Thermal Mapping: The Hot New Trend

The use of thermal imaging cameras, either hand held or mounted on an aerial platform such as a plane, is gathering a great deal of attention for measuring the state of energy use in our built environment.

Alun Jones, Managing Director of The GeoInformation Group, takes a look at the science behind the use of thermal imagery and the benefits it can bring to those seeking to manage energy budgets and even reduce carbon emissions.

Climate change

In recent years the most common application for thermal imaging has been in support of the Home Energy Conservation Act 1995 for the targeting of loft and cavity wall insulation grant applications.

Thermal cameras mounted on an aircraft can cover a small city of say 40,000 – 70,000 dwellings in one night, producing hundreds of thermal images. These thermal images can be combined with Mapping or address databases to identify high temperature buildings (or roofs to be more exact). But, you exclaim, why is this important and why should I care?

The Climate Change Bill which became law on 26th November 2008, made UK the first country to put carbon emission reduction targets into law with a target of 80% reduction from 1990 levels by 2050.

Local authorities are now being measured on their efforts to reduce carbon emissions and improve energy efficiency through National Indicators, 185, 186 and 187. As UK housing stock contributes to some 20% of UK's Carbon emission budget, it is an obvious target for local authorities. One very efficient method for understanding the energy efficiency of UK's housing stock is, short of knocking on every door, through aerial thermal imaging. A single night's worth of thermal surveying would equal two months of ground surveying and it can all be carbon neutral as well.

The Science of Thermal Imaging

Measuring infrared energy as a technique for measuring the temperatures of objects is well known first discovered in 1800 by the astronomer Sir Willian Herschel. Infrared energy is emitted from all objects that have a temperature above -273 °C or 0° Kelvin, which makes infrared ideal for measuring small amounts of heat loss from housing in the depths of winter.

Essentially, an infrared camera is a non-contact device that detects infrared energy (heat) and converts it into an electronic signal. The electronic signal is converted to either a single temperature value or a picture.

The Rules of Thermal Imaging

There are many ways to get a thermal image, however to get the best results there are a few essential rules you should follow.

1. Use a scientific high grade thermal imaging camera.

- Make sure your survey company is using an advanced thermal imaging device, such as a FLIR Thermovison SC6000 which can record 65,550 different levels of infrared energy for every pixel. This gives you a sensitivity of 0.01°C .

2. Use a thermal imaging system that records and delivers thermal image tiles and not thermal video.

- Imaging systems are more accurate and require less post processing than video systems and when combined with airborne GPS make for a much more accurate thermal image for use in a GIS. Also video systems tend to be indicative of older thermal cameras and not so sensitive to changes in thermal emissions.

3. Make sure the thermal imaging device is hooked up to an airborne GPS.

- This also needs to be very accurate so that you can accurately stitch and merge the many hundreds of thermal images you will generate. For example, a small city of 50 sqkm, say the size of Cambridge, would need about 800 to 1000 images.

4. Use an experienced company.

- The flying conditions are very difficult due to the small footprint of each image. If you don't get it right you will have gaps in the thermal images and might miss out on important sites.

5. Strict flying conditions should be observed.

- Flying with the right weather conditions is essential. Too warm and you won't get very accurate readings, too cloudy and you won't get any readings, too wet the same, too windy and your temperature readings will be lower due to increases in surface convection. Surveys should be undertaken only when ambient air temperature is less than 4°C and when there is no cloud or rain between your camera and the ground.

6. Accurate analysis of the thermal data.

- Providing a simple mean, minimum and maximum temperature for each roof will be insufficient to accurately describe the true roof temperature as these often omit very critical features from the roof, chimneys and ventilation shafts. You need more statistically robust techniques for describing the true surface temperature.

7. Match your thermal results to mapping or address data.

- If all of the above have been followed you should now be able to obtain from the supplier a derived database that calculates the temperature or relative heat loss for every building and every address. This is essential in being able to plan targeted mailing or advertising campaigns to raise awareness of climate change issues.

Benefits of Thermal Imaging

So now you have a thermal database and you are armed with all this information. What can you expect to do with it?

The biggest advantage given to you with thermal data is the ability to target properties and to improve your targeting by combining your thermal data with other databases you may have. Here are a few strategies you could employ:

- Extract from the database all properties that show a very high heat rating and target those for a mailing campaign or arrange a visit by an energy conservation officer.

- Extract heat loss values for commercial and government buildings to run targeted campaigns for heat loss due to ventilation shafts, excessive energy use during non-working hours and industrial heat pollution.

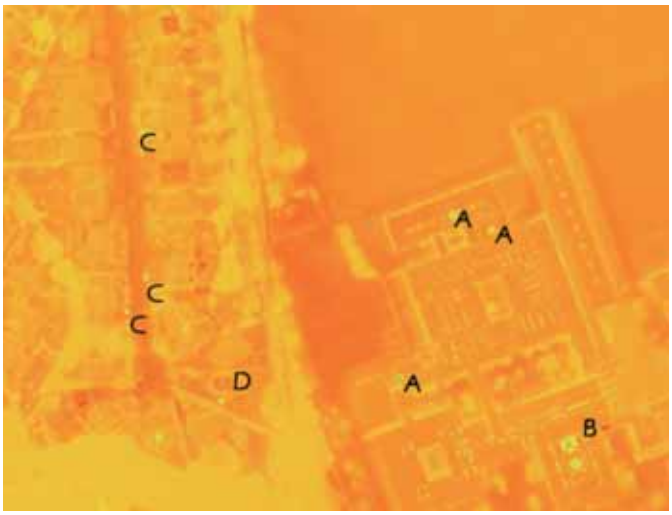
- Link the thermal classification, very high and high etc to council tax records or to lifestyle databases such as Mosaic to see if there is any correlation between deprivation or social conditions and high heat loss.

- Measure the effectiveness of previous loft insulation campaigns by comparing the address databases of those who have already had loft insulation grants with those properties showing high heat loss.

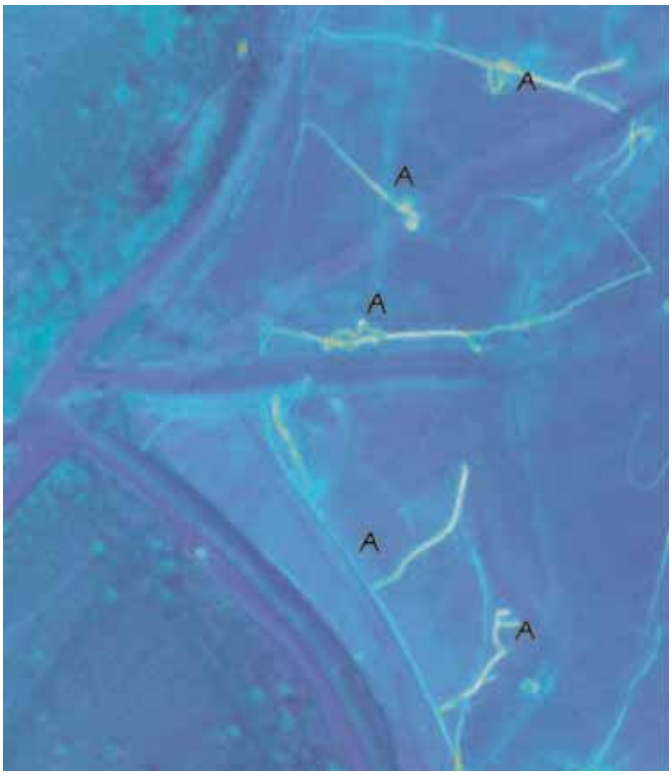
- Run poster campaigns in neighbourhoods with high heat loss to raise awareness of energy and cost savings that can be achieved.

Thermal Imaging Interpretation

The thermal image database can highlight a whole host of activities going on in your area that you cannot see with the naked eye. Here are just a few:



A thermal image of a large school on the right of the image and a housing area with trees on the left. 'A' shows high heat loss from vents, 'B' a glass atrium roof, 'C' street lights and 'D' a chimney stack on a house.



A thermal image of a large waste dump to the centre and right of the image, showing the location of underground methane ventilation pipes, marked by 'A'.