite and instrument engineering – mechanisms, UV sensors, optical imaging, energetic particle sensors, dust detection, electric and magnetic field measurements in space; large mission and project management; mission operations and data systems
• Cooperative Institute for Research in Environmental Sciences (CIRES) – Remote sensing data analysis, algorithm development, process modeling, regional climate modeling
Value Proposition

CU Boulder’s AeroSpace Ventures combines aerospace vehicle innovations and science discoveries for local and global measurements to advance solutions in climate, weather, and space environments.

Collaborations among AES, ATOC, APS, CIRES and LASP will:

• Develop unmanned aircraft systems for challenging environments
• Integrate science into the design of small satellite systems
• Design new sensors for Earth and space environments
AeroSpace Ventures in Research

AeroSpace Ventures will fully integrate engineering and science disciplines to address problems of the 21st century society:

• **Space Situational Awareness** - With increased reliance on satellites for Earth observation, communications, and navigation, and a growing population of debris, we need more accurate and efficient predictions of ionospheric activity, satellite orbital decay and risk of collisions. Ground and space-based sensors for tracking, improved models of the near-space environment, and innovative strategies for space weather prediction and debris removal will reduce these risks.

• **Severe Weather and Climate** - Accurate and timely prediction of the onset and evolution of severe weather events like hurricanes and tornados is needed to save lives and avoid costs associated with unnecessary evacuations. In-situ measurements from UAS combined with small satellite-based remote sensing will dramatically improve the fidelity of models & predictions.

• **Global Water Cycle** - Measurements of ice, snow, soil moisture, and sea level provide critical input for observing, modeling, and predicting changes in climate, drought, flooding. By integrating ground-based, airborne, and satellite measurements with LIDAR, GPS, and passive microwave sensing technologies we will be able to construct a complete picture of the global distribution of water.
AeroSpace Ventures in Education

The academic departments and institutes in AeroSpace Ventures will collaborate to enhance student learning with the following objectives:

• Emphasize hands-on experiences for graduate and undergraduate students
• Introduce engineering perspectives to science students and engage engineering students in Earth and space sciences.
• Offer multidisciplinary courses integrating science and engineering disciplines (e.g., grad projects with science & engineering components)
• Engage students in vertically-integrated project teams of undergraduate and graduate students, postdocs, industry professionals, and faculty
• Produce broadly-educated, interdisciplinary, agile, team-oriented graduates who will become practicing engineers and scientists with end-to-end mission and systems perspectives
• Involve K-12 students in STEM outreach to build pipeline of future students.
AeroSpace Ventures in Industry

AeroSpace Ventures will collaborate with industry and government laboratories resulting in outcomes that are beneficial in the following ways:

- Develop a workforce prepared for complex, multidisciplinary problem solving
- Conduct hands-on graduate projects targeted at industry needs
- Capture new projects and programs through collaborations with industry
- Conduct joint research projects with industry that lead to new scientific and engineering innovations in space situational awareness, severe weather warnings, and global water cycle
- Increase technology transfer
  - Transition research to operations
  - Incubate and commercialize viable new technologies through eSpace: The Center for Space Entrepreneurship
The Building - Moving Forward Requires a New Facility

- AES faculty members have collaborated successfully with faculty in other departments, universities, institutes, and industry, but on an individual basis. The purpose of AeroSpace Ventures is to take these collaborations to the next level, specifically by creating an environment where aerospace engineers and atmospheric, ocean, & space scientists can interact with mutual intent and purpose to solve complex problems.
- Improved and expanded facilities are required to enable the AES department, faculty, staff, and students to flourish and build on current success.
- Our research projects require integration and test facilities, clean rooms, computational labs, and a wind tunnel.
- With growing enrollments, our undergraduate and graduate project classes require larger and better facilities.
- Co-locating scattered faculty, students, staff, and equipment would have an immediate and profound impact on collaborations within the department and with AeroSpace Ventures partners.
- Visibility and recognition of AES excellence would be raised by having a departmental home.
“Understanding the complex, changing planet on which we live, how it supports life, and how human activities affect its ability to do so in the future is one of the greatest intellectual challenges facing humanity.... Fundamental improvement is needed in the structure and function of the nation’s observation and information systems to inform policy choices about the economy and security, protect human health and property, and judiciously manage the resources of the planet.”  - National Research Council, 2007

“Although there are no NASA centers in Colorado, its importance to our nation’s civil space programs cannot be overstated.” – Aerospace Industries Association, December 2012
Current activities

• Diane Dimeff is directing the effort to move things forward with marketing and information, engaging other campus units, industry and state economic development

• Jeff Thayer is leading efforts to expand interdepartmental collaborations primarily with ATOC and LASP so far. Identifying major research opportunities that build on past individual projects

• About 2/3 AES faculty involved in projects that have potential for these collaborations

• CU Foundation (Jessica Wright and Melinda Seevers) actively involved in development for the facility and programs
Questions for Admin Council

- We welcome expanded CEAS participation – is there interest?
- Location – pros & cons of moving to East Campus?
- Is the campus-wide executive committee as defined for AS3E necessary? Is it a good idea?
- Joint faculty positions I think should initially be for small satellite and UAV engineers/scientists. What is the best way to start this process? When?
- Any advice about how to be successful in development/fundraising?