AE 4803-HAR Intro to Safety by Design Syllabus
Fall 2022

Course Instructor
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Catalog Description

This course explores multi-disciplinary issues in accident causation and system safety across different industries and introduces various frameworks for addressing system safety concerns within aerospace system design.

Prerequisites

This course is intended for junior or senior students, requiring completion of AE 3330: Introduction to Aerospace Vehicle Performance.

Introduction

This document provides basic information regarding the Intro Safety by Design class for the Fall 2022 academic term. This course is intended to provide additional context on air vehicle safety, reliability, and certification considerations the vehicle design process in order to better install critical aspects of safety culture among engineering students. Students will be introduced to core safety principles and the fundamental methods for incorporating safety analysis of aerospace systems alongside system design and engineering.

Class Website

The official SBD class website is on Canvas at https://canvas.gatech.edu/. This website is intended to provide all official lecture material, handouts, presentations, notices and relevant

information. Note that the website will be constantly updated and must be checked on a regular basis. All announcements are automatically emailed to your GT student account. It is the student's responsibility to maintain access to this account and address email filtering issues. To log in use your GT account username (usually your first name initial followed by your last name and a number, e.g., *gburdell3*) and your GT account user password. Once on Canvas, select the AE 4803 course.

Class Schedule

The course meets on Monday and Wednesday, 9:30 AM to 10:45 AM in Weber SST III Lecture Room 1. Please check for announcements in Canvas or emails to the class distribution list indicating details or changes to the meeting place.

Calendar

The official school calendar of Georgia Tech is provided by the Office of the Registrar and is available at http://www.registrar.gatech.edu/home/calendar.php.

Course Overview

This course is an application-oriented course aimed at introducing students to safety concepts and approaches for integrating complex aerospace system development with safety by design and flight certification processes.

To better understand the nature of system safety, students will engage with prominent accidents and incidents from across a range of industries, exposing students to the multidisciplinary issues of accident causation and system safety. Students will reinforce this understanding of system safety issues through introduction to interactive approaches for aircraft and system development and safety assessment, as notionally illustrated in Figure 1.

The goal of the course is to provide a balance between analysis of current practices and description of cutting-edge techniques that address the shortcomings of current practices. Students participate in group projects and in-class discussions where they apply introduced concepts, techniques, and tools to existing and newly developed aviation systems while developing safety competence and culture.

Course Objectives

1. To instill a proper safety culture among engineering students before they enter the workforce

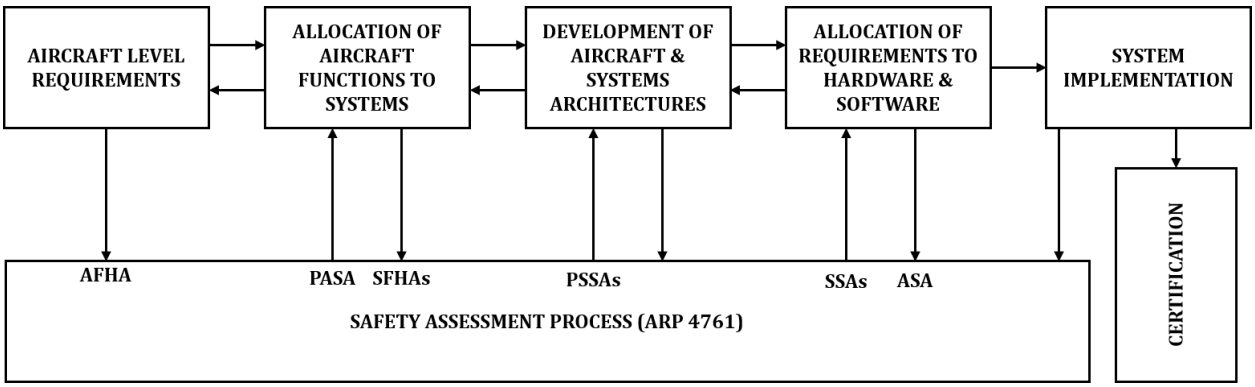

Figure 1: FSM approach for commercial transport aircraft.

2. To enrich the students understanding of causality (temporal depth, diversity of agency, coordinability), and in so doing, to expand the scope of accident prevention options they can conceive and consider

3. To provide the students with a solid understanding of the multi-disciplinary issues in accident causation and system safety, including:

   (a) the anatomy of accidents across different industries, and their common features;

   (b) fundamental failure mechanisms and causal basis of this distinctive class of adverse events;

   (c) general system safety principles for accident prevention;

   (d) issues in risk analysis, human factors, and safety culture.

4. To develop a familiarity with standard system safety analysis methods and techniques within the broader context of multidisciplinary design and analysis of complex systems.

Grade Breakdown

Grades are be based on participation, deliverables, updates, and presentations. The distribution of these elements are shown below.

- In-class Participation - 5%
- Individual Summary of Weekly Topics and Reading - 20%
- Team Presentation of Reading - 20%
- Team Term Paper Progress Update - 5%
- Team Term Paper Abstract - 5%
- Team Term Paper & Final Presentation 45%

Class Structure

Over the course of the semester students will participate in both individual and group learning activities. At the outset students will examine a number of high-profile accidents drawn from a variety of industries in order to examine Safety by Observation. Following this study of accidents students will then be introduced to several aspects of Safety by Design, gaining insight into methods and techniques for addressing safety within future system development.

For both the Safety by Observation and Safety by Design portions of the course, students will read through the assigned articles in preparation for in-class discussion. For each article, each individual student will prepare a one-page reflection on the article. In addition, one team of students will be assigned prepare a presentation for each article and to subsequently lead in-class discussion on the article and the safety issues it entails.

In parallel with the in-class material, teams will work together to prepare a term paper and final presentation. The term paper should present a study of the team's choosing which examines a safety-centric issue of interest. The final paper should be approximately 15 pages in length with a minimum of 10 cited and incorporated references.

Course Material

No textbook is required for this course. Over the course progresses the following articles will be assigned for student reading and review as the subject of in-class discussion. Note, the following list is under development and subject to change. Any changes to the list of articles and assignment of readings will be communicated via the course Canvas.

1. Pate-Cornell, E. "Learning from the Piper Alpha accident: A postmortem analysis of the technical and organizational factors." Risk Analysis, vol. 13, No. 2, 1993, pp. 215–232.

2. Hopkins, A. "Was the Three Mile Island a "Normal Accident?" Journal of Contingencies and Crisis Management, Vol. 9, No. 2, 2001, pp. 65–72.

3. Leveson, N. G., Turner, C. S. "An investigation of the Therac-25 accidents." Computer, vol. 26(7), 1993, pp. 18-41.

4. "Safety report on the treatment of safety-critical systems in transport airplanes". National Transportation Safety Board report, NTSB/SR-06/02. Washington, DC. Read only till page 30.

5. Foreman, V. L., Favaro, F. M., Saleh, J.H., Johnson, C.W. "Software in military aviation and drone mishaps: analysis and recommendations for the investigation process". Reliability Engineering and System Safety, Vol. 137, 2015, pp. 101–111.

6. Saleh J.H., Tikayat-Ray A., Zhang K.S., Churchwell JS (2019) "Maintenance and inspection as risk factors in helicopter accidents: Analysis and recommendations". PLoS ONE 14(2): e0211424.

7. Saleh, J. H., Cummings, A. M. "Safety in the Mining Industry and the Unfinished Legacy of Mining Accidents: Safety Levers and the Principle of Defense-in-Depth for Addressing Mining Hazards." Safety Science, Vol. 49, Issue 6, 2011, pp. 764–777

8. Wallace M. et al. "Pedestrian and Light Transit Accidents: An Examination of Street Redesigns in Atlanta and their Safety Outcomes". Case Studies on Transport Policy, 2021. https://doi.org/10.1016/j.cstp.2021.02.009

9. Favaro F, Eurich S, Nazanin N. "Autonomous vehicles' disengagements: trends, triggers, and regulatory limitations." Accident Analysis and Prevention, 110(2018), pp. 136–148.

10. Salmon PM et al. "Systems-based accident analysis methods: A comparison of Accimap, HFACS, and STAMP". Safety Science, Vol. 50(4), 2012, pp. 1158–1170.

Academic Integrity

Georgia Tech aims to cultivate a community based on trust, academic integrity, and honor. Students are expected to act according to the highest ethical standards. For information on Georgia Tech's Academic Honor Code, please visit http://www.catalog.gatech.edu/policies/honor-code/ or http://www.catalog.gatech.edu/rules/18/. Any student suspected of cheating or plagiarizing on an assignment will be reported to the Office of Student Integrity, who will investigate the incident and identify the appropriate penalty for violations.

Accommodations for Students with Disabilities

If you are a student with learning needs that require special accommodation, contact the Office of Disability Services at (404)894-2563 or http://disabilityservices.gatech.edu/, as soon as possible, to make an appointment to discuss your special needs and to obtain an accommodations letter. Please also e-mail me as soon as possible in order to set up a time to discuss your learning needs.

A Schedule

The following is a tentative schedule of the topics to be covered during each week of the course. Any updates to the course schedule will be provided through the course website alongside specifics of assigned readings and presentations.

Table 1: Tentative Course Schedule

Week	**Course Portion**	**Topic**
1	Introduction	Course Overview, Introduction, and Review
2	Safety by Observation	Transport Aviation Safety-Critical Systems
3	Safety by Observation	Learning from Piper Alpha
4	Safety by Observation	Three-Mile Island and Therac-25
5	Safety by Observation	Military Software and Helicopter Accidents
6	Safety by Observation	Safety in Mining and Pedestrian Accidents
7	Safety by Observation	Autonomous Vehicle Disengagements
8	Safety by Design	Accident Models
9	Safety by Design	Safety Barriers
10	Safety by Design	System Safety Principles
11	Safety by Design	Risk Analysis
12	Safety by Design	Functional Safety Analysis
13	Safety by Design	Reliability
14	Safety by Design	Human Factors
15	Safety by Design	Safety Culture
16	Safety in Review	Review & Reflection
17	Finals Week	Final Project Presentations