

ASEN 6216
HUMAN OPERATION OF AEROSPACE VEHICLES

Fall 2022
Tuesday/Thursday 8:30-9:45am
Room AERO 232

Professor Torin K. Clark
telephone: (303) 492-4015
email: torin.clark@colorado.edu
office: AERO N301

TA: Sage Sherman
email: sage.sherman@colorado.edu
office: AERO 340

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

Clark: Friday from 8-9am or by appointment. In my office (AERO N301) and on

Zoom: [_____](#)

Sherman: Thursday from 4-5:15pm or by appointment. Will hold office hours in the 3rd floor AERO lobby (specific tables are called B_AERO – 300S), and on

Zoom: [_____](#)

Textbook

[Engineering Psychology and Human Performance](#), Wickens and Hollands, ideally the Fourth (or Fifth!) 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

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

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 spaceflight applications

Motion sickness

Galvanic vestibular stimulation

Design of display and control interfaces

Manual control theory

Display design principles

Multimodal displays and pilot attention

Supervisory control and vigilance

Automation

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 Dec 10, 7:30-10pm.

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

Grading

50% on Group Projects (3 fixed projects at 10% each, 1 semester/final project 20% total)

50% from 4 Unit Quizzes (12.5% each)

Group Projects are due *at the posted due date on Canvas*. **Late project submittals will be heavily penalized.** Please let me know as soon as you are able, if a major issue arises that will impact your timely submission.

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 quizzes will not be made up. You will have a full one week window to complete each on Canvas.

Quizzes will cover all concepts/material in this course. This includes lecture slides, discussions in class, readings, projects, etc. Quizzes will typically only cover the material since the previous quiz, but occasionally previous material may be included. Quizzes will be open-book and open-notes.

Collaboration on quizzes is not allowed. Reference the honor code information below.

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.

CLASSROOM BEHAVIOR

Both students and faculty are responsible for maintaining an appropriate learning environment in all instructional settings, whether in person, remote or online. 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 [classroom behavior](#) policy, the [Student Code of Conduct](#), and the [Office of Institutional Equity and Compliance](#).

REQUIREMENTS FOR COVID-19

As a matter of public health and safety, all members of the CU Boulder community and all visitors to campus must follow university, department and building requirements and all public health orders in place to reduce the risk of spreading infectious disease. CU Boulder currently requires COVID-19 vaccination and boosters for all faculty, staff and students. Students, faculty and staff must upload proof of vaccination and boosters or file for an exemption based on medical, ethical or moral grounds through the MyCUHealth portal.

The CU Boulder campus is currently mask-optional. However, if public health conditions change and masks are again required in classrooms, students who fail to adhere to masking requirements will be asked to leave class, and students who do not leave class when asked or who refuse to comply with these requirements will be referred to Student Conduct and Conflict Resolution. For more information, see the policy on classroom behavior

and the Student Code of Conduct. If you require accommodation because a disability prevents you from fulfilling these safety measures, please follow the steps in the “Accommodation for Disabilities” statement on this syllabus.

If you feel ill and think you might have COVID-19, if you have tested positive for COVID-19, or if you are unvaccinated or partially vaccinated and have been in close contact with someone who has COVID-19, you should stay home and follow the further guidance of the Public Health Office (contacttracing@colorado.edu). If you are fully vaccinated and have been in close contact with someone who has COVID-19, you do not need to stay home; rather, you should self-monitor for symptoms and follow the further guidance of the Public Health Office (contacttracing@colorado.edu). Please let me know as soon as you are able to, if you are unable to participate in class to an extent that you won't be able to immediately make up for missed time (e.g., unable to complete a quiz or contribute to a group project).

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, see [Temporary Medical Conditions](#) on the Disability Services website.

PREFERRED STUDENT 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 Honor Code may include, but are not limited to: 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 Student Conduct & Conflict Resolution (honor@colorado.edu); 303-492-5550). Students found responsible for violating the [Honor Code](#) will be assigned resolution outcomes from the Student Conduct & Conflict Resolution as well as be subject to academic sanctions from the faculty member. Additional information regarding the Honor Code academic integrity policy can be found on the [Honor Code website](#).

SEXUAL MISCONDUCT, DISCRIMINATION, HARASSMENT AND/OR RELATED RETALIATION

CU Boulder is committed to fostering an inclusive and welcoming learning, working, and living environment. University policy prohibits sexual misconduct (harassment, exploitation, and assault), intimate partner violence (dating or domestic violence), stalking, protected-class discrimination and harassment, and related retaliation by

or against members of our community on- and off-campus. These behaviors harm individuals and our community. The Office of Institutional Equity and Compliance (OIEC) addresses these policies, and individuals who believe they have been subjected to misconduct can contact OIEC at 303-492-2127 or email cureport@colorado.edu. Information about university policies, [reporting options](#), and support resources can be found on the [OIEC website](#).

Please know that faculty and graduate instructors have a responsibility to inform OIEC when they are made aware of any issues related to these policies regardless of when or where they occurred to ensure that individuals impacted receive information about their rights, support resources, and resolution options. To learn more about reporting and support options for a variety of concerns, visit [Don't Ignore It](#).

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 contact me as soon as you are able if religious observances conflict with completing course deliverables (e.g., quizzes or group projects).

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