SAIT UAV Research

Video Analytics & Automatic Control Systems for Smart Pipeline Patrol

Bob Davies

SAIT Researcher
U of C Adjunct Professor

robert.davies@sait.ca

Content

- **Applied Research & Innovation**

- **SAIT Polytechnic's interest in UAV and video content analysis**

- **SAIT's research plan**

- **Applied Research & Innovation (ARIS)**
  - **RFID development and test**
  - **Environmental**
  - **Green buildings**
  - **Health**

- **Most research takes place in Industry collaborations**

- **SAIT Polytechnic's interest in UAV and video content analysis.**
  - **Unmanned Vehicles: Every node in the transportation infrastructure will unmanned.**
    - **Freeway decongestion, small package transport , air travel.**
  - **… as long as**
    - **UAV's are safe**
      - **Regulatory compliance**
      - **Robust and reliable control systems**
      - **Weather resistant aircraft**
   - **No necessity for trained operators**

- **Video content analysis (VCA).**
  - **Proven in security applications**
  - **Cheap**
- **Pipeline research virtues**
  - **Long, remote sections.**
    - **Safer area for UAV's to play.**
    - **Right-of-way affords high speed telecom infrastructure, power, etc**
- **Safer transport of crude from extraction plants.**

- **Proposed pipeline security system: three basic functions**
  - **Patrol, Detection, Response.**
  - **Patrol**
    - **Designed to relieve burden on human operator**
    - **Constant altitude video collection 10 km along pipeline tangent, 2 km tangent normal.**
    - **Continuous comparison of new video with 'normal model'**
    - **Electric flying wing at ceiling of uncontrolled airspace geo-fenced within latest coverage area calculation.**

10 Km
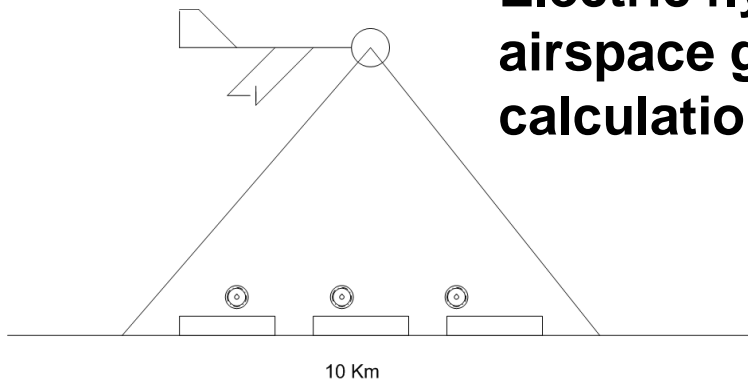
– Detection

- **Anomaly is detected by high altitude drone (or any other means) and human operator is alerted.**

- **Human operator has database of maintenance and other expected activity.**

- **If a closer look is required, human operator may deploy a smaller multi-rotor craft (placed at 20 km intervals along right-of-way) with surveillance equipment, lights and video equipment.**

- **Assessment delivered to human operator.**

10 Km
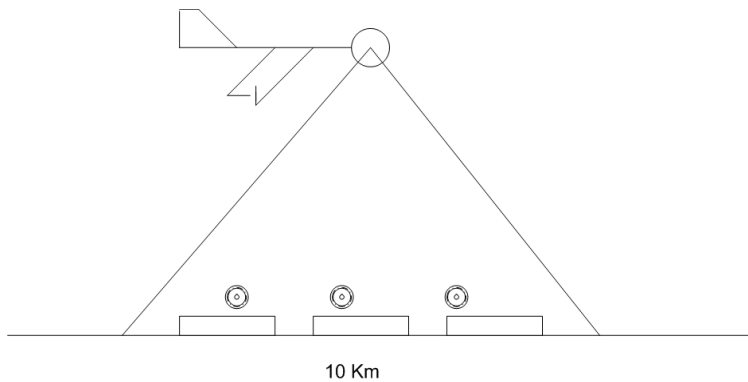
– **Response**

- **Human operator determines response based on detection data.**

- **Specialized video detection and instrumentation to determine environmental hazard.**

- **Aerial defense for pipeline sabotage (weaponized, equipped with sound broadcast etc.)**

- **Orderly stand-down and return to status-quo.**

– **Research areas**

- **UAV technology (Transportation Layer)**
  - **Weather-proof airframe and engine(s)**
    » **Ingress analysis**
    » **Seals, materials**
  - **Range extension**
    » **Batteries**
    » **Propulsion**
      » **Prop design, COMSOL modeling.**
    » **Weight**
  - **Control**
    » **Lightweight coding**
      » **Optimal distribution of computational resources**

– **Research areas**

- **Video Content Analysis(Sensory Layer)**
  - **Distributed processing**
    - » **Power consumption**
    - » **Information Processing**
  - **Advanced Sensing**
    - » **Situation analysis**
    - » **Presence of hazardous substance**
    - » **Night Vision**
  - **Implementation of non-video sensors**
    - » **LIDAR, SAR**

– **Research areas**

- **Human Interface (Management Layer)**
  - **Detection routing decisions**

- **Communication Layer**
  - **Radio interface(s)**
  - **Remote video processing**

- **System Management Layer**
  - **Service oriented design**

- **SAIT as *Educator*:**
  - **UAV research adds industry relevance.**
    - **Through student participation in test activities.**
  - **Tracking of policy and forecasts for evolving technologies.**

- **SAIT as *Industry Enabler***
  - **Education programs for UAV avionics.**
  - **Industry resource for aid in *interpretation* of regulatory**

- **SAIT as *Technology Leader***
  - **Participation in Standards Development.**
    - **ISO, IEEE**
    - **Transport Canada, FAA**