УДК 536.2:802.0

THERMOGRAPHY IN OUR LIFE

Sabenina L.S.
Scientific supervisor - Associate professor Lobyneva E.I.
Siberian Federal University

Infrared thermography, thermal imaging, and thermal video, are examples of infrared imaging science. Thermal imaging cameras detect radiation in the infrared range of the electromagnetic spectrum and produce images of that radiation, called thermograms.

Infrared radiation is electromagnetic radiation with a wavelength between 0.7 and 300 micrometres. Its wavelength is longer (and the frequency lower) than that of visible light, but the wavelength is shorter (and the frequency higher) than that of terahertz radiation microwaves. Bright sunlight provides an irradiance of just over 1 kilowatt per square meter at sea level. Of this energy, 527 watts is infrared light, 445 watts is visible light, and 32 watts is ultraviolet light.

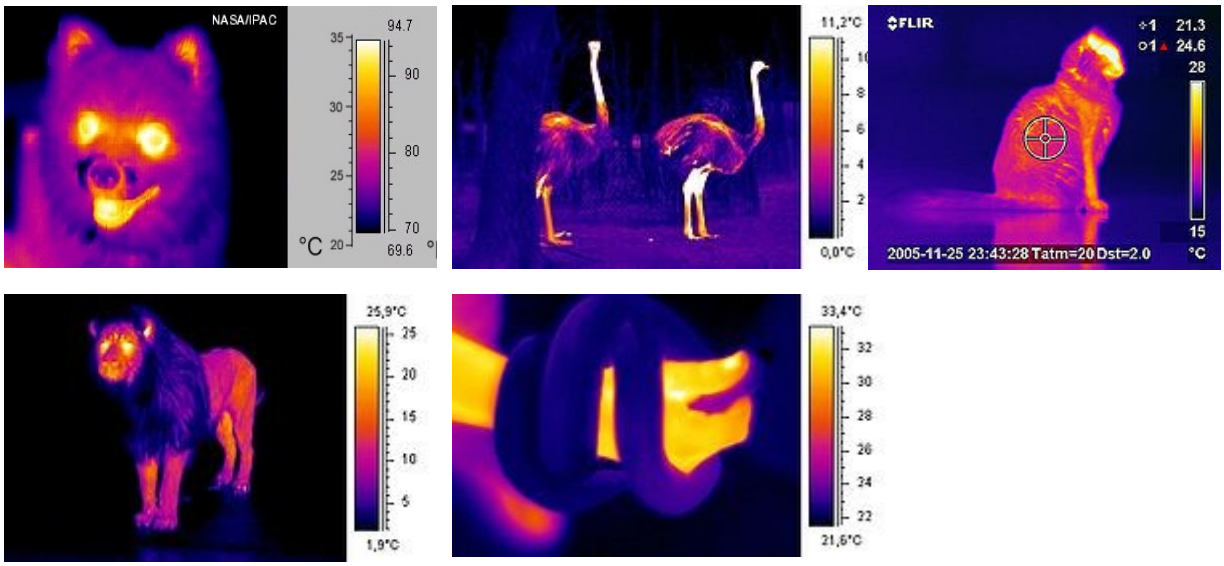

Figure 1: Animals in infrared light: a small dog, two ostriches, a cat, a lion and a snake held by a human.

Since infrared radiation is emitted by all objects near room temperature, thermography makes it possible to see one's environment with or without visible illumination. This pictures is referred a thermogram. The amount of radiation emitted by an object increases with temperature; therefore, thermography allows one to see variations in temperature. When viewed through a thermal imaging camera, warm objects stand out well against cooler backgrounds; humans and other warm-blooded animals become easily visible against the environment, day or night. As a result, thermography is particularly useful to the military and to security services.

For example FLIR Systems has been awarded a $1 million contract from the Office of National Drug Control Policy for over 100 ThermoVision Scout handheld cameras. The Scout allows officers to see suspects or victims clearly in complete darkness or fog, through foliage, and in other hard-to-see situations, often times from 1200 feet away.

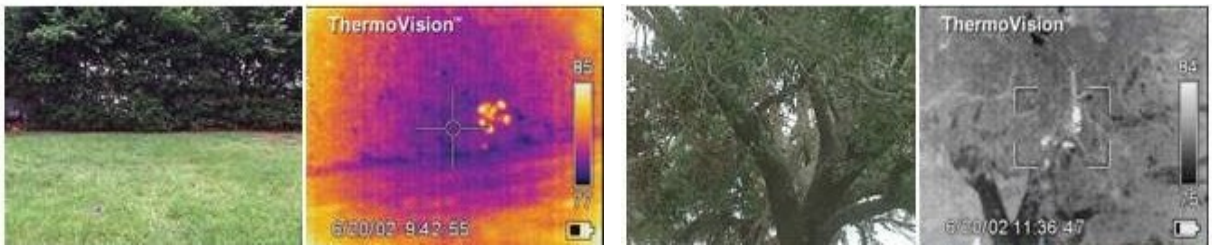

Figure 2: The Scout allows to see suspects.

The instrument for thermal imaging is called Infrared camera, Thermal camera, thermocam or thermal imager. Thermal imagers were originally developed for military use during the Korean War, thermal infrared cameras have slowly migrated into other fields.

The appearance and operation of a modern thermographic camera is often similar to a camcorder. Often the live thermogram reveals temperature variations so clearly that a photograph is not necessary for analysis. A recording module is therefore not always built-in.

Figure 3: Thermal Cameras.

Thermography has a long history, although its use has increased dramatically with the commercial and industrial applications of the past fifty years. Government and airport personnel used thermography to detect suspected swine flu cases during the 2009 pandemic. Firefighters use thermography to see through smoke, to find persons, and to localize the base of a fire. Maintenance technicians use thermography to locate overheating joints and sections of power lines, which are a tell-tale sign of impending failure. Building construction technicians can see thermal signatures that indicate heat leaks in faulty thermal insulation and can use the results to improve the efficiency of heating and air-conditioning units. Some physiological changes in human beings and other warm-blooded animals can also be monitored with thermal imaging during clinical diagnostics. Since there is a high degree of thermal symmetry in the normal body, subtle abnormal temperature asymmetry's can be easily identified. For example the mean temperature differential in peripheral nerve injury is 1.5°C. In sympathetic dysfunction's temperature differentials ranging from 1° C to 10° C depending on severity are not uncommon. Rheumatological processes generally appear as 'hot areas' with increased temperature patterns.

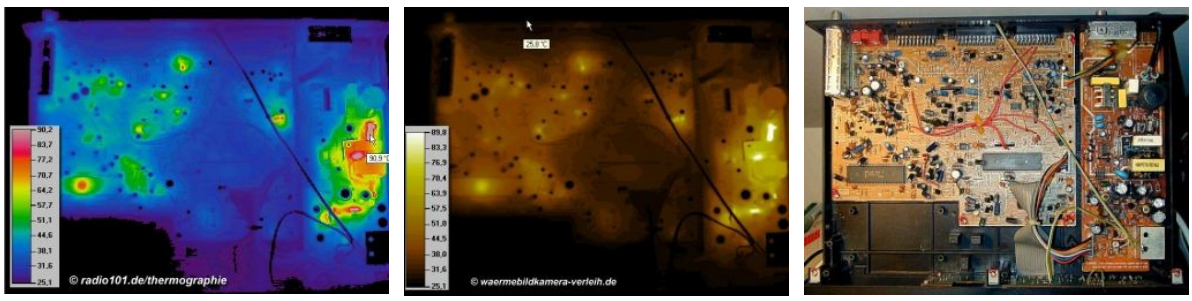

Figure 4: Thermal imaging of a circuit board (the hot spots are in the power supply) in different color scales and how our eyes see usually this.

Thermography are usually used for Building Diagnostic. The building sector offers the largest single potential for improving energy efficiency, and therefore there are some documents for Energy Performance of Buildings.

Infrared thermography is the easiest and quickest method to detect energy waste, moisture and electrical issues in buildings. An infrared camera shows exactly where the problems are and helps focus the inspectors' attention allowing him or her to properly diagnose areas with energy loss.

Poor or inadequate insulation, moisture, building envelope leaks, and substandard work are costly to residential and commercial building owners. An infrared camera helps see where energy efficiency can be improved.

Buildings may be quickly and thoroughly scanned using a thermocam thermal imager, identifying problem areas that can't be seen by the naked eye.

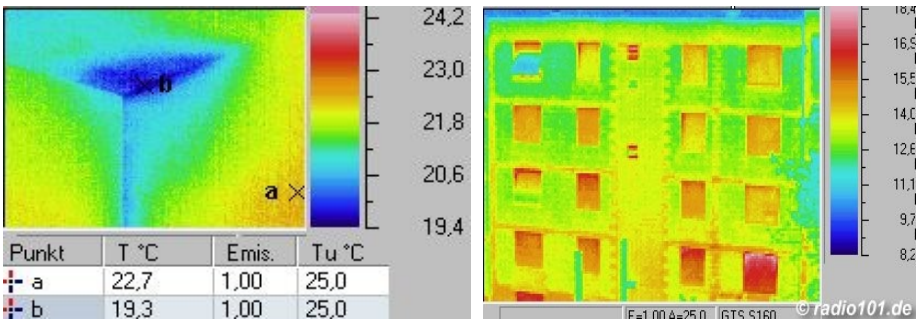

Figure 5: Lower temperature caused by a humid corner inside a flat and high temperature in window outside the house. It is several hotspots.

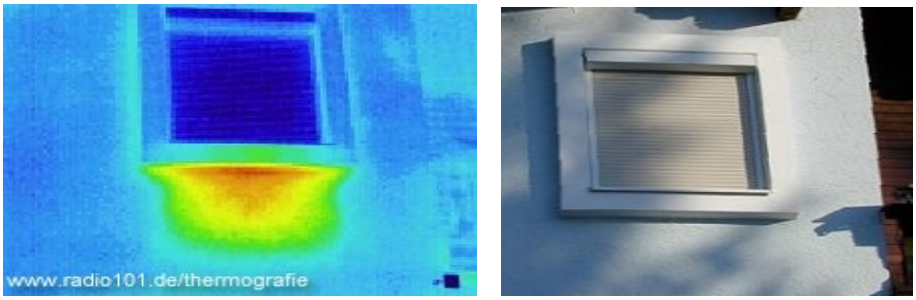

Figure 6: Example for bad insulation: Heating / radiator beneath a window radiates warmth to the outer skin of the building (around the window there is a projection, thus the warmth dams up a bit).

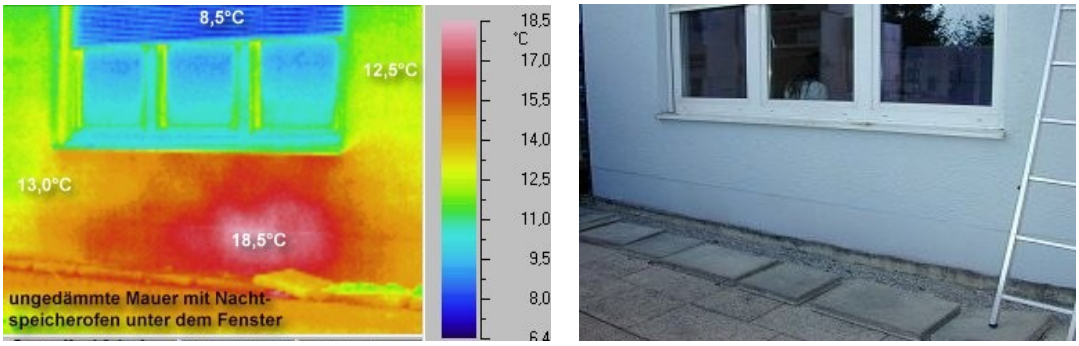

Figure 7: Another example of poor thermal insulation: Radiator under the window.

Moreover excessive air leakage can account for up to half of the energy consumed to condition buildings. The leakage pathway is often complex and, without thermal imaging, extremely difficult to visualize.

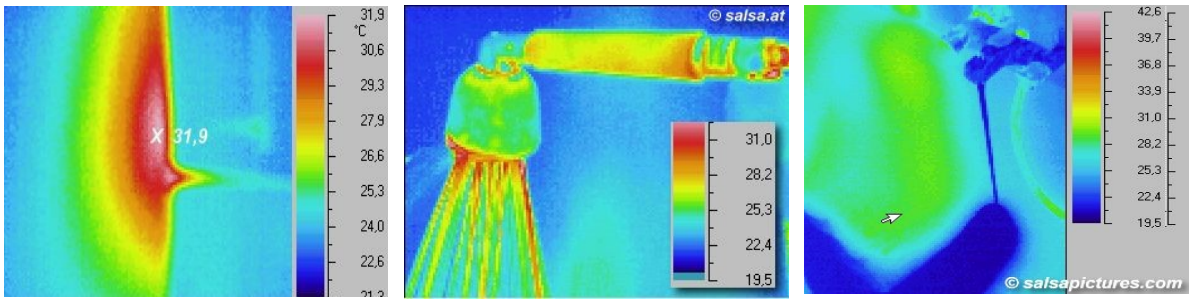

Figure 8: Thermograms of water: thermal leak at a boiler, hot water and cold water.

A "whole building" approach is needed to maximize energy efficiency of a building or a home. Indoor environment can be compromised by poor insulation, poorly sealed windows and doors, inadequate or poorly sealed ductwork, plumbing leaks, or other plumbing issues relating to heating, ventilation and air conditioning systems. And, with cameras, you get advanced features to help you see how, when, and where energy saving solutions can be implemented.

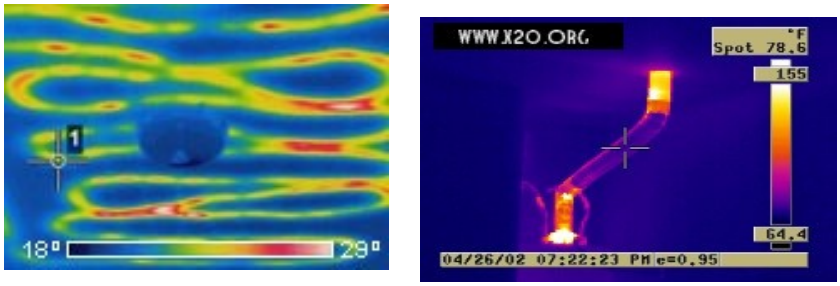

Figure 9: Thermograms of sewers and of ventilation.

Thermography is a very useful and promising branch of Technical Science. It is necessary for diagnostics of sewers, ventilation, central heating, water supply and insulation in any serious construction.