Sensors and Digitization
Infrared Imaging
Lab 2 Report
GrTP1A

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Objective

The goal of this practical work is to study the application of IR imaging to temperature measurement and to observe the influence of several parameters on the efficiency of these measurement.

1. Defect detection on an electronic circuit

One of the main application of infrared imaging is the thermography, measuring an objects temperature using IR camera. In this part of the lab we detect a defect in an electronic circuit by measuring the temperature of the circuit using IR camera. The experiment is setup in such a way that, the circuit board is put in front of the IR camera and we captured images automatically using the Altair software. First the camera focus is adjusted to get good image. The circuit is turned on for a while by the push button and the temperature measurement are made all over the surface of the circular circuit board.

Accordingly we are able to detect specifically two areas which are short nodes on the circuit board. We used the circle tool to select the surface of the circuit and profile mono segment to know the exact temperature of the defect point . The minimum temperature of the circuit was 20^0c , mean was 23^0c and the maximum temperature at those two nodes was 56^0c.

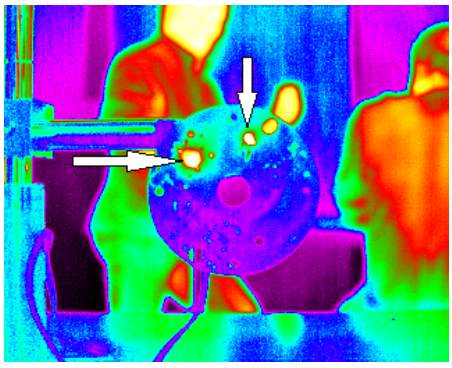


Figure 3) Defect points on the circuit board

2. Camera Calibration

A camera is like a photon counting device it counts the number of received photons and stores the data as electrical voltage expressed as digital level.

We used a hot plate as a reference and a digital thermometer to measure the actual temperature of the hotplate. We used the circle tool from the software to encapsulate the plate with radius little a bit smaller to avoid false data coming from the edge of the plate . By changing the temperature of the hotplate readings are taken from the thermometer and Digital level readings from the software.

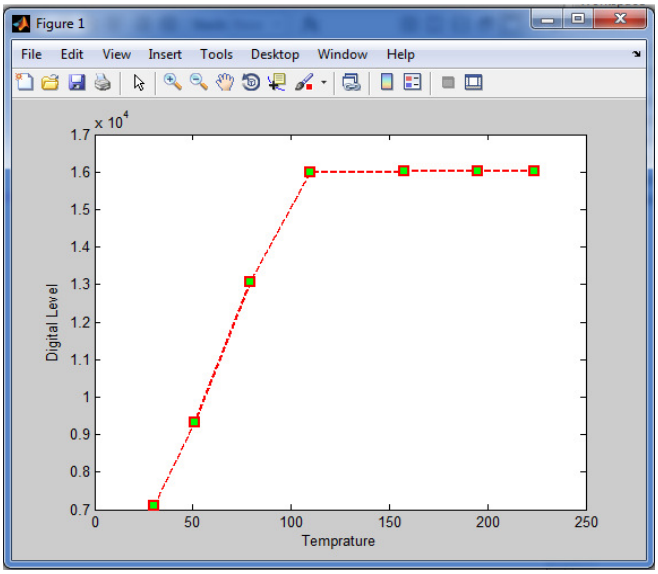


Figure 4)Relationship curve of actual and measured temperature

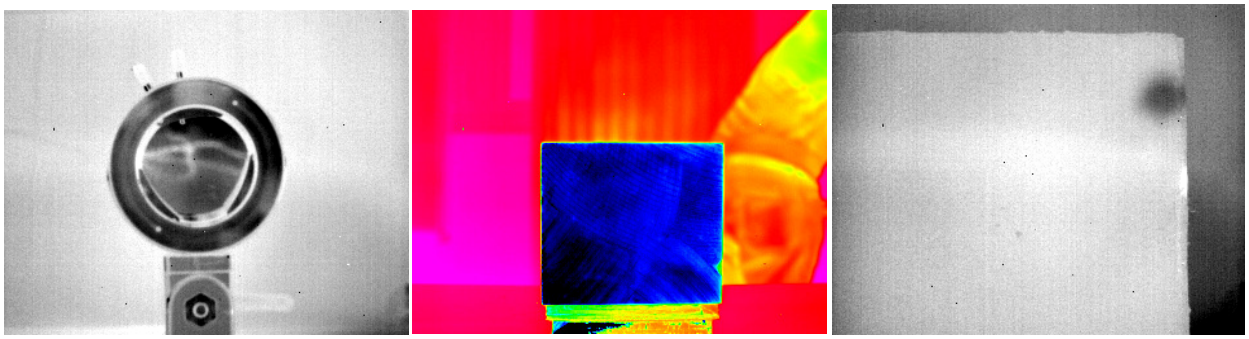
From plot the we observe that graph starts to saturate at around 110 degree. During the experiment we notice that the hot plate is not acting as an ideal black body since there was reflections specially at small temperature. So hot plate is not a good choice to make a calibration. Normally IR camera calibration is made using black body object.

3. Estimation of emissivity, transmission and reflection coefficients

In this part of the experiment emissivity, transmission and reflection coefficients for wood, copper, PVC are estimated. First we measured the luminance(which is directly proportional to temperature) of different objects

Table1 : Digital level measurement of different material on IR domain

Material	Luminance (digital level)
Black body reference object	7440
Wood	7360
Copper	7465
PVC	7376



(a) copper (b)wood (c)PVC

Emissivity of wood

emissivity of wood= luminance of the wood/luminance of black body =7360/7440=0.989

PVC

Normally in visible spectrum PVC is translucent material but in R domain we observe that it is transparent. We take measurement the digital level in front of black body reference. transmission coefficient of PVC=7376/7440=0.9913

Copper

Although copper is not specular in visible spectrum, we notice that it is specular on the IR domain. We put the copper in front of the black body and we took digital data measurements for both. There was reflections as shown in the above figure on the copper surface. The digital level of the black body is changed this time.

reflection coefficient of copper= 7459/7487 =0.996

4. **Active thermography**

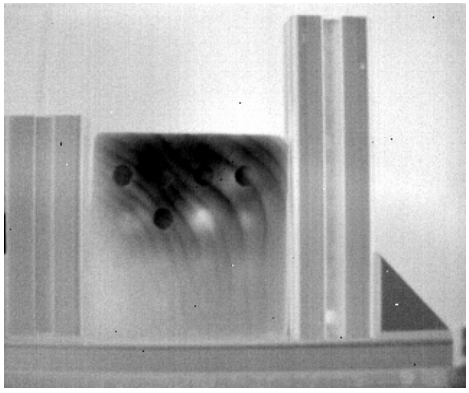
   On those experiments we have seen another application of IR imaging for non destructive testing. It is possible to see the defects or objects which are covered or shielded by another objects using IR cameras by heating the objecting to some temperature.

Experiment I

Halogen lamp is used as IR source of light in this experiment and is controlled by sinusoidal voltage generator. The halogen lamp is feed with voltage at 0.5 hz. After heating the paint for some time we start observing the image details on the Altair software and also on the actual seen.

We observe that there is another paint which is not visible in the normal paint. It is a paint of one "Teletubbies" characters. The object in the paint appears when the paint is exposed to Halogen lamp and observed using IR camera. This paint is possibly made using some coppers so that when it is exposed to bright light it will be detected by the IR camera(as result of temperature difference between paint layers). In this experiment we are able to see another paint layer behind the scene. One application of IR imaging is to detect defects which are not visible from the outside seen.

Experiment II



Plates with a flat bottom-holes is used in this part of the experiment. We notice the holes of the object has different temperature according to the thickness of the remaining surface.

From the picture it is possible to see the holes at the back of the wood object using IR camera. Since the holes has different length on the grabbed image they appear to have different temperature.

Conclusion

Generally In this lab we have seen the practical applications of IR imaging. It helps us to understand how IR cameras are used to measure temperature of an object and detect an defects on the surface of the objects which are not visible in visible spectrum(the case detecting the defect of a circuit).Additionally we have seen how IR imaging is used for non destructive testing. We have also seen how materials are classified based on their transmission, reflection properties on IR domain.