Combining Technologies: LiDaR, High Resolution Digital Images, Infrared Thermography and Geographic Information Systems

Presented by:

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Combining Technologies

Overview:

Combining LiDaR with High Resolution Imagery and/or Infrared Thermography allows efficient production of 3D modeling, Surveying, Topography and Planimetrics; all essential tools for:

- ❑ Planning
- ❑ Design
- ❑ Construction
- ❑ Rehabilitation
- ❑ Monitoring
- ❑ Retrofitting
- ❑ Assessment / Inventory / GIS
- ❑ Others

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Introduction:

We will demonstrate how by combining these technologies with GIS we can assist in the rehabilitation, retrofitting and optimization of the existing utilities and infrastructure of Puerto Rico.

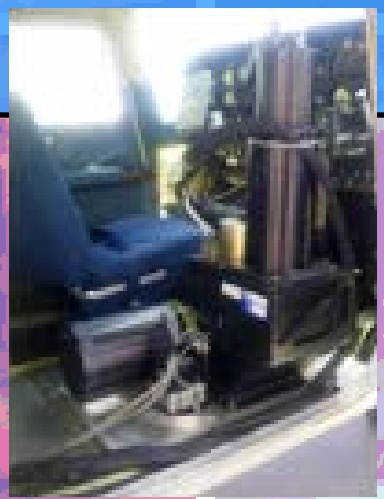
Nowadays one of the major obstacles for steady economic development, in any country, is the high cost of construction, operation and maintenance of needed infrastructure and utilities. In Puerto Rico this is specifically true for water and power distribution systems.

PRASA claims that almost 60% of the distributed water, form the WTP to the end user, is lost, unmetered and unbilled. This could be due to illegal connections, lack of efficiency or simply leaks.

PREPA has considerable loses because of deficiencies in the transmission and distribution systems, as well as due to lack of maintenance and vegetation encroachment.

LiDaR:

- **LiDaR** (Light Detection And Ranging) – is an active optical remote sensing technology that can measure the distance to, or other properties of a target by illuminating the target with light, using pulses from a laser. Gathering, storing, processing and delivering geographic or spatially referenced information.
- The basic components of a LiDAR system are a laser scanner, a Global Positioning System (GPS), and an Inertial Navigation System (INS). The laser scanner is mounted within a properly outfitted aircraft and emits infrared laser beams at a high frequency.



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LiDaR:

- The scanner records the difference in time between the emission of the laser pulses and the reception of the reflected signal.
- The position and orientation of the aircraft is determined using GPS. GPS systems are located in the aircraft and at two ground stations.
- The orientation of the aircraft is then controlled and determined by the INS.
- The round trip travel time of the laser pulses from the aircraft to the ground are measured and recorded, along with the position and orientation of the aircraft at the time of the transmission of each pulse.
- After the flight, the vectors from the aircraft to the ground are combined with the aircraft position at the time of each measurement and the three dimensional XYZ coordinates of each ground point are computed. This generates a extremely dense point cloud.

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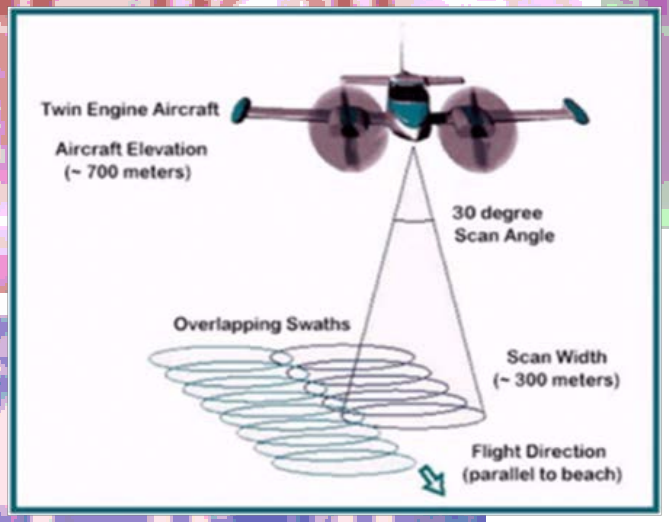
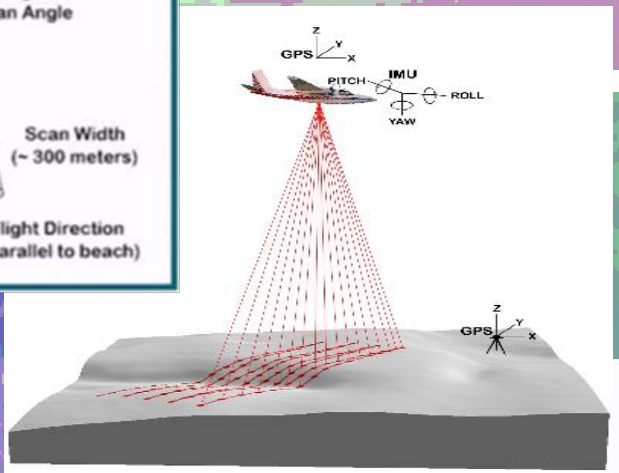
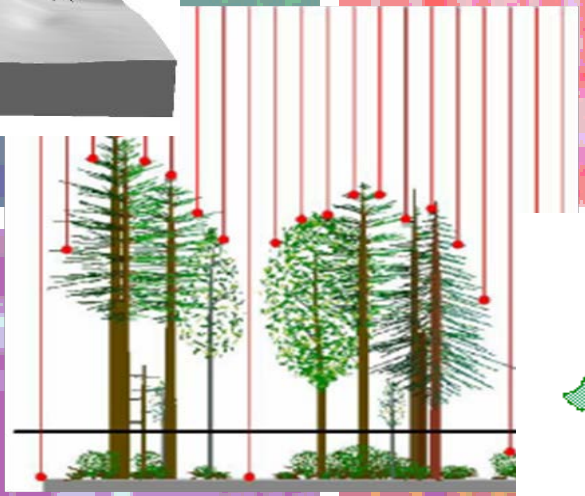
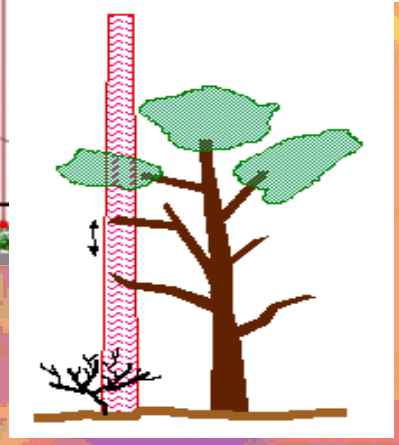
LiDaR:









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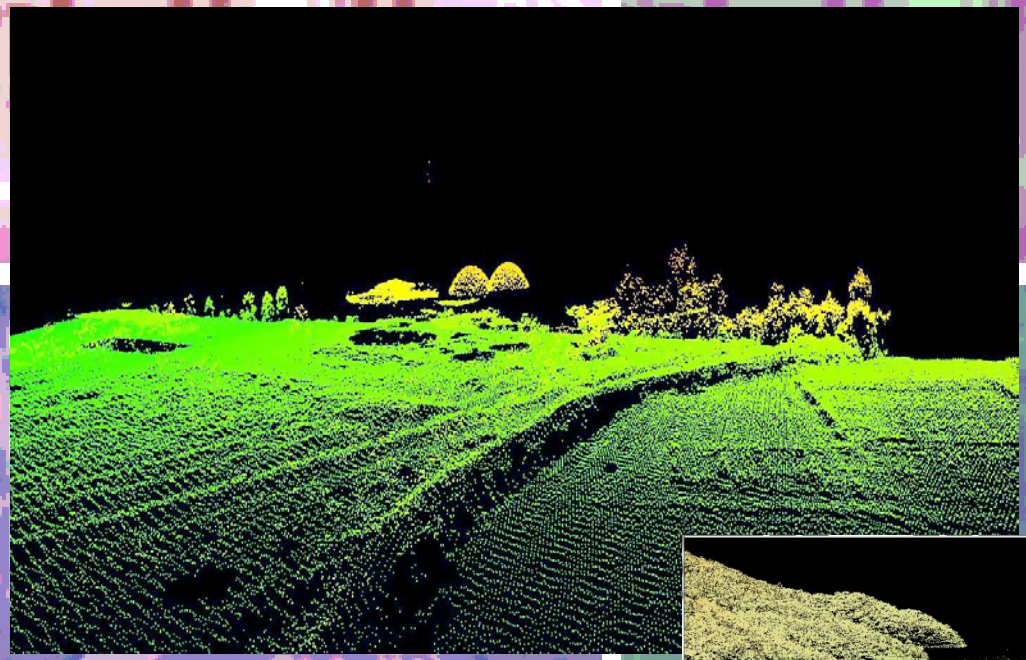
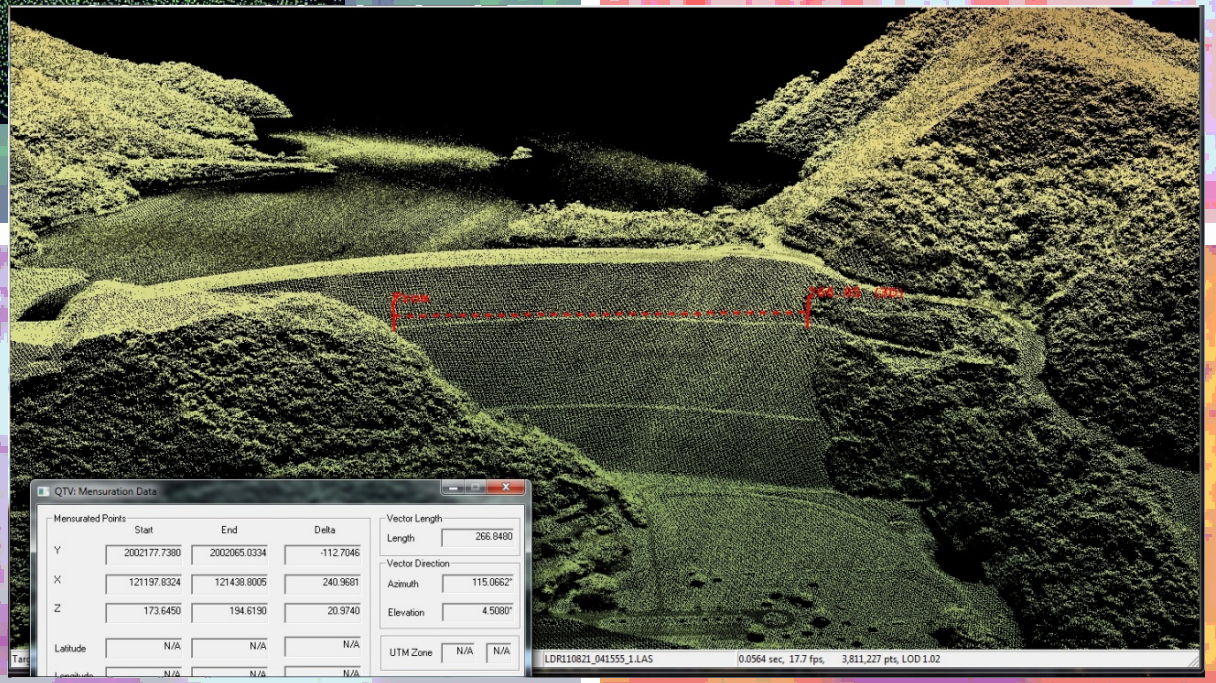
LiDaR:





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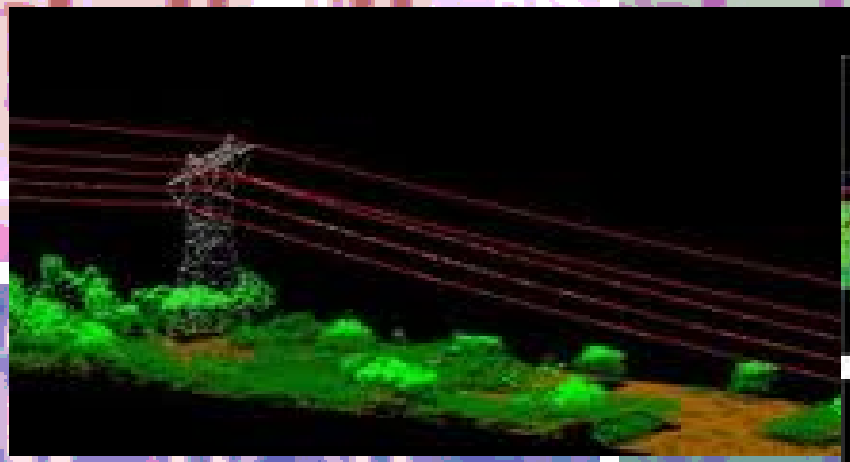
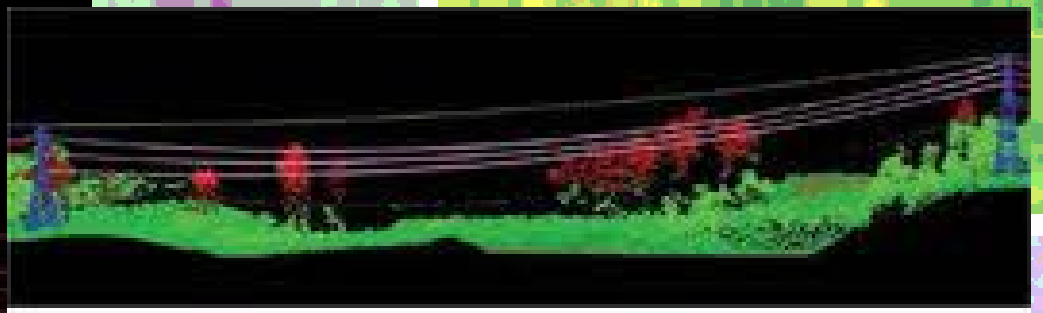
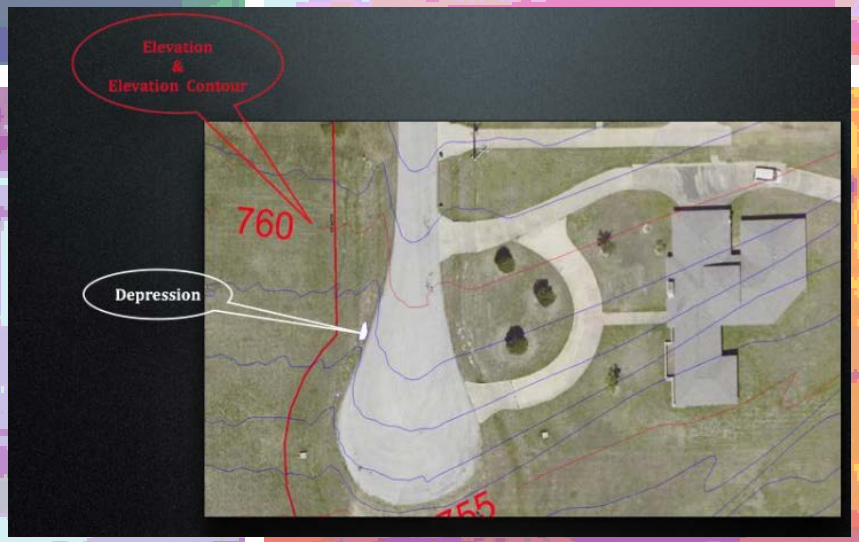
LiDaR:







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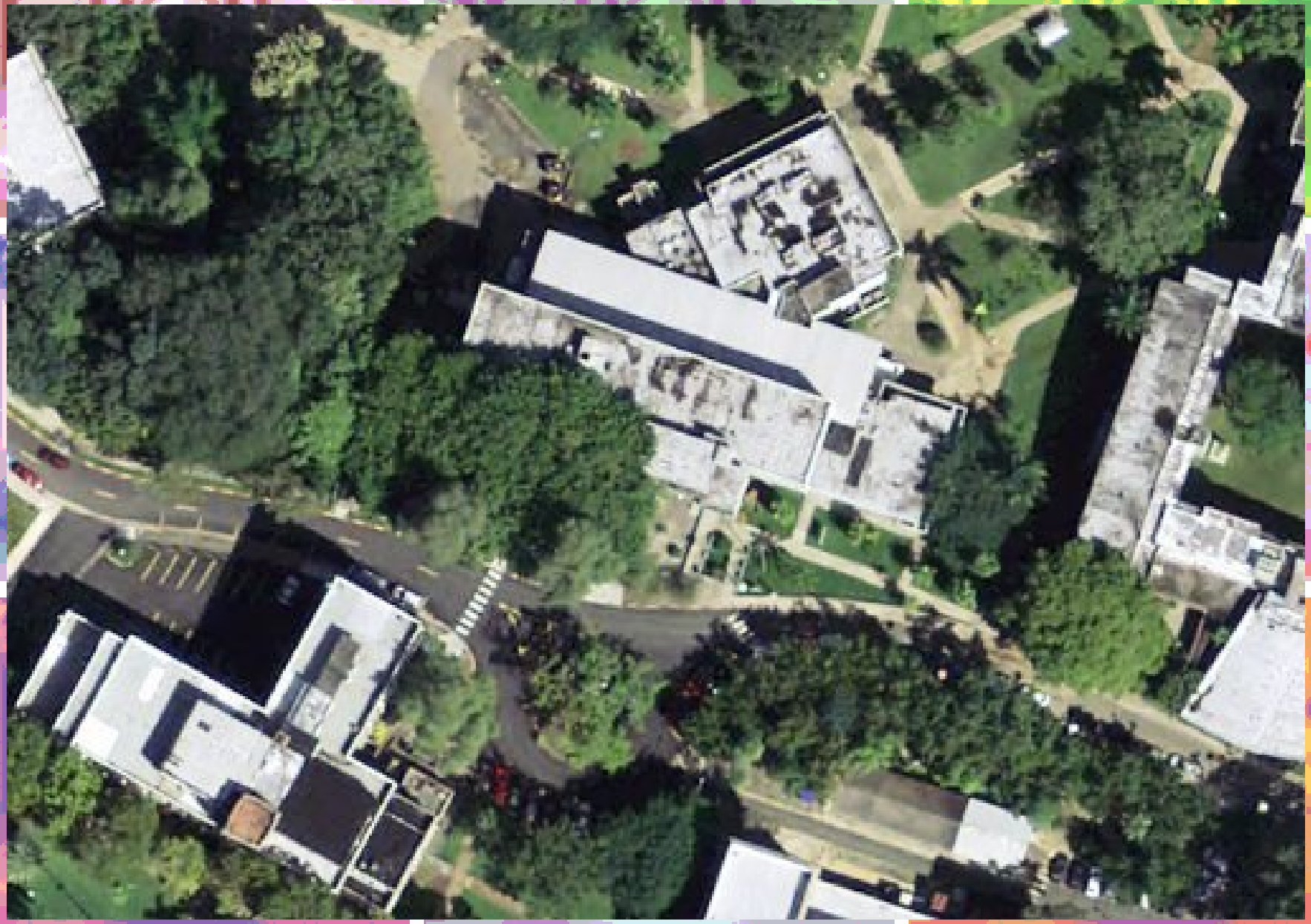
High Resolution Imagery:



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Infrared Thermography (IRT):

- IRT cameras detect radiation in the infrared range of the electromagnetic spectrum (roughly 9,000–14,000 nanometers or 9–14 µm) and produce images of that radiation, called thermograms.
- Since infrared radiation is emitted by all objects above absolute zero, thermography makes it possible to see one's environment with or without visible illumination.
- The amount of radiation emitted by an object increases with temperature; therefore, when viewed through a IRT camera, warm objects stand out well against cooler backgrounds.
- Thermal imaging cameras convert the energy in the infrared wavelength into a visible light display.

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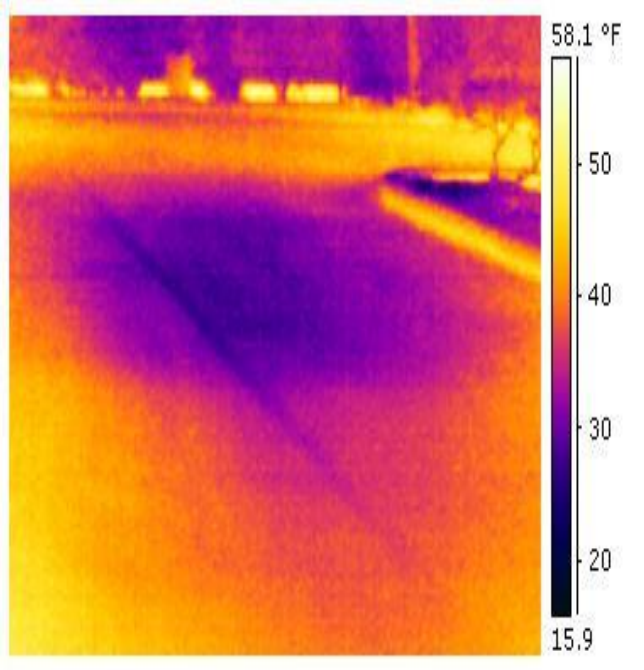
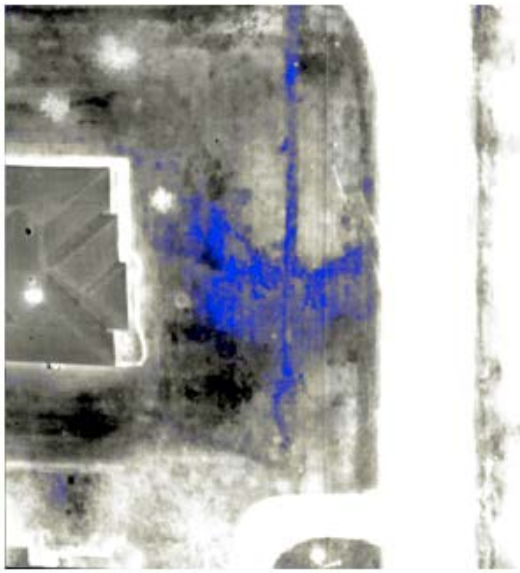
Infrared Thermography (IRT):

❑Water leaks can be detected using Thermography due to the water cooling the surrounding soil. This temperature variation can be detected, captured in an image and geolocated, giving you the exact location of a potential leak. Equipping an aircraft with a thermal imaging sensor allows the coverage of large areas and is faster than having individuals walk the entire area with other devices.



Aerial view



Aerial Infrared Energy Pattern Analysis (IR-EPA) data indicating subsurface moisture

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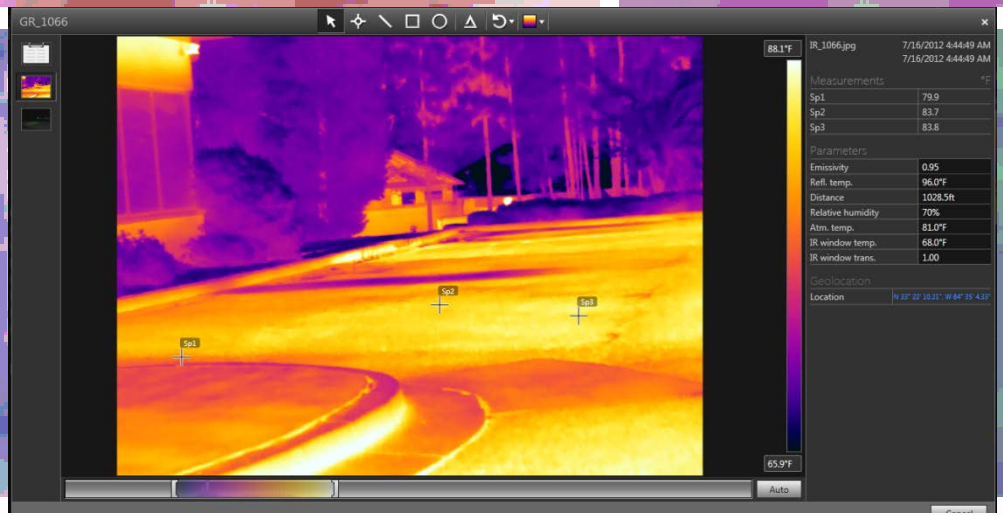
Infrared Thermography (IRT):

Underground Water Leaks Detection



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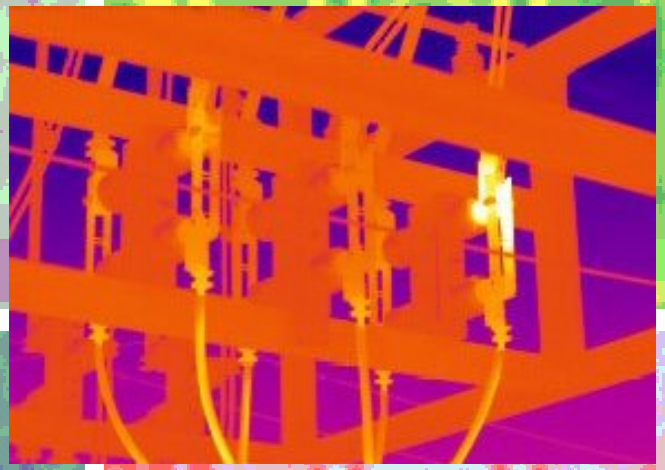
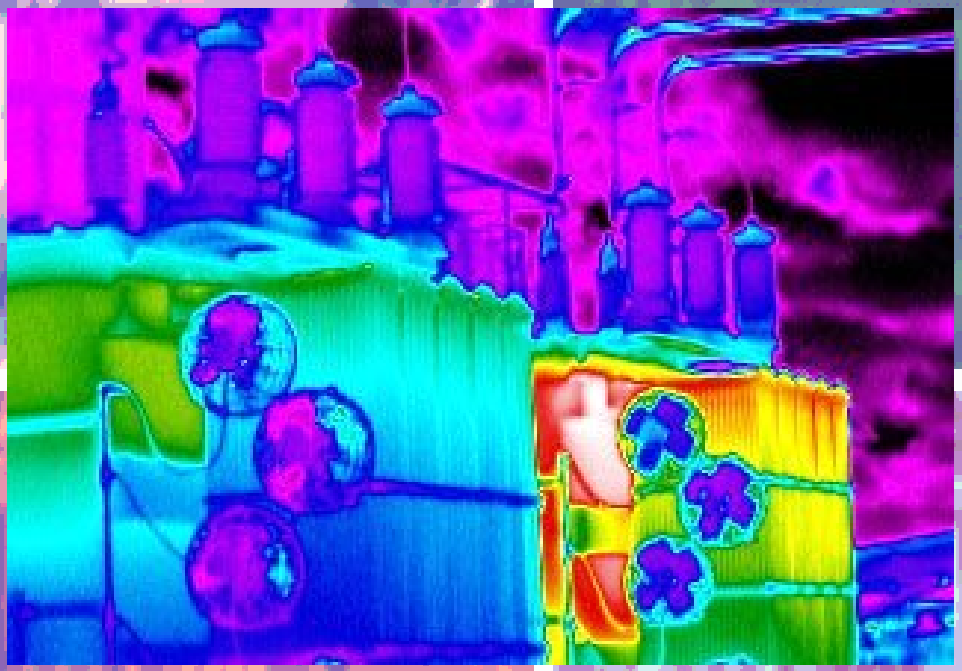
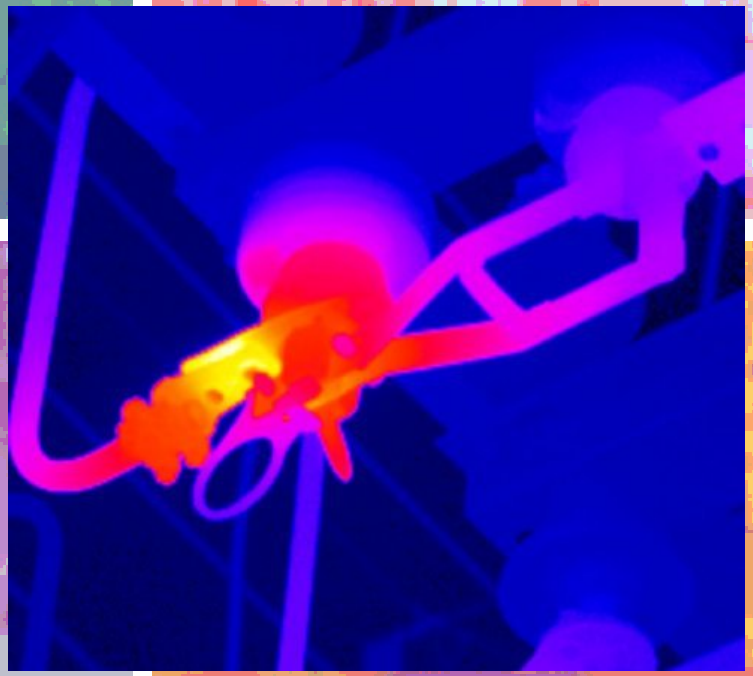
Infrared Thermography (IRT):

Electrical Power Leaks Detection







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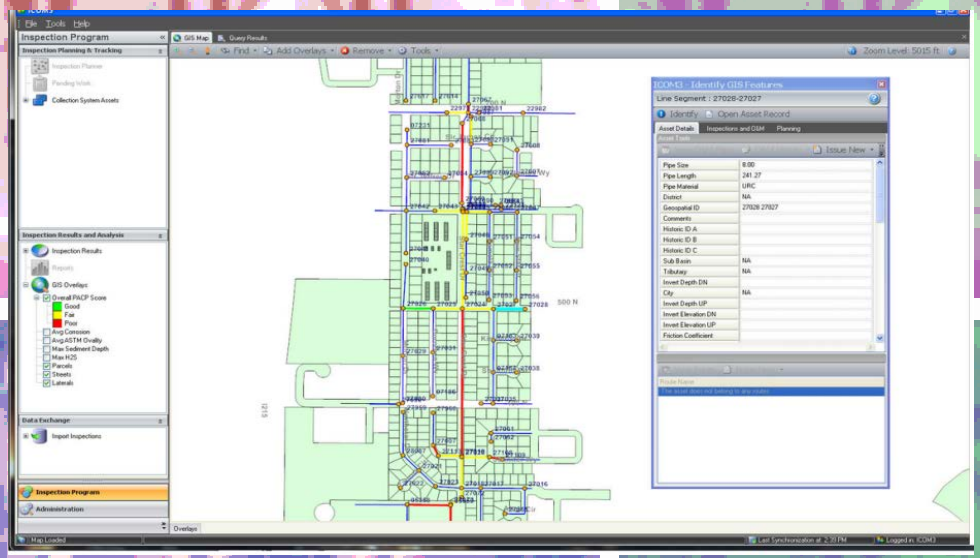
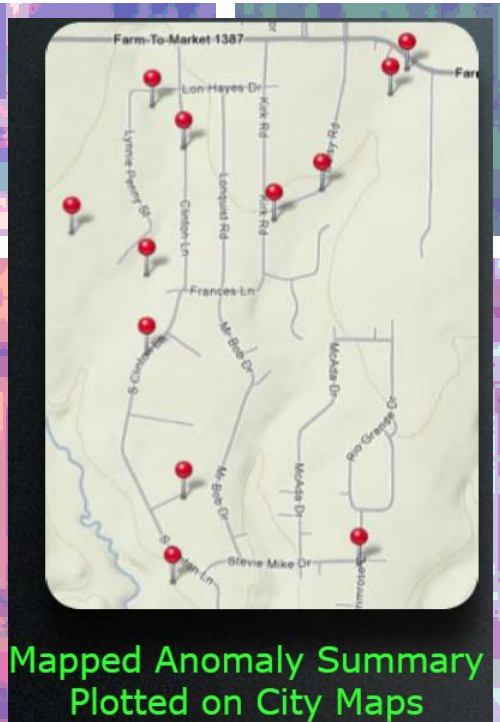
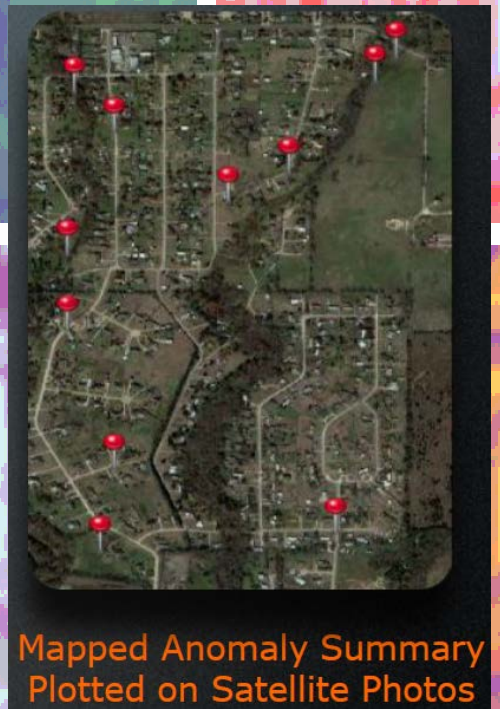
Geographic Information Systems:





Mapped Anomaly Summary Plotted on City Maps



Mapped Anomaly Summary Plotted on Satellite Photos

Conclusions:

In the case of PRASA, by combining the studied technologies we could feed a GIS data base in order to generate a geolocated water leaks inventory. Such GIS would also assist in the planning and execution of construction, repairs, rehabilitation and retrofitting.

In the case of PREPA, by combining the same technologies we could create a GIS database in order to design a predictive model for vegetation encroachments. Such GIS would also geolocate existing power loses or overheated spots. Once the geolocated data is available preventive maintenance plans could be designed and enforced.

On both cases, all data collection would be performed by remote sensing technologies form an aerial platform in a fast and economical way.

Questions?

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