RecognAIse
Infrastructure Inspection

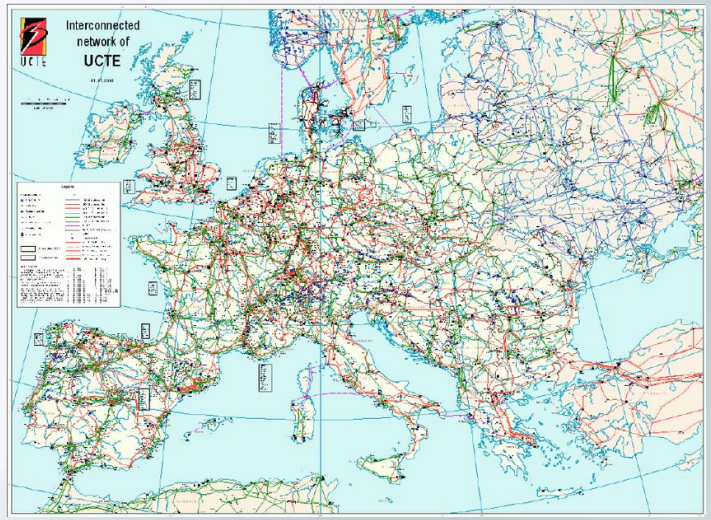
Unmanned Systems for Transmission Lines

by
Dr. Janos Toth

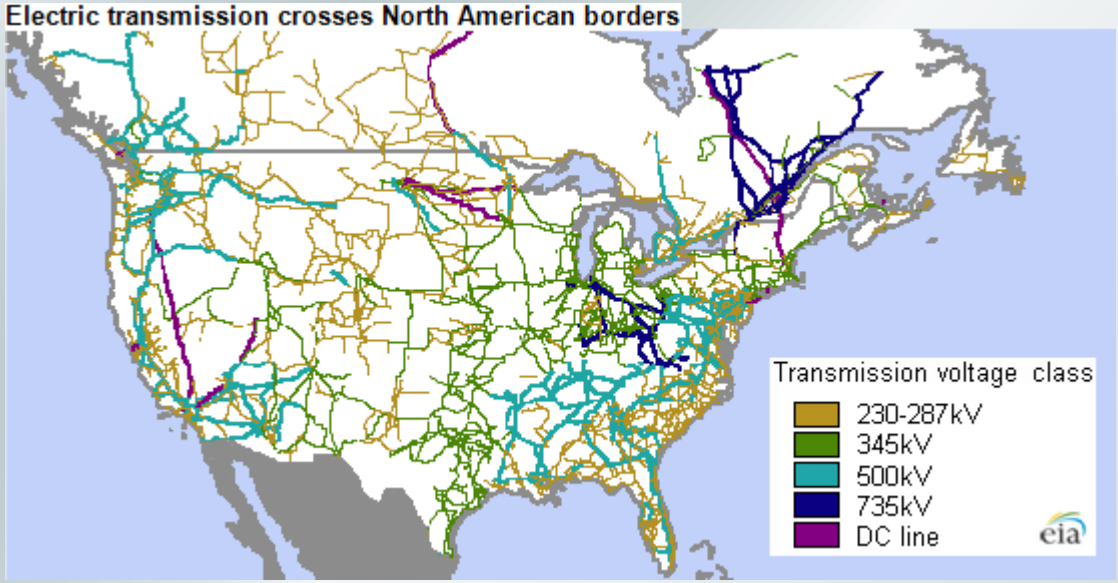
Transmission Grid

Transmission lines

- Canada 200,000 km
- USA 300,000 km
- European Union 400,000 km
- China 190,00 km



https://www.researchgate.net/figure/UTCE-Western-European-Power-Grid-courtesty-of-UTCE_fig1_228919607



https://www.eia.gov/todayinenergy/detail.php?id=8930

RecognAIse
Infrastructure Inspection

The Problem(s)

- Most transmission line in North America and Europe were built over 50 years ago
- The system in North America operates close to its capacity limits
- Decarbonization of the system is in progress due to climate change pressures
- Renewable energy (mainly wind and solar) integration put additional strain on the system
- Electrification of transportation is estimated to require about 2.5 times the transmission grid capacity
- Building new transmission lines is difficult due to public acceptance (Not in My Back Yard NIMBY)

RecognAIse
Infrastructure Inspection

Transmission Grid Needs

- More frequent inspections
- Refurbishing work
- Insulator replacements
- Hardware replacements
- Reconductoring

But

- Skilled labor is not readily available
- Labor is expensive (Engineering cost, lineman cost)
- Certain skillsets are necessary (for example live line work)
- Everything has to be done in a safe and coste effective manner
- Do more with less resources

RecognAIse
Infrastructure Inspection

Solution(s) for the Problems

- Automation at every possible level
- On the ground robots (Mainly substations)
- Crawling robots (crawling on the conductor)
- Flying robots (Unmanned Aerial Vehicles)
- Managing the collected data flow
- Processing collected data (Big Data, Artificial Intelligence)

RecognAIse
Infrastructure Inspection

Inspection with Ground Based Robots

- China

https://transformers-magazine.com/tm-news/2180-intelligent-robots-presented-at-power-substation-in-beijing/

RecognAIse
Infrastructure Inspection

Inspection with Ground Based Robots

- National Grid, USA

https://www.tdworld.com/test-and-measurement/article/21152823/boston-dynamics-robots-bring-safety-to-national-grid-converter-station

RecognAIse
Infrastructure Inspection

Inspection with Crawling Technologies

- Kinectrics LineVue (Canada)
- Hydro Quebec systems (Canada)
- HiBot (Japan)
- Refurbishing work
- Insulator replacements
- Hardware replacements
- Reconductoring

RecognAIse
Infrastructure Inspection

Inspection with Crawling Technologies

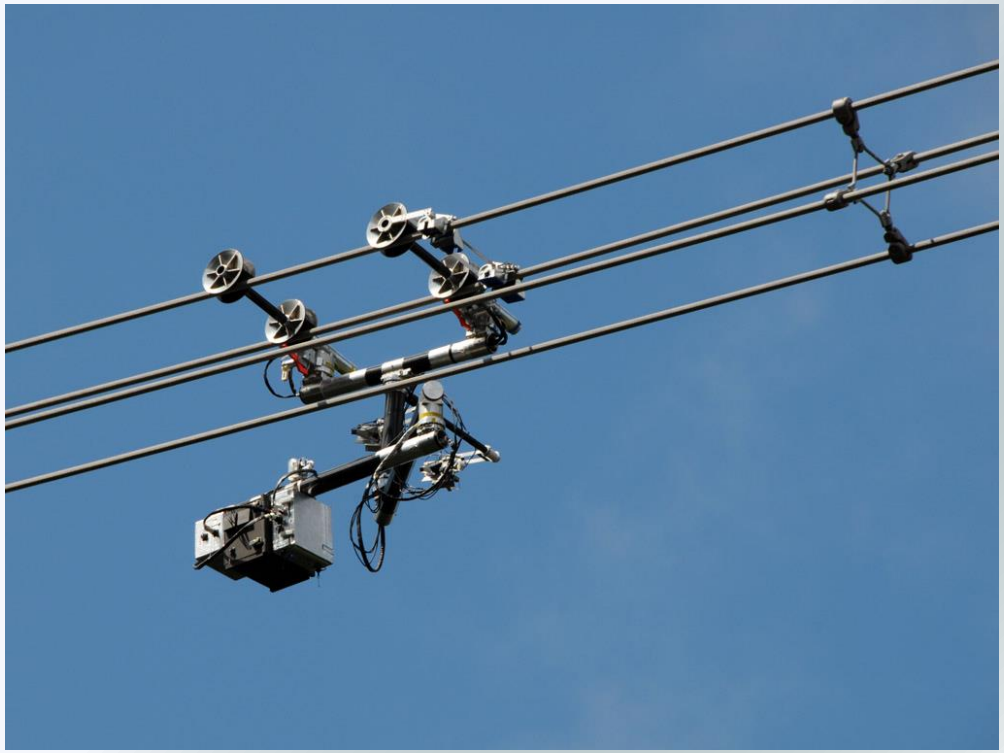
- LineVue, Kinectrics, Canada

https://www.kinectrics.com/spotlight/Documents/2021%20Brochures/LineVue8PG%20Brochure%20LV0203218PG.pdf

RecognAIse
Infrastructure Inspection

Inspection with Crawling Technologies

- Expliner by HiBot (Japan)



https://robots.ieee.org/robots/expliner/?gallery=photo3

https://www.youtube.com/watch?v=ueYWzmuYD_0

RecognAIse
Infrastructure Inspection

LineRover

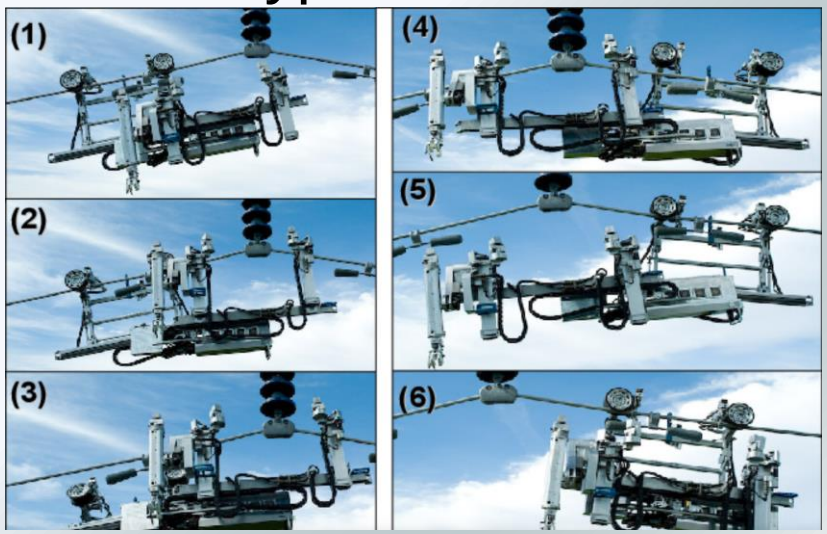
- Developed by Hydro Quebec, Canada
- Crawling on the conductor
- Camera system
- Ohm Stick

http://www.hydroquebec.com/robotics/distribution-solutions-linerover.html

RecognAIse
Infrastructure Inspection

LineScout

- Developed by Hydro Quebec
- Platform for inspection (visual, infrared, X-ray, Ohm Stick))
- Platform for repair (tighten bolts, temporary fixing of conductors
- Able to bypass obstacles



http://www.hydroquebec.com/innovation/en/pdf/2010G080-02A_LineScout.pdf

https://www.semanticscholar.org/paper/Reliable-and-intuitive-teleoperation-of-LineScout%3A-Pouliot-Latulippe/ba52d99f3895cba656631f6a98b9658420a6b201/figure/1

RecognAIse
Infrastructure Inspection

LineRanger

- Developed by Hydro Quebec, Canada
- For bundled conductors
- Live line installation and removal
- Platform for cameras and sensors

http://www.hydroquebec.com/robotics/transmission-solutions-lineranger.html

https://www.youtube.com/watch?v=OItActG9S6U&t=54s

RecognAIse
Infrastructure Inspection

LIneCore Technology

- Conductor core corrosion assessment
- Broken strands detection

http://www.hydroquebec.com/robotics/distribution-solutions-linecore.html

http://news.hydroquebec.com/en/press-releases/1708/hydro-quebec-and-nucleom-sign-a-commercialization-agreement-for-linecore-and-lineohm-power-line-inspection-sensors/

RecognAIse
Infrastructure Inspection

LineDrone

- Developed by Hydro Quebec, Canada
- Mainly for conductor condition assessment
- Live line landing and take off

https://www.pressreader.com/canada/les-affaires/20170520/282024737197958

RecognAIse
Infrastructure Inspection

Unmanned Aerial Vehicles for Transmission Lines

- Unmanned Aerial Vehicles (UAVs)
- Emergency and Regular inpections
- Damage assessment for after extreme events (wind and ice stroms etc.)
- First eye on site
- Fault and damage assessment (reclose or not reclose)
- Right of Way inspections (vegetation control, encroachments etc.)
- Hardware, structure inspection (Condition assessment)

2010 1st International Conference on Applied Robotics for the Power Industry
Delta Centre-Ville
Montréal, Canada, October 5-7, 2010

Smart View for a Smart Grid – Unmanned Aerial Vehicles for Transmission Lines

Janos Toth, Ph.D.,P.Eng, P.E., and Adelana Gilpin-Jackson, P.Eng

RecognAIse
Infrastructure Inspection

Challenges with UAVs

- Rules and regulations (controlled and uncontrolled airspace)
- Flying over line of sight
- Navigation
- Following line
- Electro Magnetic Filed (EMF) exposure
- Sensors deployed (Visual, Thermal, Corona, Multispectral etc.)
- Lidar survey
- Data collection, transfer and processing

RecognAIse
Infrastructure Inspection

UAVs for line construction

- Mapping

https://www.uavgl.com/sale-8166198-high-accurate-mapping-fixed-wing-drone-easy-to-control-rtk-version-intelligent-thrust-reverse-decele.html

RecognAIse
Infrastructure Inspection

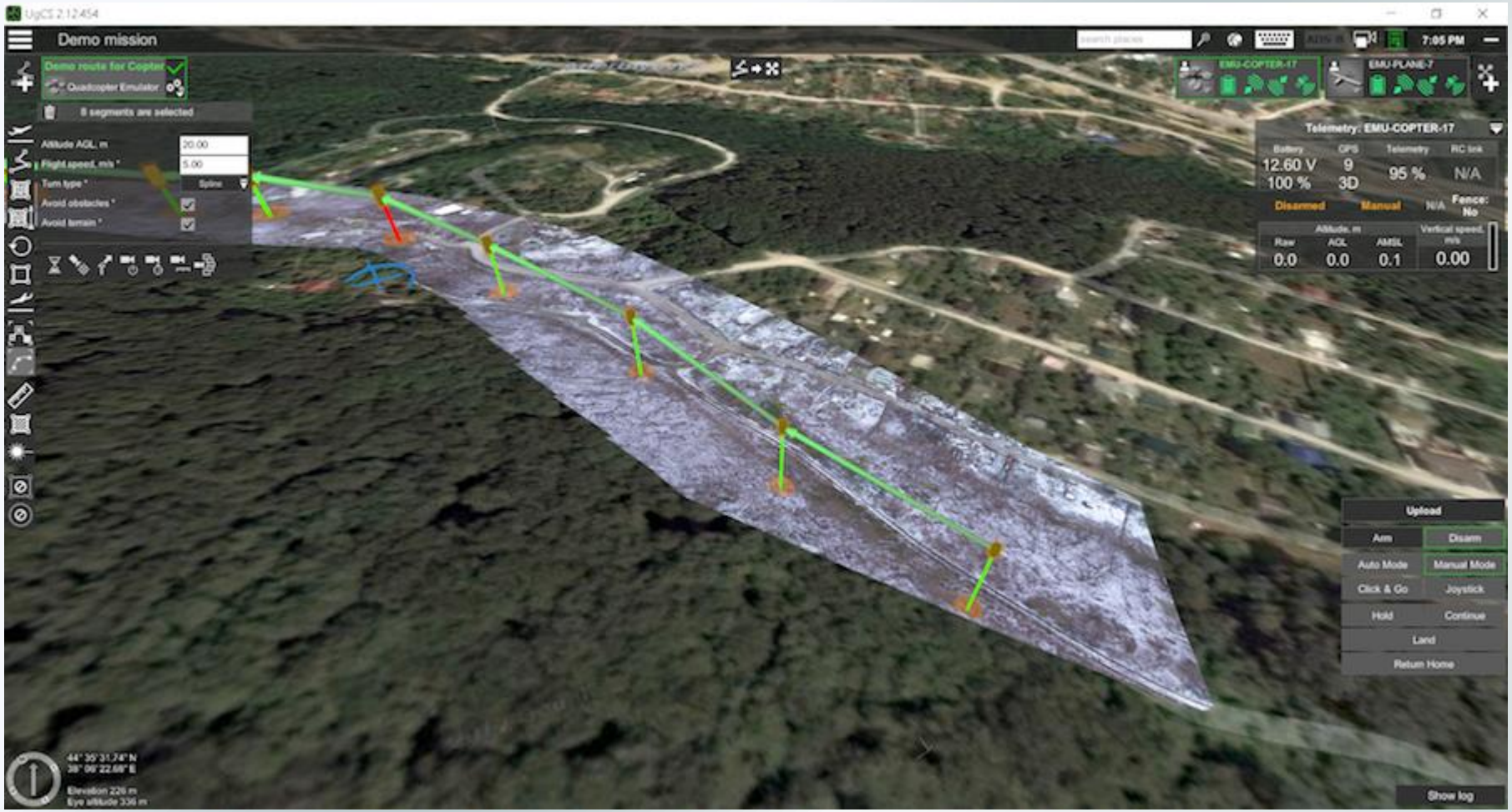
UAVs Fixed wing VTOL

- Field surveys
- Tower spotting checking
- Pilot line pull

https://dronerush.com/best-fixed-wing-drones-vtol-10757/

RecognAIse
Infrastructure Inspection

UAV Line Routing



https://www.ugcs.com/page/powerline-inspection-with-ugcs

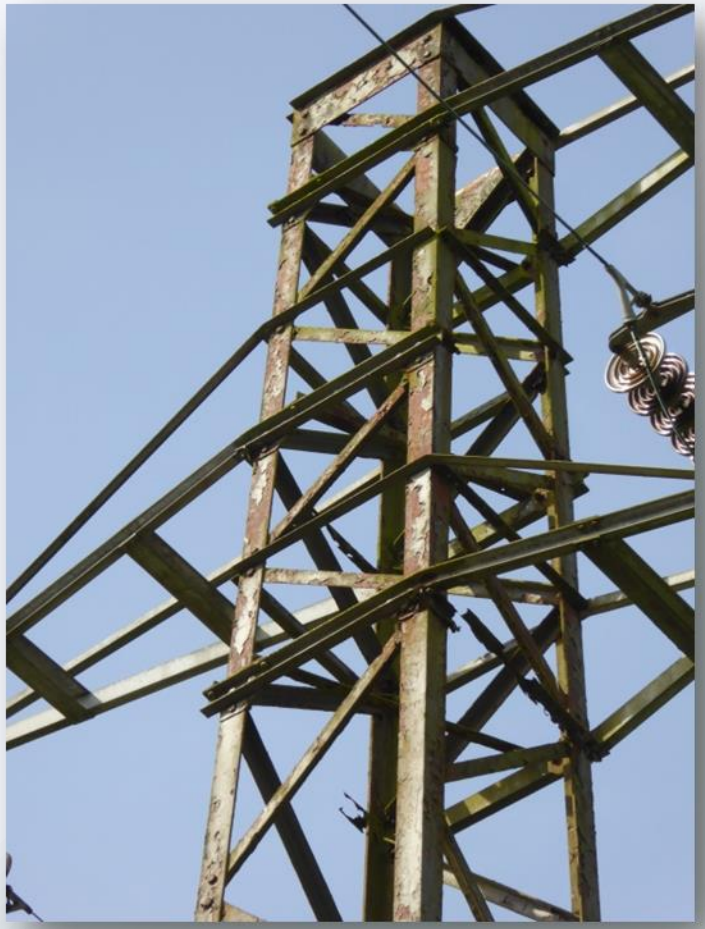
RecognAIse
Infrastructure Inspection

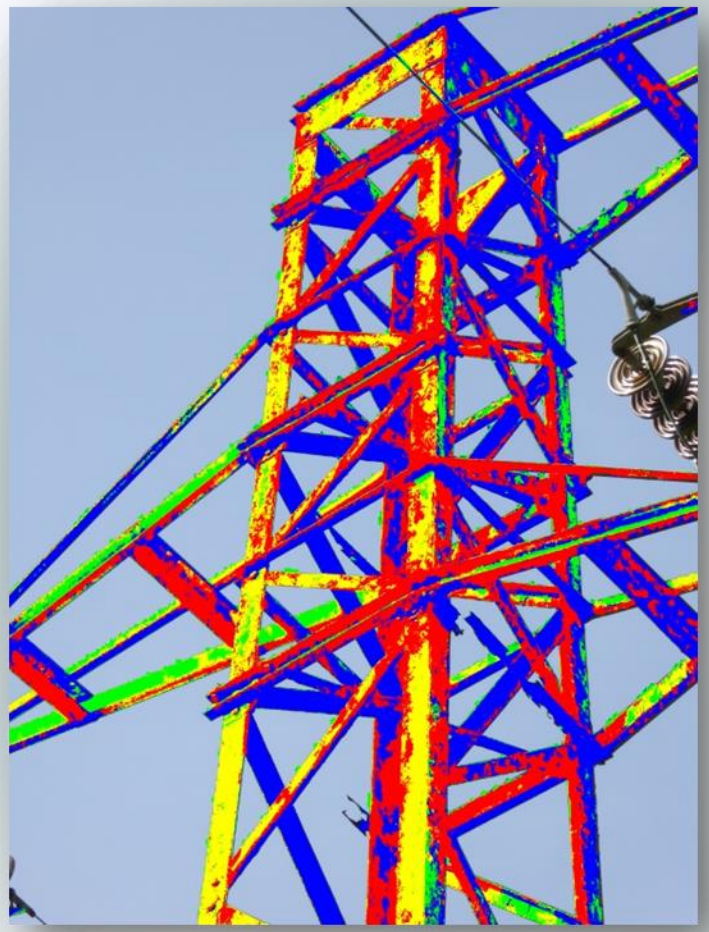
UAVs for Visual Inspection

- Flying UAV for image collection
- Tower spotting checking
- Pilot line pull

RecognAIse
Infrastructure Inspection

UAVs for Surface Corrosion Detection





RecognAIse
Infrastructure Inspection

UAVs for Transmission Line Stringing

- Replacing helicopter work
- Make work safer

RecognAIse
Infrastructure Inspection

UAVs for Multiple Roles

- Schiebel UAV helicopter platform
- Cameras
- Lidar

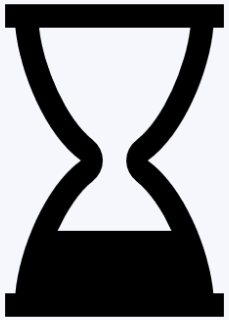
https://schiebel.net/products/camcopter-s-100-system-2/

https://schiebel.net/wp-content/uploads/2021/09/CAMCOPTER_S-100_214.jpg

RecognAIse
Infrastructure Inspection

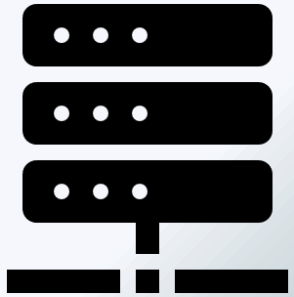
The Problem

AGING POWERLINES



Older powerlines require **frequent** inspections

INSPECTION BACKLOG



Inspections collect **thousands** of images each week

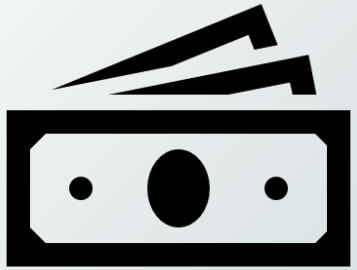
INSPECTION INCONSISTENCY

Human inspectors are prone to make costly mistakes

SLOW INSPECTIONS

A single image can take over **5 minutes** to properly inspect

EXPENSIVE INSPECTIONS



An inspector's man-hour cost is over **$155**

RecognAIse
Infrastructure Inspection

Why now?

Aging workforce is leaving with knowledge that can be absorbed by the software

Aging infrastructure needs to be inspected more often

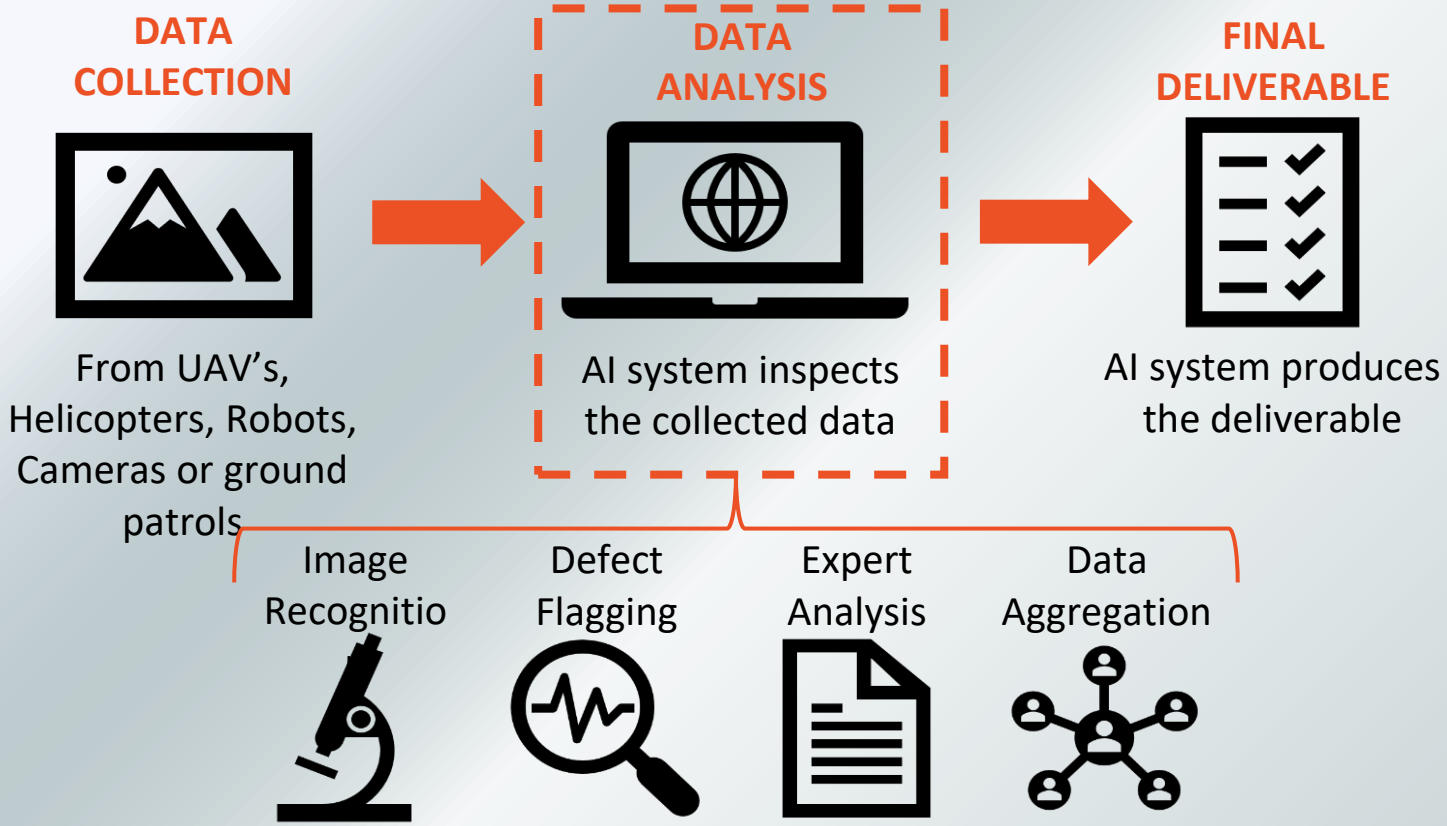
More frequent drone, robot and helicopter inspections are collecting large amounts of images

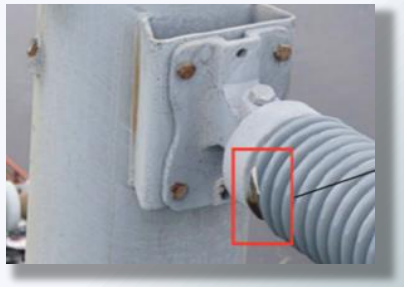
RecognAIse
Infrastructure Inspection

Streamlining Inspections

Using image recognition to identify defects on transmission lines

- **Saves time & money, while increasing accuracy**





RecognAIse
Infrastructure Inspection

The Solution

Helping transmission line managers streamline their drone, helicopter or mechanical robot inspections.

- Analyze images in all formats
- Inspect up to 1000 images per minute
- 98% effective in recognizing objects
- Low-cost solution

RecognAIse
Infrastructure Inspection

Questions

RecognAIse
Infrastructure Inspection

The Solution

RecognAIse
Infrastructure Inspection

RecognAIse
Infrastructure Inspection

Powering Infrastructure Inspections using Artificial Intelligence

info@recognaise.com

+1 (604) 671-4785