

ASEN 6519
HUMAN OPERATION OF AEROSPACE VEHICLES

Spring 2020
Monday/Wednesday 11:30am-12:45pm
Room AERO 114

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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 11:30am-12:30pm or by appointment. In my office (AERO N301).

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 Canvas. In general, there will be a reading to be done prior to each class lecture.

Class Website

We will use Canvas for our class website: <https://canvas.colorado.edu/courses/58020>

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

Topics (subject to 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 ~ February 17

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

Spatial disorientation illusions

Geographic disorientation and controlled flight into terrain (CFIT)

Sensorimotor impairment and motion sickness – spaceflight applications

Exam 2 ~ March 18

Design of display and control interfaces

Manual control theory

Display design principles

Multimodal displays and pilot attention

Supervisory control and vigilance

Automation

Exam 3 ~ April 15

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 ~ Sunday May 3, 7:30-10pm.

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

Grading

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

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 project submittals will be heavily penalized.**

Collaboration on Group Projects (within your group) is expected and encouraged. Working with other groups is allowed, but your submission must be your own group's effort. This means you may discuss the means and methods for solving the project problems and even compare answers, but you are not free to copy someone's work. **The Project you submit 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**, 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 your accommodation letter from Disability Services to your faculty member in a timely manner so that your needs can be addressed. Disability Services determines accommodations based on documented disabilities in the academic environment. Information on requesting accommodations is located on the [Disability Services website](#). Contact Disability Services at 303-492-8671 or dsinfo@colorado.edu for further assistance. If you have a temporary medical condition or injury, see [Temporary Medical Conditions](#) under the Students tab on the Disability Services website.

Classroom Behavior: Students and faculty each have responsibility for maintaining an appropriate learning environment. 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 race, color, national origin, sex, pregnancy, age, disability, creed, religion, sexual orientation, gender identity, gender expression, veteran status, political affiliation or political philosophy. For more information, see the policies on [classroom behavior](#) and the [Student Code of Conduct](#).

Preferred Study Names and Pronouns: CU Boulder recognizes that students' legal information doesn't always align with how they identify. Students may update their preferred names and pronouns via the student portal; those preferred names and pronouns are listed on instructors' class rosters. In the absence of such updates, the name that appears on the class roster is the student's legal name.

Honor Code: All students enrolled in a University of Colorado Boulder course are responsible for knowing and adhering to the Honor Code. Violations of the policy may include: plagiarism, cheating, fabrication, lying, bribery, threat, unauthorized access to academic materials, clicker fraud, submitting the same or similar work in more than one course without permission from all course instructors involved, and aiding academic dishonesty. All incidents of academic misconduct will be reported to the Honor Code (honor@colorado.edu; 303-492-5550). Students found responsible for violating the academic integrity policy will be subject to nonacademic sanctions from the Honor Code as well as academic

sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found at the [Honor Code Office website](#).

Sexual Misconduct, Discrimination, Harassment, and/or Related Retaliation: The University of Colorado Boulder (CU Boulder) is committed to fostering a positive and welcoming learning, working, and living environment. CU Boulder will not tolerate acts of sexual misconduct, intimate partner abuse (including dating or domestic violence), stalking, or protected-class discrimination or harassment by members of our community. Individuals who believe they have been subject to misconduct or retaliatory actions for reporting a concern should contact the Office of Institutional Equity and Compliance (OIEC) at 303-492-2127 or cureport@colorado.edu. Information about the OIEC, university policies, [anonymous reporting](#), and the campus resources can be found on the [OIEC website](#).

Please know that faculty and instructors have a responsibility to inform OIEC when made aware of incidents of sexual misconduct, discrimination, harassment and/or related retaliation, to ensure that individuals impacted receive information about options for reporting and support resources.

Religious Holidays: Campus policy regarding religious observances requires that faculty 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. In this class, please notify me at least one week in advance if you are unable to attend an exam or final presentation. Assignments will be due on Canvas, unless you have made prior arrangements with me.

See the [campus policy regarding religious observances](#) for full details.