Thermography NDT Remote Access Experimental Lab

Requirements

To analyse the thermal distribution on a composite component under controlled temperature conditions. One of two defect types may be present. These will be in the form of delaminations near a drilled hole, or an impact damage defect. The laboratory exercise will be completed via remote access using a student dedicated remote desktop link from the on-line learning environment. An additional web cam link to the laboratory for communication with a supervising technician is also necessary.

Equipment

FLIR thermography system, heating lamp, Composite Component.

Method

Start Procedure

1. VPN into the University Network.
2. Establish Communication with the Supervising technician.
3. The test piece will already be set-up with an applied heat source by the supervising technician.
4. Launch the relevant Remote Desktop Link from the on-line distance learning website. Use your university user name and password to log onto the remote access computer.
5. Check with the Lab technician that the equipment is aligned, the component has an applied temperature source and all equipment is operational.
6. Launch the Altair Thermography software application 

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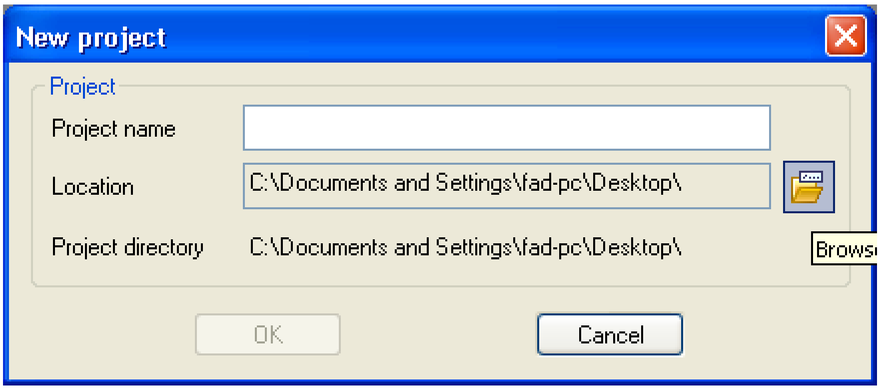
7. Before attempting data capture and analysis it is important that you set up a new project. To do this use the File- New Project Menus option. The following dialogue window will then be display. You will need to specify a project name, along with a project directory using the browse option.



8. Once you have set a project name and directory, launch the camera live view,  .

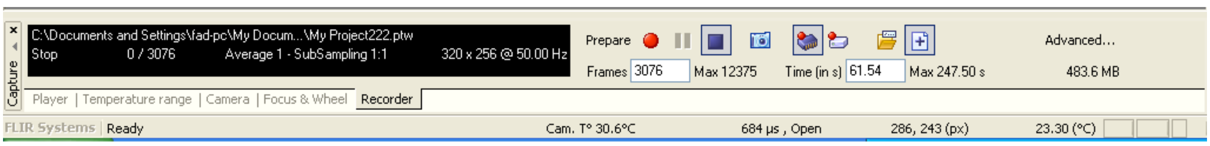
9. The default image will be grey scale and in digital values rather than temperature. To convert to a temperature scale use the menu option – Measure, Units, Temperature. An example of the live window is given below.

10. To make adjustments to the temperature range position the mouse to the top or bottom of the ranges, whereupon the cursor will change to a vertical up/down arrow. Pressing the mouse left button and moving the cursor up or down will adjust the temperature value accordingly. For this exercise, it is best to use the grey scale option, and a temperature range of approx. 24° to 36°.

Data Acquisition

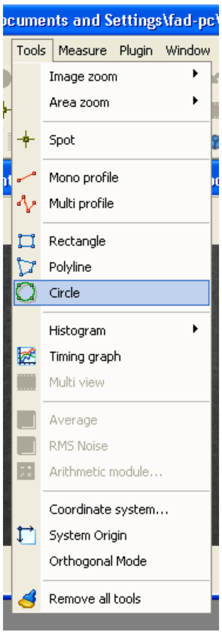
NB: Remember after each capture to save the acquired data for further analysis once the data acquisition for the experiment is complete.

1. Adjust the temperature range of the live image to try and enhance any artefacts present in the component.
2. Some manual focus adjustments by the lab technician may be necessary.
3. You should be able to make out weave patterns within the component, along with any damaged areas.
4. Capture and store the resulting image. This is achieved by using the record one image icon  on the lower tab recorder page of the main screen.



Data Analysis

Using the tools menu options or icons displayed on the top of the page it is possible to look at temperature distributions within the live or acquired images. Also the pixel coordinates for the mouse position over an image are provided in the lower right hand corner of the main screen. A combination of these tools can be used to determine defect/indication sizes in combination with the camera distance correlation curve provided.

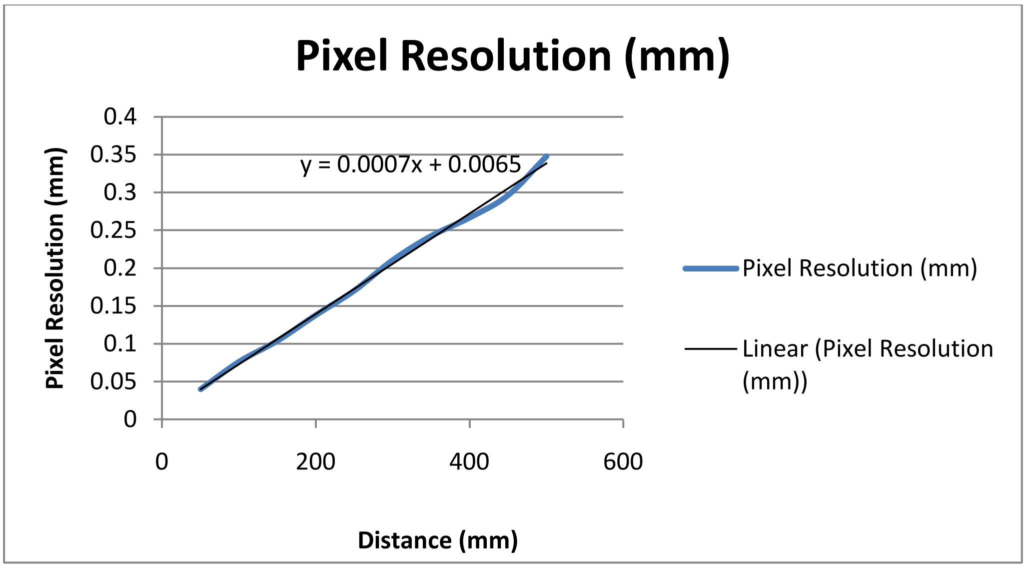


1. Compile an experimental report by analysing the acquired data. Attempt to analyse the image using the in-built tools. Further analysis is also possible using third party image processing tools.
2. To convert pixel measurements into true sizes in mm, you will need to use the following camera/lens combination distance/pixel resolution correlation curve, and obtain the lens distance from the test piece from the lab technician. For example if the camera was placed 100mm away from the test piece, then if an artefact was 20 pixels wide, then that would correspond to:

   $Width_{mm} = ((0.0007x100) + 0.0065) * 20$
   $Width_{mm} = 1.53mm.$

3. Features like defect size area in the case of an impact damage should show up as a hot spot, whereas de-lamination should appear like a shadow near a drilled hole.

Compile an experimental report. Use the guidelines in the appendices when structuring your report.



Calibration curve - Thermal Imaging Camera					
Distance	Dimension (mm)	Pixels	Pixel Resolution (mm)		Calculated
50	8	201	0.039801		0.0415
100	8	105	0.07619		0.0765
150	8	77	0.103896		0.1115
200	8	58	0.137931		0.1465
250	8	47	0.170213		0.1815
300	8	38	0.210526		0.2165
350	8	33	0.242424		0.2515
400	8	30	0.266667		0.2865
450	8	27	0.296296		0.3215
500	8	23	0.347826		0.3565

Distance	Pixel Res (calculated)
1	0.0072

Data aquired using 25mm lens, field of view = 22x17°

Appendices

Structure of an Experimental Report

The convention, when writing a scientific report, is to adopt a rather formalised structure. The table below describes what sections a typical report should have and a brief description of what each section should contain. Whether the experiment is largely theoretical or more biased towards data analysis, you should still comply as closely as possible with the structure set out in the following table. The table also gives a typical breakdown of the marks allocated to each section (if the experiment is for assessment). Since no two experiments or investigations are the same, the relative weights of each section might well vary from one experiment to another. As with any open-ended piece of work, some flexibility in the marking scheme is usually required, to take account of each student's approach. Remember, there is no hard and fast rule about the relative importance of different sections for different experiments, so the marks in the table below are just a typical breakdown for a typical experiment.

A typical length would be 7 to 10 pages for the main body of the report.

Section of Report	**Typical mark**
Date, title and general presentation and organisation of the report.	*~5 marks*
Abstract - This should be three or four sentences, summarising what you did, how you did it, what the results (and uncertainties) were and what your conclusions were. In practice, **you will write this last**, so leave about half a page at the beginning of your write-up in which to put an abstract later.	*~5 marks*
Apparatus - List the apparatus with a diagram where necessary. Describe in particular anything different or additional to that in the script.	*~10 marks*
Introduction/Method/Procedure - Explain very briefly what the experiment is about. Record what you did - particularly if it differs from the script. Include problems and disasters.	*~10 marks*
Measurements and Graphs of Raw measurements - Record **all** raw measurements (good, bad or indifferent) as and when you obtained them. If the raw data or calculations are voluminous, they could be summarised here and included in their entirety in an appendix. It is often worthwhile to plot a graph of your measurements as you go. This can save time since it indicates quickly if you need to repeat readings or if you need more.	*~20 mark*
Calculations and error estimates - Describe the calculations or other processing of your results. Explain what equations you used and include a sample calculation, even if you use a spreadsheet programme to carry out the calculations. Discuss the sources of error in your measurements and use these to estimate the uncertainties (or experimental error) on your final results. Include any graphs used in your analysis.	*~10 marks*
Results and Discussion - Discuss the interpretation of your results. The questions in the experimental script usually lead you through what is required, so you should record your responses to these questions as you come to them. Clearly state your results with estimated errors and units. This is where you should compare your results with accepted values from reference books or other sources.	*~25 marks*
Conclusion and bibliography - Write a conclusion drawing the results together, discussing their physical implications, the validity of the theory and the methods, and scope for improvement of the experiment. Remember to list the books, articles or web pages that you used for reference in a bibliography at the end.	*~15 marks*
Appendix - Most reports will not require appendix as tables of data, calculations and graphs of results should normally be included in the main body of the report to create a coherent whole. Only relegate large volumes of data to the appendix if absolutely necessary. **Don't forget** to go back and write the abstract.	*N/A*