ICAROS
Imagery Made Simple

What's Hot about Thermal Imaging?

by Jim Peters, CP, VP Products and Services at Icaros, Inc.

If you Googled the phrase "thermal imaging" back in the fall of 2014, you would find links to the release of cell phone compatible thermal cameras to assist with ground based energy audits of your home or office. For most of us, we are more familiar with viewing color imagery in the visible spectrum between 0.4 µm and 0.7 µm (to the naked eye that would be the range of colors from violet to red). When you think of the term thermal, thermal can cover the electromagnetic spectrum from near infrared to long wave infrared. Near infrared is collected in the [0.7 µm to 2.5 µm]. One application for using the NIR range is to detect the amount of chlorophyll in vegetation for reliable plant condition analysis. The long-wave infrared (LWIR) range of the electromagnetic spectrum is detectable within a wavelength of 8 µm to 15 µm, which we feel as warmth, but don't see. To put this into perspective, humans at normal body temperatures radiate near 10 µm. This is why thermal imaging is a critical tool in search and rescue missions both in use by the military and civilian entities.

For an aerial thermal camera to capture a digital LWIR image, the camera will be detecting energy intensity that is radiated from objects visible to the sensor in the 8 µm to 15 µm range. The amount of thermal radiation emitted depends on the emissivity values of the structure's surface (i.e., a painted metal roof versus a nearby water pond). Emissivity ranges in values of 0 to 1 as it represents the ratio of existence from a real object to the existence of a perfect black-body at the same temperature. A black-body is an ideal material that allows all incident radiation to pass into it with no energy reflected from it. In nature there are no materials with an emissivity of 1 but within the geographic environment there are a few features that are close to 1 and water is one of them.

Water features like lakes and ponds can be used as relative black-body features for control objects in a thermal imagery project. Thermal IR imagery is typically flown at night when solar loading is at a minimum. Water with an emissivity of 0.97 will be absorbing thermal energy during the day. Water also has a small diurnal temperature variance as water warms slowly after sunrise and cools slowly after sunset reaching a minimum near dawn. Due to the nature of natural features near the water (soil and vegetation as shown in Figure 1a), the water will appear warmer than the surrounding land (see Figure 1b). The varying shades of orange (in Figure 1b) are an indicator of differing amounts of sediment in the water body.

Thermal imagery proves to be a great method for stream location when vegetation covers areas of hydrography features. Figure 2a shows tree canopies over parts of the stream channel. Thermal imagery in figure 2b can be used to aid in the location of the stream since water will be a warmer feature in the imagery as compared to the surrounding geographic features.

Figure 1a. A natural color image showing water/ vegetation area at NASA Langley Research Center. **

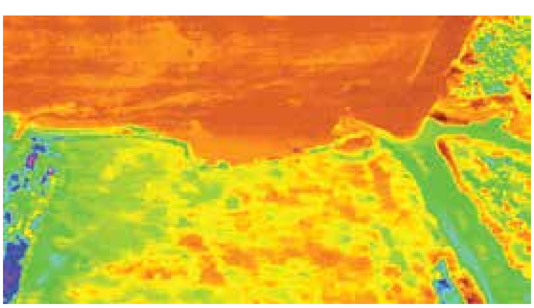

Figure 1b. During a night-time thermal imagery capture, water can be used as a black-body source to validate temperatures of features in the imagery. **

Figure 2a. Several locations of the linear hydrography feature are hidden by tree canopies. **

Figure 2b. Delineation of streams can be derived from thermal imagery. **

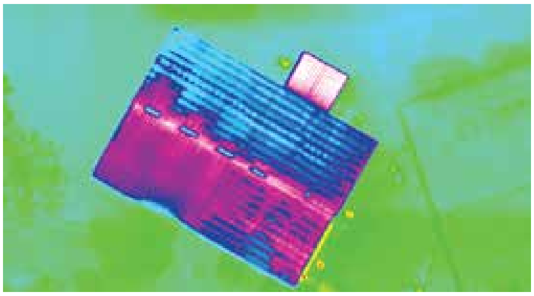

Figure 3a. Long-wave thermal imagery showing warmer (shades of blue) on the north facing slope of the roof compared to the cooler (violet) south facing slope. **

Figure 3b. The natural color image showing a metal roof building (as seen in Figure 3a) at NASA Langley Research Center. **

A developing trend in the use of aerial thermal imagery (long wave IR) is for determining heat loss from building structures. In using thermal imagery, infrastructure managers can determine roof locations where more insulation is needed to reduce heating costs. Figure 3a shows varying warmer heat signatures on the north side of the roof as compared to the cooler (violet) temperatures on the southern side of the structure. For reference, figure 3b shows the natural color image of the same structure.

With aerial thermal imagery providing people with insight to the location of possible heat loss of their home or business, my google search found a "cool" apple/android compatible cell phone thermal camera and app to show thermal signatures. The link was for the IR-Blue at the https://www.kickstarter.com/projects/andyrawson/ir-blue-thermal-imaging-smartphone-accessory. The IR-Blue was first developed and made available through the Kickstarter crowd funding organization. This Kickstarter web site is the best link to review the device and has additional links to the RHWorkshop.com for current purchase options (just under $200). If you are a gadget geek or just interested in determining heat loss for your home, the IR-Blue looks to be an interesting device to determine issues prior to hiring a professional energy auditor.

So, what's so hot about thermal imagery? Put simply, it highlights heat anomalies, both hot and cold. That is why alien predators in the movies use thermal sensors to detect the human game they are hunting. Fortunately for us humans, mud is a great camouflage. It both masks the heat from our bodies, and matches the thermal emissivity of the area around us – assuming, that is, that we are in a jungle. Mud probably won't save us from being eaten in the desert, but thermal imagery would certainly help us find water.

** Imagery provided by courtesy of NASA Langley Research Center's GIS Team.