Updated Task: 02

Date:19.05.2021

Aerial inspection and concepts used in:

In aerial inspection there are 4 steps:

1. Planning:

   Aerial inspection is about to catch the defects in a particular area. For that we need to make a particular path for UAV and design a pattern to fly. This step is a must for determining the parameters to inspect effectively.

2. Inspection:

   After planning we are ready to take off the UAV for the detection. The pattern we decide on the drone it follows and gives us a High resolution image of that particular object. UAV has its sensors and camera to generate complete and reusable data as history of inspection in the future inspection.

3. Analysis:

   In inspection collected the specific raw data it undergoes to data preprocessing. The processing is based on type of data. Also resize, rotate the images for that purpose we use the software “scopito”. Scopito helps to transform the raw data into actionable data insight.

4. Reporting:

   Final step is to report the data which is finely visualised and analysed with detailed information about location, sorted images makes it easy to detect the damage or defects. All this information is mentioned in one user-friendly format for the client is a report of inspection.

Concepts:

Some basic concepts are used in aerial inspections:

1. Focal length:

   Distance from the middle camera lens to focal plane. As focal length increases image distortion decreases.

2. Scale:

   The ratio from actual point on a photo to distance from ground.

3. Large scale :

   A large scale photo simply means that ground features are at a larger, more detailed size. The area of ground coverage that is seen on the photo is less than at smaller scales.

4. Small scale:

A small scale photo simply means that ground features are at a smaller, less detailed size. The area of ground coverage that is seen on the photo is greater than at larger scales.

5. Roll and photo numbers:

   Each aerial photo is assigned a unique index number according to the photo's roll and frame. Identifying numbers allows you to find the photo metadata information such as the date it was taken, the plane's altitude (above sea level), the focal length of the camera, and the weather conditions.

6. Overlap:

   The amount by which one photograph includes the area covered by another photograph, and is expressed as a percentage. The image survey is designed to acquire 60% forward overlap (between photos along the same flight line) and 30% lateral overlap (between photos on adjacent flight lines).

7. Stereoscopic Coverage:

   The three-dimensional view which results when two overlapping photos (called a stereo pair), are viewed using a stereoscope. Each image of the stereo pair provides a slightly different view of the same area, which the brain combines and interprets as a 3-D view.

8. Flight Lines and Index Maps:

   The aerial survey contractor plots the location of the first, last, and every fifth photo centre, along with its roll and frame number, on a National Topographic System (NTS) map. Photo centres are represented by small circles, and straight lines are drawn connecting the circles to show photos on the same flight line.This graphical representation is called an air photo index map, and it allows you to relate the photos to their geographical location.

Advantages of aerial inspection:

1. Safety environment
2. Easy to control
3. Cost saving
4. Quality images and live streaming

Disadvantages of aerial inspection:

1. Privacy violation
2. Endangering public safety
3. Potential threat to nature
4. Unclear legislation

Inspection methods:

1. ground inspection:
    a. Conducted by a team traveling along the power line corridor on foot or by off-road vehicle .
    b. Inspectors visually inspect the power lines using observation tools such as binoculars,infrared cameras and corona detection cameras. decades due to the high accuracy
    c. Problems:
        i. Labour-intensive
        ii. Low efficiency
        iii. Extremely complex landform
        iv. Weather

2. airspace inspection:
    a. Typically performed by a climbing system or an aerial system
    b. It applies a mobile robot to cross obstacles found on power lines and inspects the passing components along the line .
    c. Climbing robots can obtain high quality images due to their proximity to the conductors. 4. Inspects power lines based on aerial vehicles such as helicopters, multi-rotor UAV and fixed wing UAV.
    d. UAV travels along the power line which is controlled by humans or flies automatically. Multiple sensors on-board the aerial vehicle are utilized for visual observation and data collection.
    e. Problems:
        i. Labour-intensive
        ii. Low efficiency
        iii. Extremely complex landform
        iv. Weather

Aerial Triangulation:

Triangulation is a technique for establishing the relative position of two or more points. Aerial triangulation (AT) is a method for producing maps by overlapping aerial images.

How it Works:

Aerial triangulation represents the process for determining the correct position and orientation of each image in a series of aerial images so they can be compiled into a map.

Tower / Structure inspection using drone:

When it comes to 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.

Things to inspect in tower inspection:

1. The ground movement or erosion.
2. Powerlines hotspots.
3. Transmission towers, such as corrosion, broken components, and foreign objects on the tower
4. Surrounding vegetation like tree growth rate and areas of vegetation encroachment.
5. Unauthorized debris and construction activity.

Use cases:

1. Identifying environmental or other hazards before climbing(bee, birds structural damage, etc.)
2. Identifying damages.
3. Pre-work inspection determines the tools and parts needed ahead of a climb.
4. In the case of structural emergency, you can investigate structures integrity before you climb, and find out if it's safe to climb at all

Types of Telecom towers:

1. camouflaged towers:
   They are more expensive compared to other cell tower types. They are required by zoning.
2. Lattice towers:
   These towers are usually seen along the highways. They are three and four sided.
3. Monopole towers :
   It requires one foundation and height does not exceed about 200 feet. In these types, antennas are mounted on the exterior of the tower.
4. Guyed towers:
   These towers are cheap to construct but cover a large area. Radio and tv stations use this type of cell phone tower. This tower uses guy wires connected to the

ground to provide the support to the straight tower in the middle. It is about 300 feet and above in height.

Electric Towers:

Electric towers are tall metal structures which hold electric cables high above the ground which enables the electricity to flow over long distances. Electric towers are also called Electricity Pylons.

Main parts:

1. Tower top:
   Tower top is used to carry earth shield wire. This is connected at the tip of the tower also known as earth wire
2. Cross arm:
   Cross arm is used to hold insulators. Insulators are used to carry transmission conductors. The Dimension of the cross arm depends upon the level of voltage to be transmitted.
3. Beam:
   Beam is the portion between cross arms. This is used to hold cross arms.
4. Insulator strings:
   Insulator string is used to carry transmission lines. There is no. very depending upon the level of Transmission voltage to be transmitted. As the voltage level increases no. of insulators increases in a string.
5. Cage of Transmission tower(Fork K-Frame):
   Cage is the main structure of Transmission towers which provides support to the whole body of the Transmission tower.
6. Tower body and leg of the Transmission tower:
   They are the base of the transmission tower. During the design of the Transmission tower, the minimum ground clearance of the lowest conductor point above the ground level depends upon the Tower body and leg of the transmission tower.
7. Tower base:
   Base of the tower is the main holding of the whole Transmission tower.
8. Vibration Damper:
   As clear from its name these are used for damping out vibrations due to wind in transmission towers.

Types of Electricity Pylons:

Types of pylons based on their functions:

1. Anchor Pylon
2. Branch Pylon
3. Tension Pylon

1. Anchor Pylon:

Anchor pylons or strainer pylons are hired at branch locations as branch pylons and must appear at a maximum distance of 5 km, due to technical limitations in the conductor length.

2. Branch Pylon:

Branch pylon is a pylon that is used to start a line branch. The branch pylon is responsible for holding up both the main-line and the start of the branch line, and must be structured so as to resist forces from both lines.

3. Tension Pylon:

A tension tower with phase transposition of a traction current line for single phase AC 110 kV, 16.67 Hz.

Types of towers based on places:

1. Ground-Based Tower:

   Erected on the ground, ground-based towers (GBTs) are taller, typically 200 to 400 feet. Used in rural and semi-urban areas because of the easy availability of real- estate space there. GBTs involve a capital expenditure in the range of Rs. 2.4 to 2.8 million, depending on the height of the tower.

2. Roof-Top Tower (RTT):

   Roof-top towers (RTTs), which are generally placed on the roofs of high-rise buildings, shorter than GBT more common in urban and highly populated areas. Typically, these involve a capital expenditure of Rs. 1.5 to 2 million.

Types of tower based on structures:

1. Waist type towers:

   It is a Most common type of electric tower. Used for carrying voltage of 110 kV to 735 kV.

2. Double circuit towers:

   These towers were used for carrying voltage from 110 kV to 315 kV. Size of them ranges from 25 to 60 meters.

3. Guyed V towers:

   Guyed V towers used for carrying voltage from 230 kV to 735 kV. These are More expensive.

4. Tubular steel pole:

These are Steam lined aesthetic shapes and Easy to blend with the environment.

5. Guyed crossed rope suspension tower:
   These types of towers are Simple design with Supports 735 kV conductors.

6. Crossings tower:
   Crossing towers are the most prominent towers and these are used when overhead power lines must cross large water bodies.

Inspection methods and Tools:

1. Orthomosaic Map:
   An orthomosaic is a geometrically correct aerial image that is composed of many individual still images that are stitched together.
   This Orthomosaic images are used to create 3D model or elevation model for analyzing all inspections

2. Thermal Image :
   a. Thermal images are captured by thermal cameras which are used to analyze heat distribution.
   b. In the transmission line, if more heat is produced which shows that there will be a short circuit or corona effect.

3. LiDAR Point Cloud:
   a. LiDAR point cloud is a 3D model which is created by LiDAR data points. This 3D model is very useful to analyze all kinds of things.

4. Multi-spectral image:
   a. A multi-spectral image is one that captures image data within specific wavelength ranges across the electromagnetic spectrum. This image used the analysis property of a land tower.

Inspections example: Cell tower

Goal :

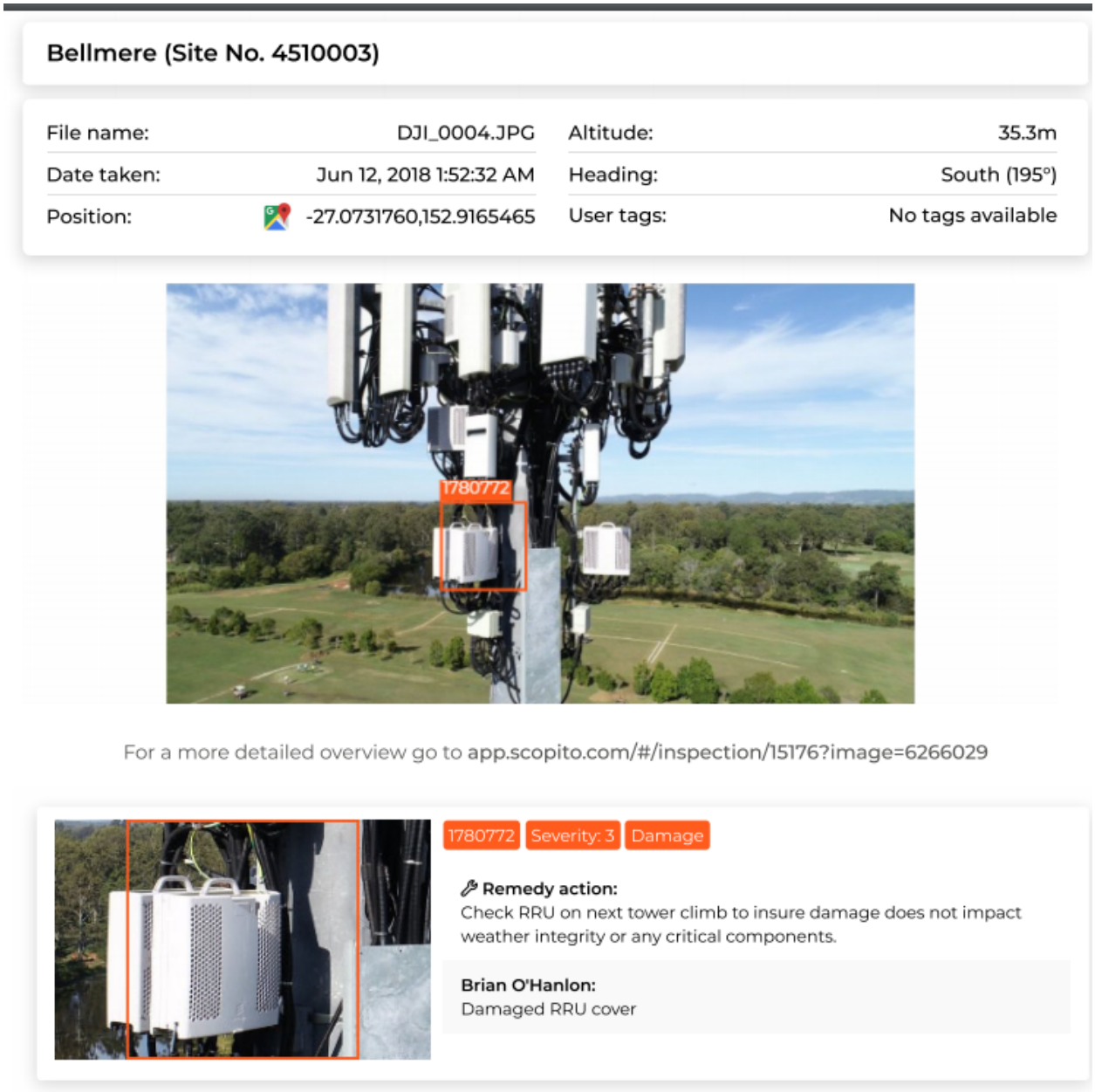
collect highly detailed visual data regarding the conditions of a cell phone tower.

Mission:

collect the data, accurate visual data on the state of the cell phone tower. Using a camera that allows for high accuracy while zooming. Maintain equal distance from the tower while collecting visual data.

Deliverables:

Visual data that can be used to analyse the condition of the cell towers .

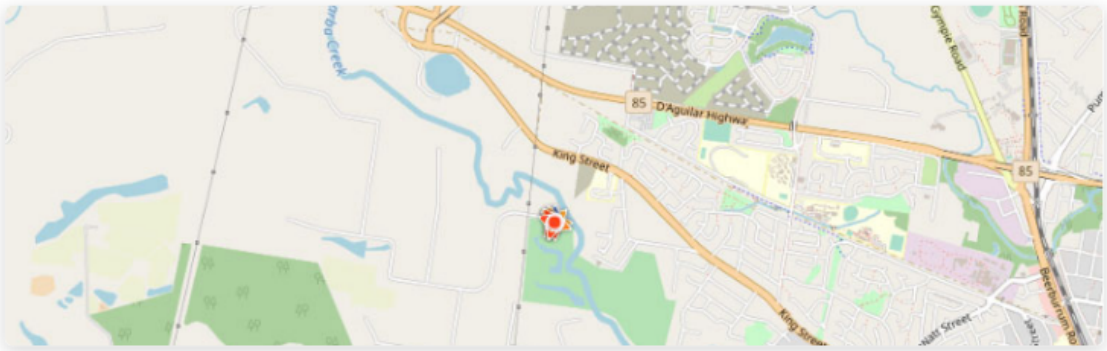


Here shows how aerial inspection is done using drones. In the report there is mentioned the name or roll number of particular images with location and time taken.

At the end of the report they commented about the problem in that particular tower part. And also mentioned about the remedy action.

Bellmere (Site No. 4510003)

Report date:	Type:	Company:	Report images:	Annotations:
Aug 24, 2020	**Cell Tower**	**Scopito Demo 1**	**22**	**26**



Severity overview

Severity 1	Severity 2	Severity 3	Severity 4	Severity 5	POI (?)
6	3	5	7	0	5

Bellmere (Site No. 4510003) - Summary

F03 Preliminary Report for Site No. 4510003

1. Concrete Damage and Corrosion to Base Plate:

The concrete apron around the base of the tower is damaged. This exposed advancing corrosion around the bottom of the base plate. Recommended that an accredited inspector determine severity of corrosion.

2. Antenna Brackets:

There is visible surface rust and initial metal loss on the western facing antenna threaded rods and nut on northeast facing antenna. Recommended that an accredited inspector determine severity of corrosion. Suggest nuts and threaded rods be swapped out at next site visit.

Antenna bracket on western facing antenna night aligned to antenna. Suggest adjusting and re-securing this bracket at next site visit.

3. Damaged RRU Covers:

The damaged RRU on the northern face appears to be cosmetic only. The integrity of the RRU should be checked on next site visit.

4. Bad Termination:

The coax cable at the top of the monopole has not been sealed. Recommend this be brought to the attention of wireless network engineering and actioned as priority.

Components used in towers:

1. Antenna
2. DSPs
3. Transceivers
4. Control circuitry
5. Gps receiver
6. Power sources
7. Shelter structures

Hazards of towers:

1. Disrupted sleep, Headache, Dizziness, Altered reflexes, Depression, Fatigue, Joint pains, Heart disorders, Alzheimers, DNA damage, cancers are just some of the health hazards of exposure to cell tower radiations.
2. Hazards to bees and birds are also an endangered species.

Terminology:

Stronghold, lookout, fortification, belfry, skyscraper, column, pillar, spire, mast, refuge, steeple, monolith, castle, fortress, fort. Triangulation is a technique for establishing the relative position of two or more points.

Conclusion :

I've studied briefly about Aerial inspection concepts and telecom and electric towers.