Technology And Applications Of Thermal Imaging On The Rise

Facilities are among the most important assets for any airport. Without proper upkeep and the ability to detect problems early, repair and replacement costs quickly can escalate.

BY MELISSA RANK

Utilizing technology to assist in regular facility inspections provides vital information needed to monitor and maintain airport infrastructure, avoiding the massive costs associated with infrastructure failure. An underutilized technology in facility assessment is thermal imaging.

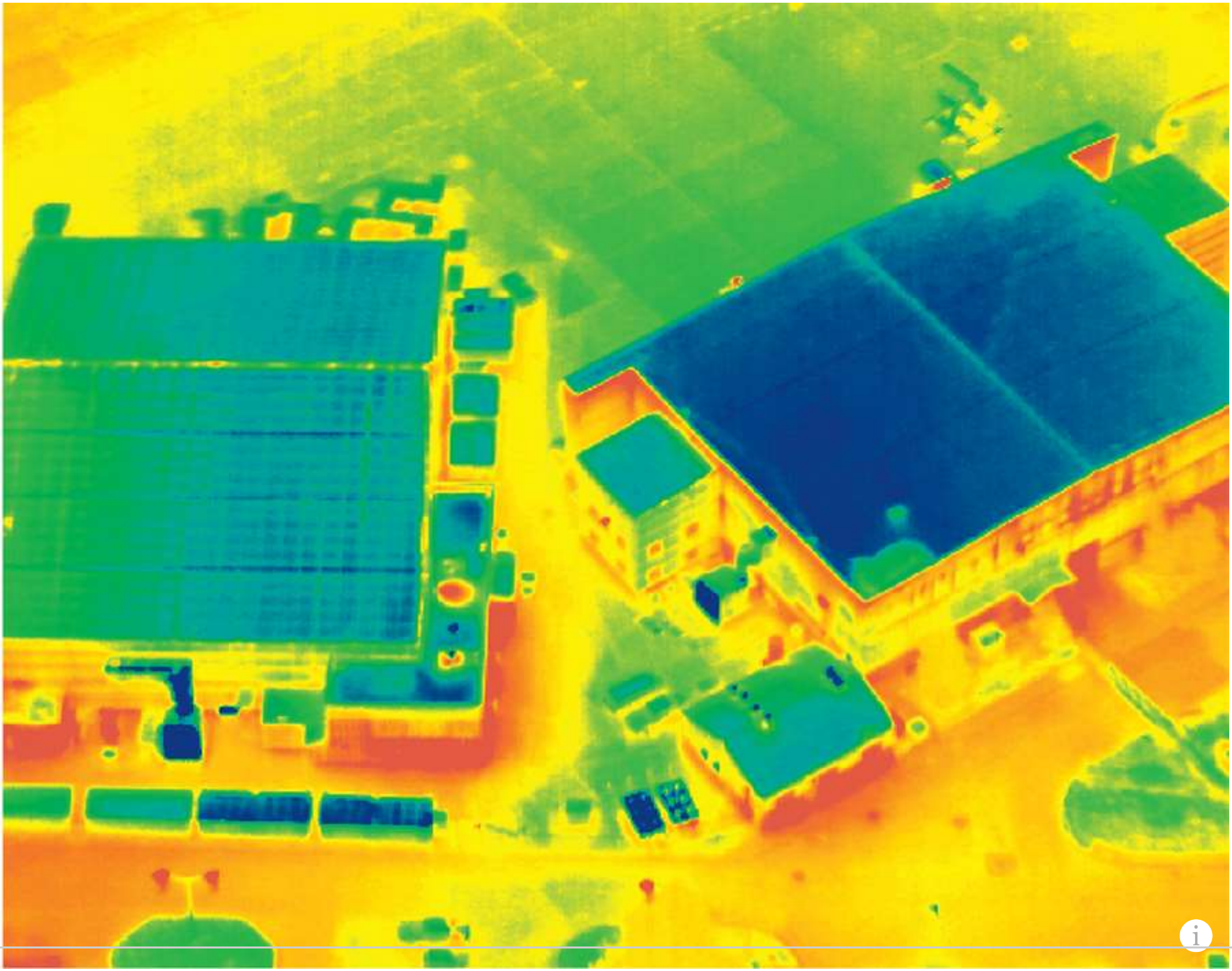
Thermography, or thermal imaging, uses thermal cameras to detect heat patterns. Originally developed by a Hungarian physicist in 1929 for British anti-aircraft defense, thermal imaging widely has been used by the military for surveillance for the last 90 years. As thermal imaging systems have evolved, thermal sensors have become smaller, more sensitive, and more affordable. The availability of accurate, portable thermal sensors has led to new opportunities and applications for public and private use.

HEAT DETECTS WATER AND AIR CONCERNS

Thermal imaging has the capability to detect issues that are inaccessible and/or not visible to the human eye. The Energy Department's Federal Energy Management Program recommends thermal imaging for water supply

distribution systems of all sizes. Water leaks can be detected within walls or underground because of their distinct heat signature, appearing warmer in the winter and cooler in the summer due to the temperature of the water and the cooling effect that occurs during evaporation. Other sources of moisture, like mold and mildew, also can be detected in ceilings and drywall. By identifying leaks and mold before they are visible and before they spread, thermal imaging can prevent the extensive damage they cause.

Handheld thermal cameras long have been a staple of electrical system inspections, as abnormal heating caused by excessive resistance or current flow helps identify electrical problems before they become a fault or a fire. Thermal imaging also can detect inefficiencies in HVAC systems. Duct leaks cannot be identified by the naked eye and often go undetected, silently driving up energy costs and reducing the sustainability of the facility. Routine inspections of HVAC systems using thermal imaging can pinpoint system defects so they can be corrected. Air leaks around doors, windows and equipment, which lead to energy loss and increased costs, also can be identified.

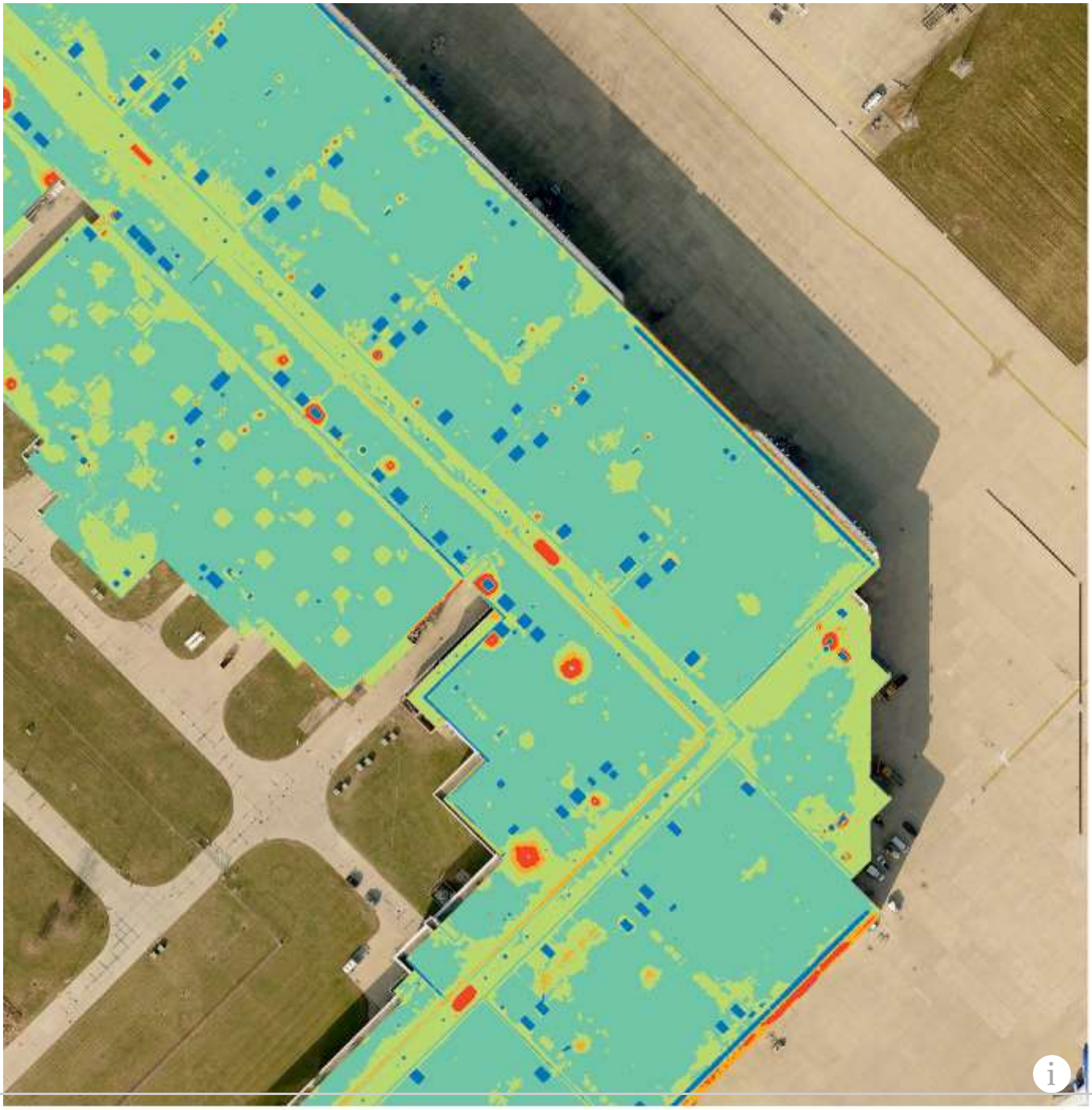


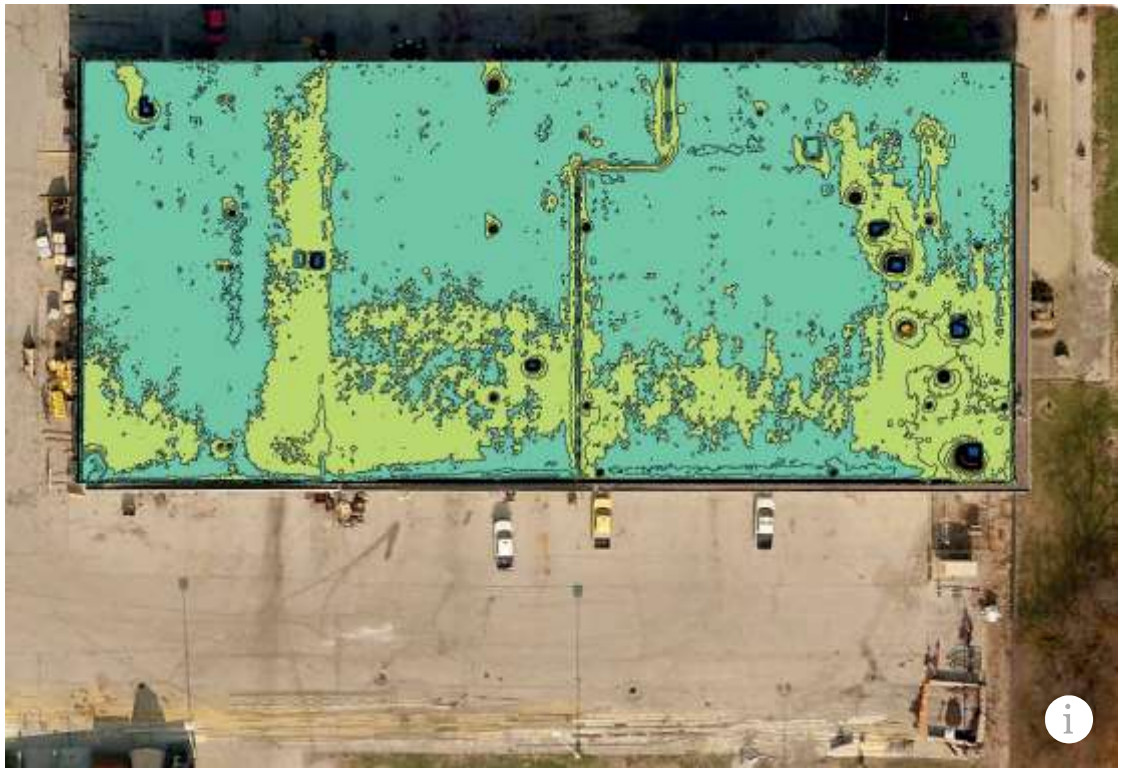
The roof on a facility is one of the most critical and costly components of any building. Roofs are expensive to replace, and those that are not properly maintained can leak and result in additional structural damages. Wet insulation and water seepage are apparent in thermal imaging before they are evident via visual inspection. Thermal imaging also can detect insulation deficiencies by capturing anomalous heat transmission.

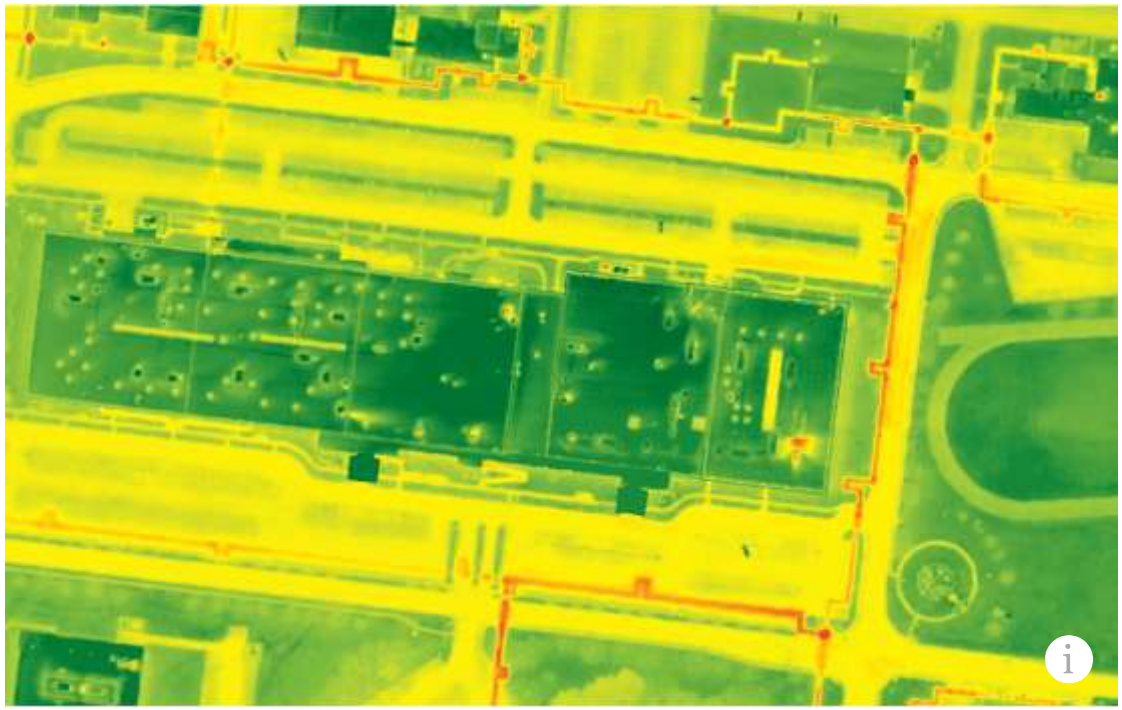
COLLECTING DATA WITH DRONES, SMARTPHONES

There are three primary methods to collect thermal imagery: handheld devices, or manned or unmanned aircraft equipped with sensors. There are even affordable thermal sensors that can be used with a smartphone. Each option has its place, and each can detect moisture, air and water leaks, as well as electrical anomalies, HVAC inefficiencies and insulation deficiencies.

Handheld devices are used for inspections inside a facility and can identify electrical and mechanical problems, such as overheating. Unmanned aircraft systems (UAS) can be equipped with sensors to collect top-down thermal imagery for small footprints or can carry an oblique sensor to collect the building envelope. Collecting the building envelope provides a comprehensive analysis of the overall air and moisture tightness. It also estimates R-values, which rate an insulation's thermal resistance to conductive heat flow. R-values are analyzed as part of an energy assessment.







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For large footprints, manned aircraft acquisition is ideal. This method supports property-wide roof assessments; campus-wide energy audits; wildlife inventory studies; underground water, sewer or steam line leaks; and irrigation system assessments.

ADDITIONAL OPPORTUNITIES FOR ANALYSIS

Data collection is only one part of the thermal imagery equation. How these data are processed, analyzed and utilized is equally as important. Handheld thermal imaging equipment can take photos and record video of the thermal data

collection for use in building inspections and maintenance. In addition to collecting the building envelope, UAS oblique sensors also can produce photos and video, which can be geo-referenced, and a building elevation rendering can be produced. Data collected utilizing top-down UAS and manned aircraft can be analyzed in a more detailed manner.

Top-down thermal imaging is processed with ground control to develop an image that has been rectified with GIS to enable accurate positional measurement. The data contained in the image is not just pictorial; each pixel of the image has a temperature value assigned to it.

This allows for further investigation, utilizing GIS to determine the vector and magnitude of the temperature returns for advanced analysis, modeling and quantification. These data then can be used for the various facility assessment applications and can provide the information to generate worst/first assessments to help prioritize the repairs needed. Change detection can be utilized for regular thermal imaging collection to identify deteriorating issues.

Because of the unique nature of thermal dynamics within different objects, interpretation of thermal imagery requires certain educational background and sometimes professional certifications such as those issued by the FLIR (forward-looking infrared) Infrared Training Center.

Interpreting imagery acquired with a camera is different than operating in the visible range of the electromagnetic spectrum. Simultaneously collecting targeted temperature, weather and material emissivity measurements is important for certain energy analysis with thermal imagery.

The uses for thermal imaging continue to expand as the technology advances, becomes easier to use, and is increasingly more affordable. The practice enables a large amount of versatile, rich data to be collected very quickly. The no-contact, noninvasive assessment approach detects concerns before they become crises and extends the health and energy usage of an airport facility.

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