

ASEN 6519
HUMAN OPERATION OF AEROSPACE VEHICLES

Fall 2017
Tuesday/Thursday 8:00-9:15am
Room FLMG 103

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Course Description

This 6000 level graduate student course is aimed at examining the fundamental issues associated with human operation of aerospace vehicles. The approach is a mixture of theoretical, quantitative, and experimental, emphasizing human-centered engineering principles. Topics range from theoretical models of human information processing and decisions, physiological limitations of the human (particularly spatial orientation illusions), the design of display and control interfaces, and the evaluation of those interfaces for human interaction with complex aerospace systems. Examples of operational applications and accidents/incidents resulting from human-automation interactions will be stressed throughout.

The course will begin with a theoretical background of human pilot information processing, signal detection theory, Bayes theory, and biases in naturalistic decision making. Next, physiological limitations, focusing on sensorimotor challenges and spatial disorientation, will be covered, ranging from sensory cues, integration, perceptual illusions, to adaptation to altered gravity environments. Given these limitations, practical and quantitative approaches for designing displays and control interfaces will be summarized including a review of manual control theory, display design principles, and multimodal displays. High-level supervisory control and vigilance of highly automated complex systems will be studied. Finally, state-of-the-art experimental and simulation approaches to evaluating human system designs will be covered. This includes design of experiments, workload, situational awareness, trust, and complacency measures, pilot performance and flight simulation. A secondary focus of this course is to improve both oral and written presentation skills.

Office Hours

Thursday from 9:30-10:30am or by appointment. In my office (ECAE 100 in the Engineering Center).

Textbook

[*Engineering Psychology and Human Performance*](#), Wickens and Hollands, ideally the Fourth Edition, but earlier versions should be fine.

There will be numerous additional readings, book chapters, etc. which will be posted to D2L.

Class Website

We will use Desire2Learn (D2L) for our class website: <https://learn.colorado.edu>

Please check regularly (or set up alerts!) as new material, assignments, etc. will be posted regularly.

Topics (subject to potentially major revision)

Application of human operated aerospace vehicles

Case study 1

Case study 2

Theoretical considerations of human operation of aerospace vehicles

Information processing theory

Rational decision and signal detection theory

Information acquisition and Bayes theory

Judgement under uncertainty including biases in human naturalistic decision making

Exam 1 ~ September 21

Physiological and cognitive limitations of humans in aerospace vehicles

Hypoxia

Gravity-induced Loss of Consciousness (G-LOC)

Introduction to vestibular system and orientation perception

Sensory integration

Common spatial disorientation illusions

Geographic disorientation and controlled flight into terrain (CFIT)

Sensorimotor impairment and motion sickness – spaceflight applications

Exam 2 ~ October 24

Design of display and control interfaces

Manual control theory

Display design principles

Multimodal displays and pilot attention

Supervisory control and vigilance

Exam 3 ~ November 14

Evaluating human system designs

Design of experiments

Usability testing and evaluation

Workload and situation awareness (background and experimental methods)

Trust, complacency, and over-automated systems

Final ~ Saturday December 16, 7:30-10pm, 2017.

Will not have a formal final “exam”. Will likely use this time for group project presentations.

Grading

45% on Homework/Group Projects, 45% from 3 Exams (15% each), 10% Participation (not just showing up...but actively engaging!)

Homework assignments and Group Projects are due at the start of class *on the due date*. If you must miss class for an excused absence, you may submit early. **Late homework or project submittals are not accepted** - this includes if it is slipped under my door after class has started. However, if you will not be attending class, you may submit your homework *prior to class* by slipping it under my door.

Group collaboration is permitted on homework, but efforts are individual. This means you may discuss the means and methods for solving problems and even compare answers, but you are not free to copy someone's work or the solutions manual. **The homework you submit must be your own.** *Keep in mind that solving problems reinforces learning the material.*

Collaboration on Group Projects (within your group) is expected and encouraged. Working with other groups is allowed, but analogous to individual homework, **your Group Project must be your group's own.**

Missed exams/presentation will not be made up unless acceptable arrangements are made **at least one week in advance** of the test date. Acceptable events are considered on a case-by-case basis. **Documented** medical conditions are allowed at any time.

Exams will cover all concepts/material in this course. This includes lecture slides, discussions in class, readings, homework, projects, etc. Exams will typically only cover the material since the previous exam, but occasionally previous material may be included.

Collaboration on exams, using another student's work as your own, or allowing another student to use your work as their own, is considered academic misconduct and will not be tolerated. If you are caught in any of these activities, you may receive a grade of "F" for the course and a report may be made to the Dean's office for further punitive action.

Letter grades are determined in the standard CU-Boulder scheme: A: >92.5, A-: 90-92.4, B+:87.5-89.9, B:82.5-87.4 and so on.

Accommodation for Disabilities: If you qualify for accommodations because of a disability, please submit to your professor a letter from Disability Services in a timely manner (for exam accommodations provide your letter at least one week prior to the exam) so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities. Contact Disability Services at 303-492-8671 or by e-mail at dsinfo@colorado.edu. If you have a temporary medical condition or injury, see [Temporary Injuries guidelines](#) under the Quick Links at the [Disability Services website](#) and discuss your needs with your professor.

Religious Observances: [Campus policy regarding religious observances](#) states that faculty must make every effort to deal reasonably and fairly with all students who, because of religious obligations, have conflicts with scheduled exams, assignments or required attendance. For more information on the religious holidays most commonly observed by CU-Boulder students consult the [online interfaith calendar](#).

Classroom Behavior: Students and faculty each have responsibility for maintaining an appropriate learning environment, *not only while in class, but also while working outside of class such as in labs and study areas.* Those who fail to adhere to such behavioral standards may be subject to discipline. Professional courtesy and sensitivity are especially important with respect to individuals and topics dealing with differences of race, color, culture, religion, creed, politics, veteran's status, sexual orientation, gender, gender identity and gender expression, age, disability, and nationalities. Class rosters are provided to the instructor with the student's legal name. I will gladly honor your request to address you by an alternate name or gender pronoun. Please advise me of this preference early in the semester so that I may make appropriate changes to my records. For more information, see the [policies on classroom behavior](#) and [the student code](#).

Discrimination and Harassment: The University of Colorado Boulder (CU-Boulder) is committed to maintaining a positive learning, working, and living environment. CU-Boulder will not tolerate, *both in-*

class and outside of class, acts of sexual misconduct, discrimination, harassment or related retaliation against or by any employee or student. CU's Sexual Misconduct Policy prohibits sexual assault, sexual exploitation, sexual harassment, intimate partner abuse (dating or domestic violence), stalking or related retaliation. CU-Boulder's Discrimination and Harassment Policy prohibits discrimination, harassment or related retaliation based on race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. Individuals who believe they have been subject to misconduct under either policy should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127. Information about the OIEC, the above referenced policies, and the campus resources available to assist individuals regarding sexual misconduct, discrimination, harassment or related retaliation can be found at the [OIEC website](#).

Honor Code: All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to [the academic integrity policy](#) of the institution. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access, clicker fraud, resubmission, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code Council (honor@colorado.edu; 303-735-2273). Students who are found responsible of violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code Council as well as academic sanctions from the faculty member. Additional information regarding the academic integrity policy can be found at <http://honorcode.colorado.edu>.