

# SAIT Unmanned Aerial Vehicle (UAV) Research

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# Unmanned Aerial Vehicle (UAV) Introduction

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- Advances in UAV production and capabilities has lowered barriers to entry for operations and has lead to a rapid growth in UAV usage.
  - Unmanned Aerial Systems (UAS)
  - Unmanned Aerial Vehicle (UAV)
- This is a **disruptive technology** that will impact many industries.
- A multi-billion economic impact is being predicted in the US (2015-2020)\*

\* UAS-USA-New Economic Report 2013 - AUVSI

# UAV Introduction

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- Rapid growth has resulted in a low level of awareness for safe and compliant operation of UAV's
- This low level of awareness will create challenges for industries on how to best utilize UAV applications
- Need for certification, training, experience and applications of the technology

# SAIT UAV Inventory

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## ➤ Multirotor

- DJI s1000 (8 rotor)
- DJI s900 (6 rotor)
- Phantom II (4 rotor x2)



## ➤ Fixed-wing

- Skywalker X8
- Skywalker 1800
- Ranger
- Talon
- TBM
- Mugin



# SAIT UAV Inventory

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## ➤ Camera/Sensor/Software

- Canon EOS 5D Mark III with a 24mm f2.8 lens mounted on a DJI Zenmuse Z15-5D gimbal (s1000)
- GoPro 4 camera mounted on a DJI Zenmuse H3-3D 3-Axis Gimbal (s900)
- Tau 2 LWIR Thermal Imaging Camera Cores (s900)
- GPS and on-board flight inertial systems
- Software – Pix4D, ArcGIS, AutoCAD, Autopilot, Ground station

# SAIT UAV Capabilities

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- Flight time
  - Current flight time: approximately 20-50 minutes
  - Multiple batteries allow longer flights
- Video / Image Transfer
  - Capable of capturing HD (4K) video and imagery resolution from current camera configuration
  - Real-time streaming of HD video (s1000) within a 1 kilometer range
  - Real-time streaming of SD video (s900) from potentially 20+ km.

# SAIT UAV Capabilities

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- Line of Sight Operation
  - Visual Line of Sight (VLOS) – current operational capabilities
  - Beyond Line of Sight (BVLOS) - operational capabilities require SFOC
- Infra-Red/Thermal Imagery
  - Daytime operation - current operational capabilities allows us to capture and stream real-time video from the Infra-Red/Thermal Imagery camera to the control station
  - Nighttime operation - operational capabilities require SFOC

# SAIT UAV Capabilities

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- Payload
  - Currently operational payload capacity is approximately 16 Kg
- UAS weight
  - Total weight of each UAS is less than 25kg



# Special Flight Operating Certificate (SFOC)

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- Regulations are currently in flux
- The following was taken from Navigation Canada's website:
  - “Permission and safety requirements:  
To fly your unmanned aircraft legally, you may need to follow strict safety conditions outlined in an exemption or apply for permission from Transport Canada. It depends on the type of aircraft, its weight, as well as how and where you plan to use it.”

# Special Flight Operating Certificate (SFOC)

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- Regulations are based on UAV weight
- Based on new Transport Canada regulations, a SFOC may not be required to operate a UAV
  - 2 kg or less (must satisfy 37 exemptions)
  - 2.1 kg to 25 kg (must satisfy 58 exemptions)
    - you can meet the safety conditions in the **Transport Canada exemption** for UAVs, you don't need to request permission to fly.
    - you must [email Transport Canada](#) or complete an online [submission form](#)

# UAV Insurance

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- Previously insurance companies required SFOC to insure a UAV
- We have secured \$2,000,000 liability insurance

# Demonstration

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## ➤ Project/House Assessment



# Applications

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- UAV's gather building data faster, more thorough and safer than any other method
- Consolidates the infrared scanning and videotaped images into a comprehensive, interactive, easy-to-understand report that is presented to facility owners and managers, and technicians, through a cloud-based application. The report clearly and accurately shows problem areas, helping decision makers determine their plan of action.
- A virtual model of the building is created in 2-D and 3-D and can be viewed from any angle. Swiping the model allows the user to overlay thermal images to their exact location on the building. Photographs, comments and other data can be added in real time through a tablet, including when technicians are on site, to ensure that work can be verified and that the report always has the latest information.

# Applications

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<https://www.youtube.com/watch?v=-ucLlckILT4>



# Applications

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Crossrail tunnels beneath London (<http://www.bbc.co.uk/newsround/31837753>)

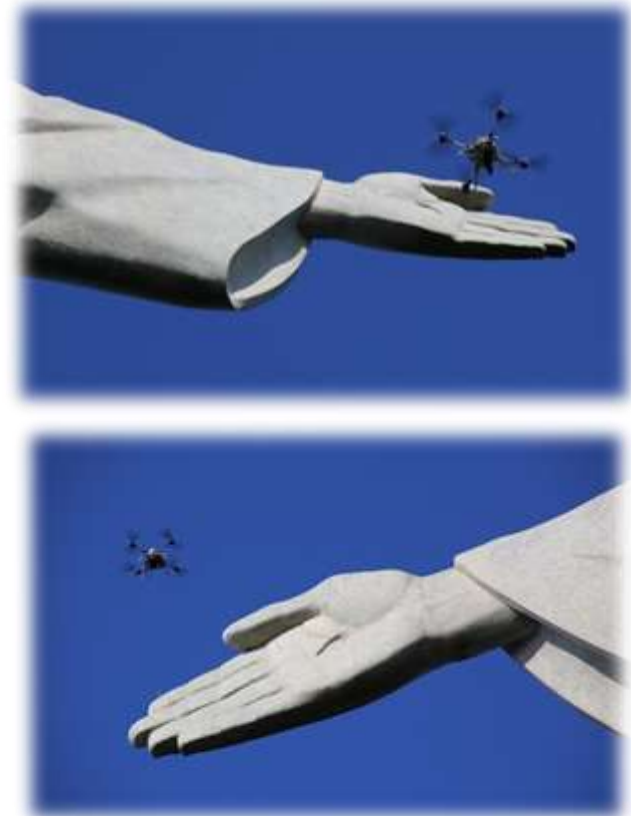




# Applications

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Pix4D - Mapping Christ the Redeemer (<https://www.youtube.com/watch?v=-ucLIckILT4>)





# Applications

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UAV application for Mining projects (<https://www.youtube.com/watch?v=PKRuJ9Dzam4>)



# Applications

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Project site inspection & monitoring





# Applications

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Project site inspection & monitoring

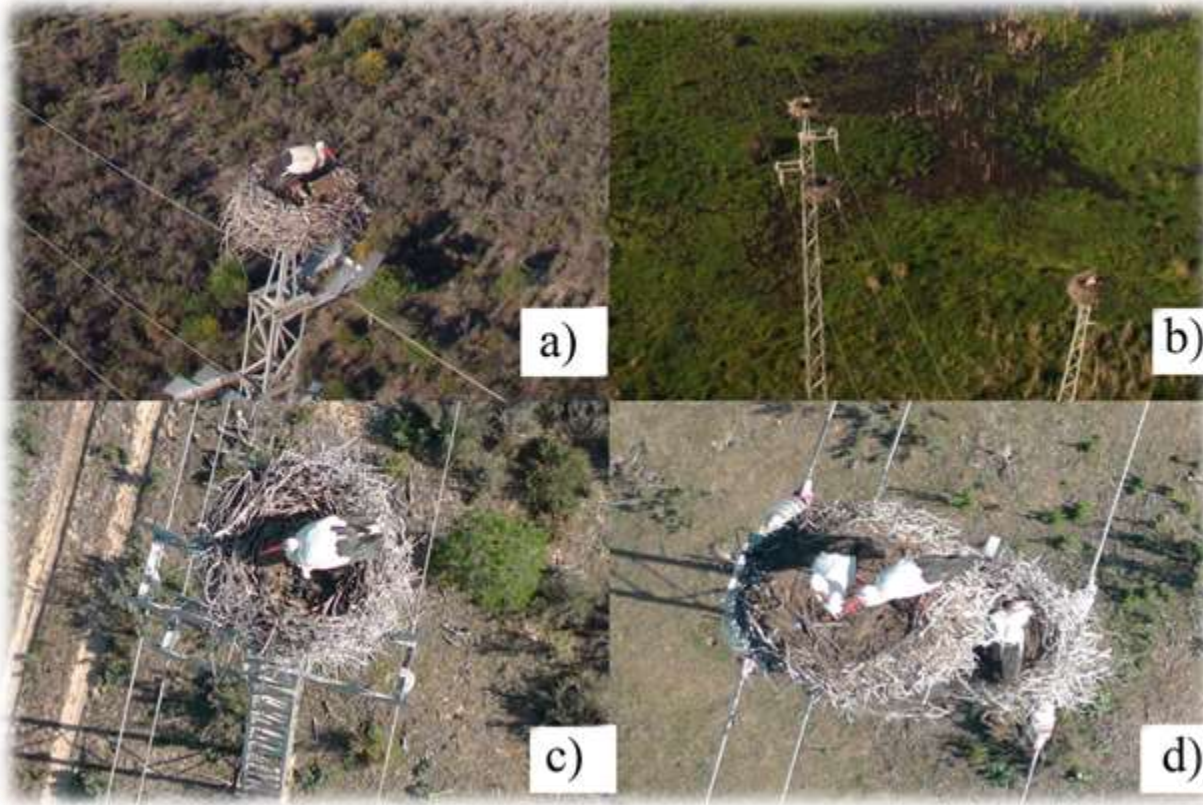




# Applications

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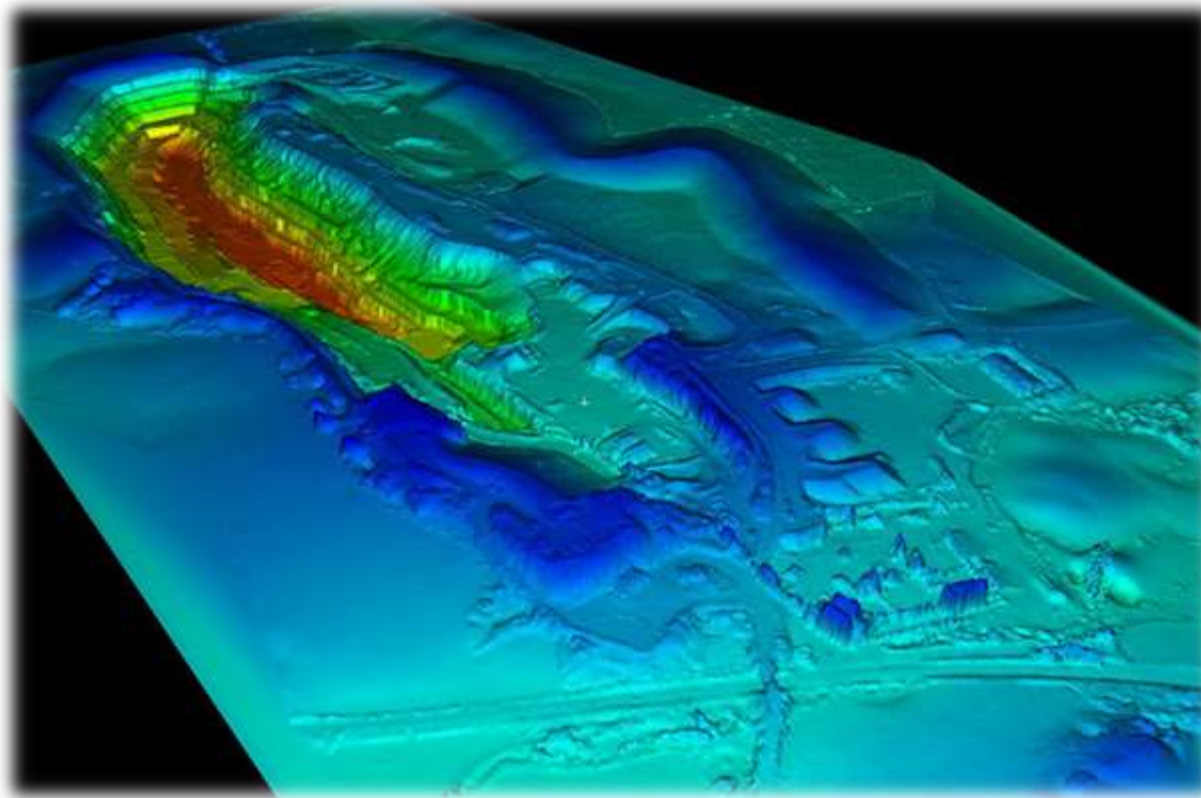
## Imagery & Video Accuracy Assessment



# Applications

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3D Infrared & LIDAR model



# Applications

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Power line inspection

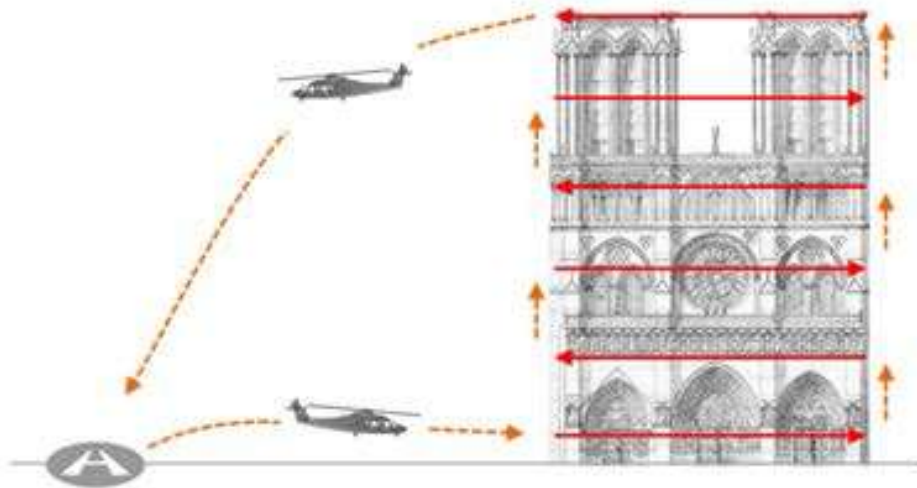




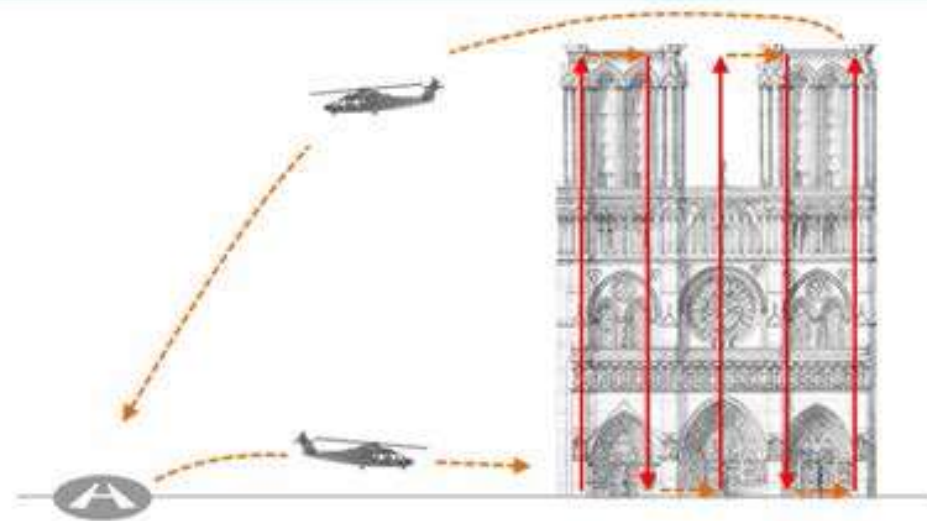
# Applications

## On-site flight pattern

Option 1: horizontally



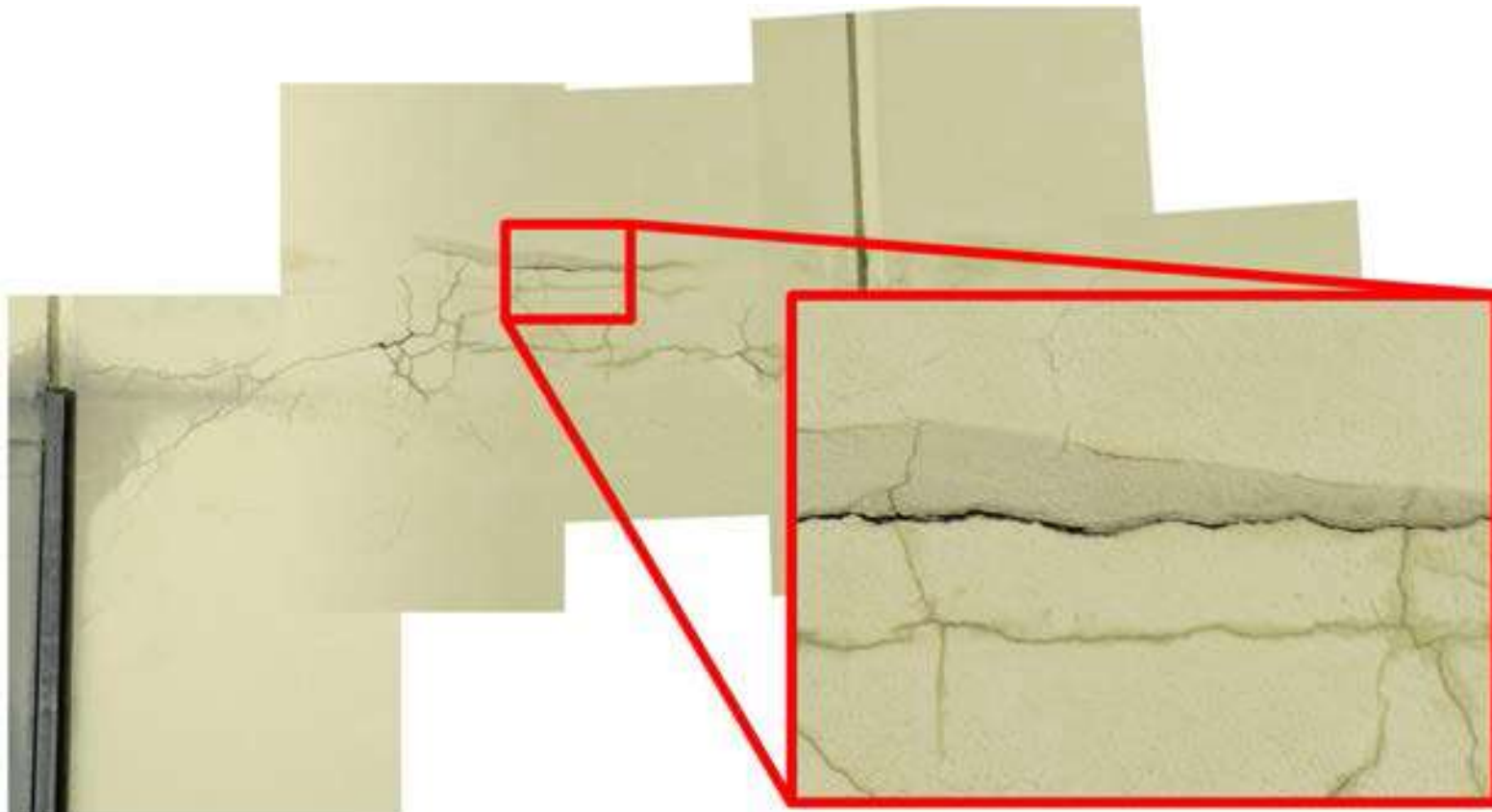
Option 2: vertically



# Applications

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High resolution crack inspection in sub millimeter range





# Applications

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- Photogrammetry and Aerial imagery
- 3D Modeling – Terrain, Build-Up Features (Road& pipeline& Transmission line)
- Surveying and GIS
- Thermal and LIDAR Images Capturing and Analysis
- Terrain Analysis ( topography, land cover and slope analysis)
- Multiband and Hyperspectral Imagery and Analysis
- Real-time Data Collection, Transfer and Analysis

# Applications

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- Environmental Impact Assessment (EIA)
- Environmental Site Assessment (ESA)
- Site Reclamation Assessment
- Pipeline and Well site Monitoring: Leak, Detection and Control
- Power Line Transmission and Assessment (3D scanning and Inspection)
- Watershed Management and Monitoring
- Emergency Management (Manmade and Natural)



# SAIT Polytechnic UAV Lab Partnership Benefits

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- What could be gained through a collaborative effort?
- Potential collaborative benefits
  - Unmanned Aerial Vehicle (UAV) access
  - Camera and sensor technology such as video, photographs, thermal infra-red
  - Flight and data processing expertise
  - Limited need to keep the technology current.

# SAIT Polytechnic UAV Lab Partnership Benefits

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- What could be gained through a collaborative effort?
- Potential collaborative benefits
  - Program, instructor and student engagement
  - Projects strengthened through the application of two district program focus areas and the blending of student knowledge
  - Applied Research

# Questions

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