

Aero2Astro

Weekly Report 1

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Report

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UAV:

UAV stands for unmanned aerial vehicle or unscrewed aerial vehicle. It is commonly known as drone. It is an aircraft without a human pilot on board. The flight of UAVs may operate under remote control under by a human operator or some other technique such as autopilot assistance.

UAVs are originally used for mission which are too dull, dirty or dangerous for humans. The application of UAVs are aerial photography, product deliveries, agriculture, policing and surveillance, infrastructure inspections etc.

Types of UAV

UAV's can be classified on different basis like :

Classification according to size

1. Very small UAV
2. Small UAV
3. Medium UAV
4. Large UAV

Classification according to Range and Endurance

1. Very low cost ,close range UAVs
2. Close range UAVs
3. Short Range UAVs
4. Mid-range UAVs
5. Endurance UAVs

Advantages of UAVs:

1. Quality Aerial Imaging:
2. Precision
3. Easily Deployable
4. Security

Disadvantages of UAVs:

1. Legislative Uncertainty
2. Safety:
3. Privacy:

Limitations of UAVS

1. Low operation Speed
2. Vulnerable to hackers
3. Privacy issues
4. Collateral Damage
5. Causes Unemployment
6. Battery Life
7. Weather changes
8. Cost

Aerial Inspection

Aerial Inspection is a process of inspecting various image data collected with the help of different types of UAVs/Drones and sensors at different places for better analysis and working of that field. Aerial inspection can provide information on many things not visible from ground.

Uses of aerial inspection

Aerial Inspection is used in different fields such as:

1. Mining
2. Geographical Survey's
3. Self-Driving Cars
4. Agriculture
5. Large-Scale Area
6. Project Surveillance

Industrial application for aerial inspection:

Industrial application of aerial inspection can be seen in many industries such as:

1. Mining
2. Infrastructure
3. Railways
4. Highways and roads
5. Agriculture
6. Power plant
7. Transport
8. Military

Advantages of aerial inspection

1. Faster inspection time
2. Real cost saving

3. More detailed survey
4. Safety
5. Greater coverage

Disadvantages of aerial inspection:

1. Privacy violation
2. Public safety
3. Threat to nature
4. Unclear legislation

Available software for Aerial Inspection:

- ArcGIS
- Agisoft PhotoScan
- Recap
- Mapware
- Pix4Dmapper
- Drone Deploy
- Micmac
- MATLAB

TOWER

Tower can be state as a building or a structure which is higher than its diameter and highly related to its surroundings that may be stand apart or stay together with a larger structure.

Telecom Tower

A cell tower, telecom tower or mobile mast is a structure equipped with antennae and other necessary electronics, transmitters, receivers and power sources needed to relay a mobile phone signal.

Types of Telecom Tower

- 1 Cell on wheel
- 2 Monopole
- 3 Roof Top Tower
- 4 Roof Top Pole
- 5 Wall Mount
- 6 Ground Based Tower(GBT)

Tower Inspection with drone

Communication companies with cell and radio towers, cities with electric towers, and other industries that use towers as part of their daily operations—all of these towers require regular maintenance, and before the maintenance work can be done, a preliminary survey must be conducted to determine where to work.

- In tower surveys, a drone can help identify potential climbing hazards, find structural damage, and help tower inspectors understand the tools they need prior to climbing.
- Once this information has been gathered, a tower inspector can follow up and address the issues revealed in the data, if any.
- Drone surveys serve to reduce the amount of time personnel are on the tower, increasing their efficiency and keeping them safe.

Things to be inspected in Tower during inspection:

- The ground, such as ground movement or erosion
- Power lines, such as hot-spots or indicators of corona discharge
- Transmission towers, such as corrosion, broken components, and foreign objects on the tower
- Surrounding vegetation, such as tree growth rate and areas of vegetation encroachment
- Others ,such as unauthorized debris and construction activity

Hazards/risks while doing tower inspection:

- 1 Falling from height risk
- 2 Electric shock risk
- 3 Unwanted weather changes risk
- 4 Equipment failure
- 5 Structural collapse

Wind Turbine:

A wind turbine is a device that converts the wind's kinetic energy into electrical energy. Wind turbines are manufactured in a wide range of sizes, with either horizontal or vertical axes.

Types of wind Turbine

There are basically 2 types of wind turbines. They are

1. Horizontal-axis turbines
- 2.** Vertical-axis turbines

Benefits

1. The base of the tall tower allows for strong air access to sites with wind shear.
2. High efficiency

Disadvantages

1. Construction of a large tower is required to support heavy blades, gearbox, and generator.
2. The horizontal wind components of the air axis (gearbox, rotor shaft and brake assembly) are raised in place.
3. Their height makes them stand out from the crowd, distorting the appearance of the earth and sometimes creating local conflict.

Components of Horizontal-axis turbines

The basic components of Horizontal-axis turbines are as follows:

1. Foundation
2. Turbines
3. Nacelle
4. Generator
5. Rotor Blades

Components of Vertical-axis turbines

The basic components of Horizontal-axis turbines are as follows:

1. Guide wire
2. Hub
3. Rotor
4. Blades
5. Shaft
6. Brake
7. Gear
8. Generator
9. Base

Aerial Inspection of Wind Turbines

Aerial wind turbine inspection can be done in three steps

1. Collecting images from drones
2. Analyze images
3. Generate report

“Analysing” the collected images can either be done manually or automatically using cutting edge machine learning models. The task of manually looking at hundreds of high definition images is tedious and mundane which leaves it vulnerable to human errors.

This step can be automated using Machine /deep learning steps. Some AI techniques can be used to analyse the image.

AI techniques that can be used in Aerial inspection of Wind Turbines can be :

1. RCNN
2. Fast RCNN
3. Faster RCNN
4. YOLO

Faults in Wind Turbine:

The three wind turbines components that have the highest incident of failure are gearbox, generators, and rotor blades.

Rotor Blades:

1. Skin/Adhesive Debonding
2. Adhesive joint failure
3. Splitting along fibres
4. Crakes in Gel coats
5. Leading Edge eroision

Generators:

1. Rotor Insulation Damage
2. Rotor Lead Vibration and/or head
3. Bearings – Thermal and vibration
4. Magnetic Wedges loosen

Gearbox:

1. Fretting
2. Micro Pitting
3. Fatigue Crakes
4. Material inclusion

Object Detection:

Object recognition is a general term to describe a collection of related computer vision tasks that involve identifying objects in digital photographs. *Image classification* involves

predicting the class of one object in an image. *Object localization* refers to identifying the location of one or more objects in an image and drawing a bounding box around their extent.

Object Detection Method

There are many deep learning methods that are available for deep learning task:

1. RCNN
2. Fast-RCNN
3. Faster RCNN
4. YOLO

Methods for Fault Detection in Wind Turbine

1. Manual Annotation:
2. Image Augmentation:
3. Using Damage Detection Framework