Aerospace Training and Research at Carleton University

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Summary

- Overview of Carleton, Department and Aerospace Research Unit
- Capstone Design Projects
- Challenges and Opportunities

Carleton University

- Founded in 1942
- Faculties of Engineering and Design, Public Affairs, Science, Arts and Social Sciences, School of Business
- 29,000+ students, 1,000+ faculty, 700 contract instructors and 1,700 TAs
- Canada's first Bachelor of Aerospace Engineering (1988)

[1945] Establishment of the Faculty of Arts and Science

[1963] Establishment of the Faculty of Engineering

[1988] Canada's First Bachelor of Aerospace Engineering Program

[1989] Department of Mechanical and Aeronautical Engineering Renamed

[1999] Wind Tunnel Renamed *Pratt & Whitney High-Speed Wind Tunnel*

[2007] Inauguration of Aerospace Engineering Stream in Space Systems Design

[2007] Opening of the Centre for Advanced Visualization and Simulation

Carleton's aerodynamics instructor uses a smoke chamber to demonstrate how air passes over the wing of a plane at different speeds and altitudes [1958]

Over 30 award-winning professors conducting aerospace research in Canada

School of Information Technology

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Mechanical and Aerospace Engineering

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Biology

Psychology

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Systems, Computer, and Electrical

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Computer Science



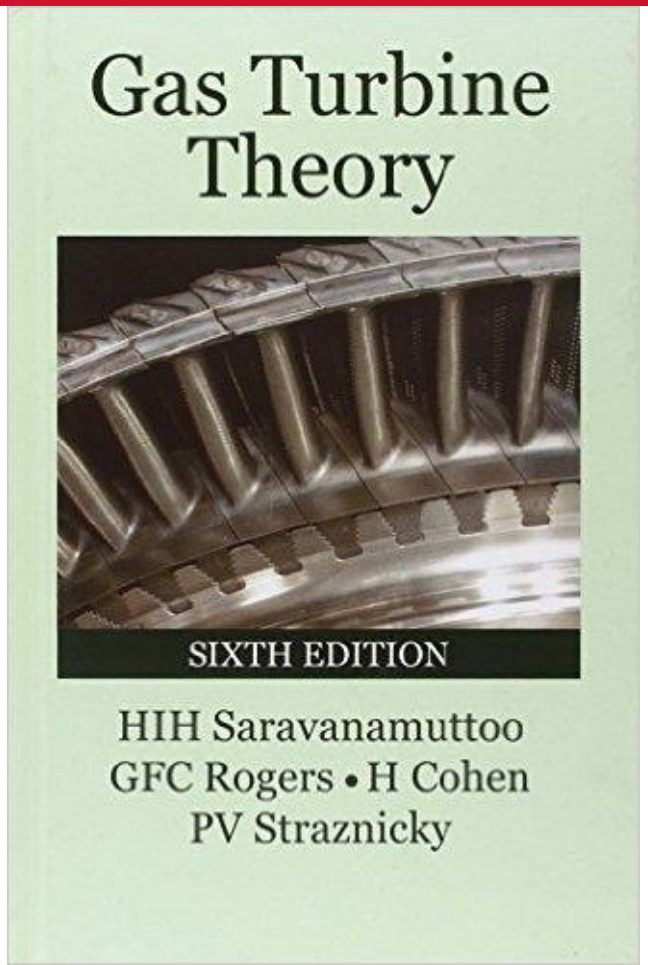


Low RPM Facility

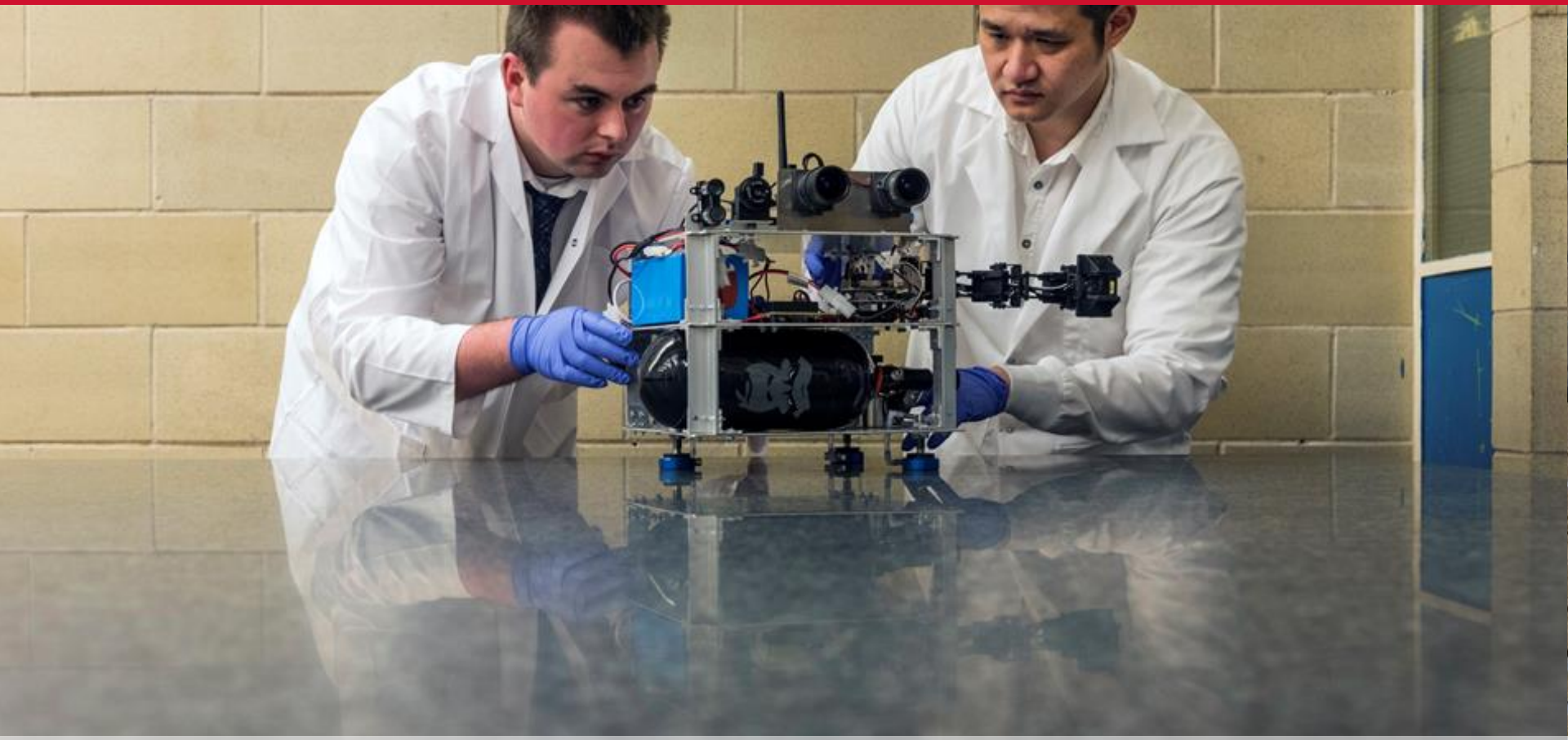
High RPM Facility [Unique in Canada]

ADVANCED PROPULSION SYSTEMS

High Speed Wind Tunnel [Unique in Canada]



SPACE ROBOTICS & SYSTEMS RESEARCH



Free-Floating Robotic Spacecraft Facility [Unique in Canada]

FLIGHT SIMULATION
AND HUMAN FACTORS RESEARCH

Carleton University Simulator Project (CUSP)

Mechanical and Aerospace Department Stats

- 40 full-time faculty, 15 Emeritus/Adjunct
- 1,000+ undergraduate students
  - Mechanical, Aerospace, Biomedical and Sustainable Energy Engineering
- 275+ graduate students
  - 175 MASc/MEng, 100 PhD
  - Masters and PhDs in Aerospace, Mechanical, Materials, Biomedical, Sustainable Energy

Undergraduate Aerospace Education at Carleton

- First Aerospace BEng program in Canada (1988)
- Significant program growth
  - From 30 in 1992 to 140 in 2015 - 1st year admissions
- Four streams
  - **A** - Aerodynamics, Propulsion and Vehicle Performance
  - **B** - Aerospace Structures, Systems and Vehicle Design
  - **C** - Aerospace Electronics and Systems (early 1990s)
  - **D** - Space Systems Design (mid 2000s)
- Capstone Design Project participation

Capstone Project Background

- Based on Cranfield University Group Design Project
- Originally two projects (1991-92)
  - Aircraft and Spacecraft
- Success of team-style projects led to adoption across Department (early 2000s)
- Evolved into multi-year projects with external collaborators, funding and links to graduate research
- Several projects include students from other departments, faculties and schools

Learning Objectives

- Learning Objective:

  "*To provide a realistic design learning environment to expose students to the complexities of modern engineering design processes, tools and practices.*"

- Each project has its own "corporate" approach dictated by industry-specific design processes
- 20-30 students with 3-5 faculty members per project
- Dedicated project workspaces
- Weekly meetings and technical objectives

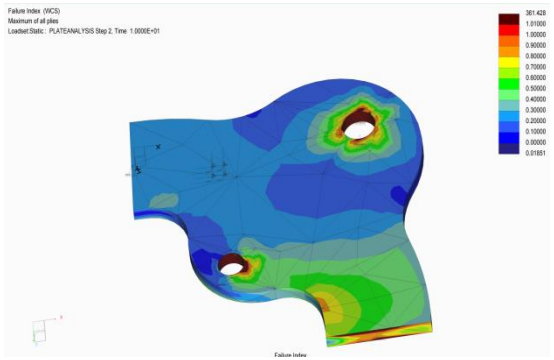
2016-17 MAE Capstone Design Projects

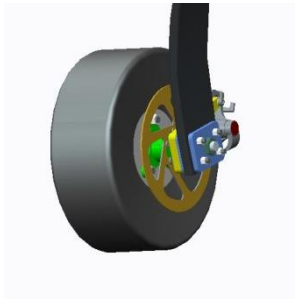
- Fixed Wing Aircraft Design
- Rotary Wing Uninhabited Aircraft System (UAS)
- Spacecraft Design Project
- Intelligent and Assistive Devices (iTAD)
- Formula Student Racecar Team
- Carleton University Simulator Project (CUSP)
- Hybrid Natural Gas Ground Vehicle
- Crash Test Dummy
- High Performance Housing

CUSP 2016 / 2017 Overview

- Finish Commissioning Atlas
  - Complete calibration
  - Benchmark testing, MOOG, and motors
  - Design refinement (where required)
- Integrate developed technology
  - Vehicle modelling
  - Washout control
  - Orientation sensing, VOS, and IOS
- Applications
  - Road vehicle model
  - Rigid inflatable boat
  - Extra 300 aircraft

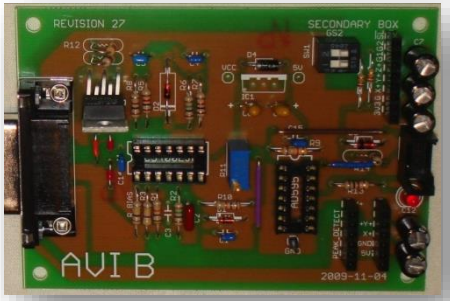
Fixed Wing Aircraft Design





Air vehicle Design and Analysis

Manufacturing and Testing



Avionics design and development

Flight Testing

2017 MAE Design Forum

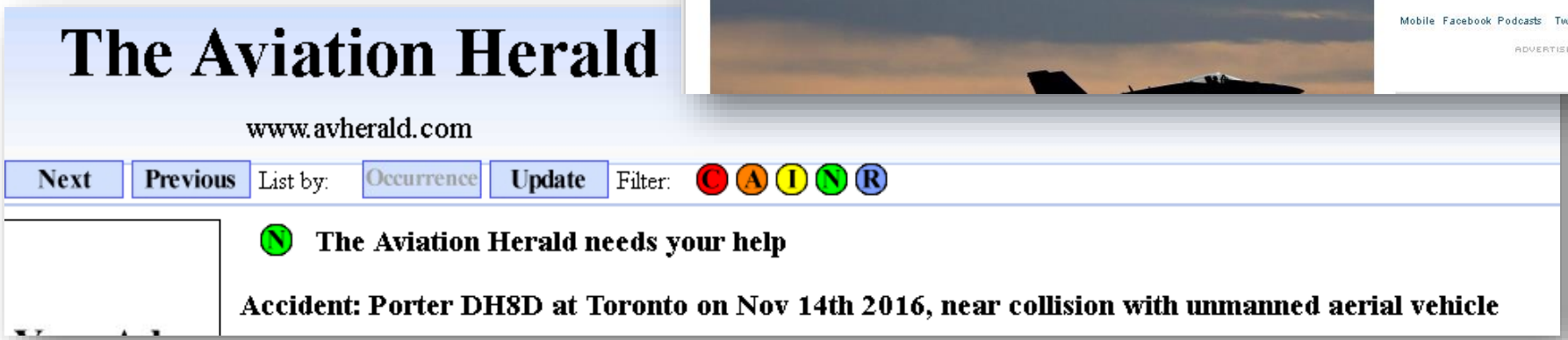
- Final presentations for all 4th year students
- Saturday April 1st, 2017
- Parallel presentation sessions for each project by students
- Hardware displays and demonstrations
- Contact: jeremy.laliberte@carleton.ca

Training Challenges and Opportunities

- Competition for talent
- Increasingly complex safety critical software and cyber-security challenges
- Advanced materials and new manufacturing methods
- Increasing levels of automation
- Uninhabited aircraft systems (UAS)

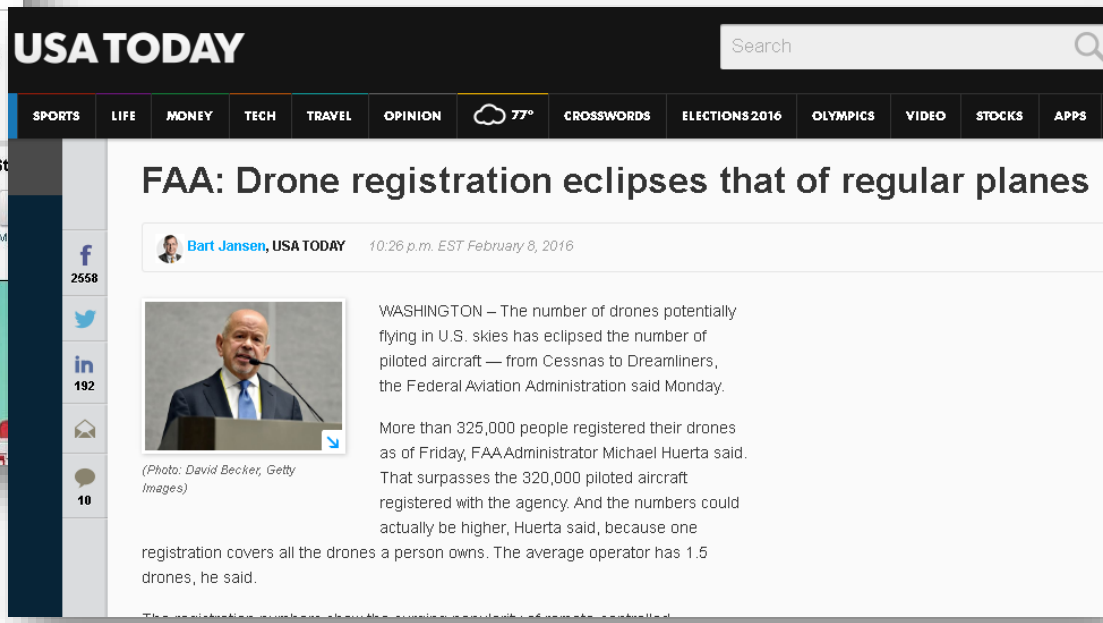
UAS and Aerospace Education

- Safety above all else – *UAS are aircraft*
  - http://www.tc.gc.ca/eng/civilaviation/drone-safety.html



UAS Proliferation Challenge

http://www.cbc.ca/news/canada/ottawa/drone-flew-over-hull-jail-courtyard-sunday-1.2440726



http://www.usatoday.com/story/news/2016/02/08/faa-drone-registration-eclipses-regular-planes/80002730/

Update - As of May 2016 there were over 460,000 individual UAS registered in the US (https://www.faa.gov/news/updates/?newsId=85548)

The Three "E's" of UAS

- Engagement
  - Stakeholders, regulators, air operators, policy makers, public, first responders, ANSPs
- Education
  - Public – critical safety messages
  - Students – systems engineering, software, sensors, flight controls
- Enforcement
  - Local law enforcement, bylaws, prosecutors

Questions?