

ANALYSING THERMAL IMAGES TAKEN BY THE FLUKE TiS20 THERMAL IMAGER*

F. PROTOKLITOW, K. ROSLON, M.J. PERYT[†]

Warsaw University of Technology, Plac Politechniki 1, Warszawa, Poland
and

Joint Institute for Nuclear Research, Joliot-Curie 6, Dubna, Russia

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NICA (Nuclotron-based Ion Collider fAcility) requires a significant number of specialized devices to be built. For the sake of their thermal stability, the temperature measurement and general safety, the temperature of specific devices is measured or simulated in many different ways. One of the methods of such measurements is using a thermal imager, a non-contact way of its evaluation. However, after measuring the temperature, it needs to be properly analysed and shared in a simple and easy-to-understand manner for a person not qualified in such a field. The software given by the camera's manufacturer is non-optimal for this specific use. Due to that the custom-made analysis application has been developed.

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1. Introduction

The software was created to measure the temperature of various elements and systems utilised in NICA. Those elements range from single PCBs to RACK cabinets' insides used for the Slow Control System (SCS) [1]. Those measurements are employed in five major tasks. First of them is the check-up of elements that are known for overheating. They are also used to compare simulation results with the actual data. The next one is checking the devices of unknown efficiency and inspecting the non-electrical equipment, which might have unusual temperature caused by external factors. Finally, the camera is used as a diagnostic tool and a check-up of the laboratories full of electronics can be done, with the influence on any anomalies that may occur.

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[†] Deceased.

2. Hardware and software

The chosen camera needed to satisfy a few of the requirements. Due to the necessity of measuring temperature in different buildings and laboratories, mobility was a concern. For this reason, the camera needed to be wireless, with a wi-fi connection, preferably with an SD card and with a variety of color palettes. Moreover, its resolution was an issue and it was necessary to differentiate components of height from 1U up to 4U mounted in the RACK. The temperature range had to be between 0°C and 80°C, where 0°C is the lowest foreseen temperature in the building and 80°C is the temperature at which it is sure that electronic devices are malfunctioning. The final requirement was a price that needed to be less than 12 000 PLN. Fluke TiS20 was chosen since it satisfied all of the mentioned conditions with a very good price to performance ratio from the cameras available on the market.

It was decided that the manufacturer's software will not be used in the image analysis. A variety of factors caused such a decision. The most important are the necessity to download and install this software, shut-downs and freezes, lack of user-friendliness and inability to export the data to the database. Due to those reasons, MATLAB was chosen. Using MATLAB's Image Processing Toolbox and Computer Vision Toolbox allows for quick and efficient software development. What is more, MATLAB's app designer allows creating an .exe file of the program or use it using the browser.

3. Image analysis

In this case, the software is prepared for specific files. Most of the algorithms are universal, however, the first step — pre-processing is tuned for 320×240 temperature data, CSV files from the TiS20 thermal imager. Moreover, files should not contain any markers. Markers of different shapes can be automatically added to the image on taking the image or after, in the camera's software [2]. The next thing considering the files is calibrating the images for the emissivity of the inspected materials. It is solely the role of the camera's operator, files that can be analysed by the MATLAB are supposed to have proper emissivity, because the created software is unable to manipulate it at any stage of processing.

Figure 1 presents the first tab, which allows loading an image and shows the basic information about the analysed image. The drop-down menu allows to select the colormap, "show the temperature value from the selected point" button places a movable point on a graph which returns the temperature at this point to a box below the button. Two tickboxes on the bottom left put the black (maximum temperature) and white marker (minimum temperature) on the image.

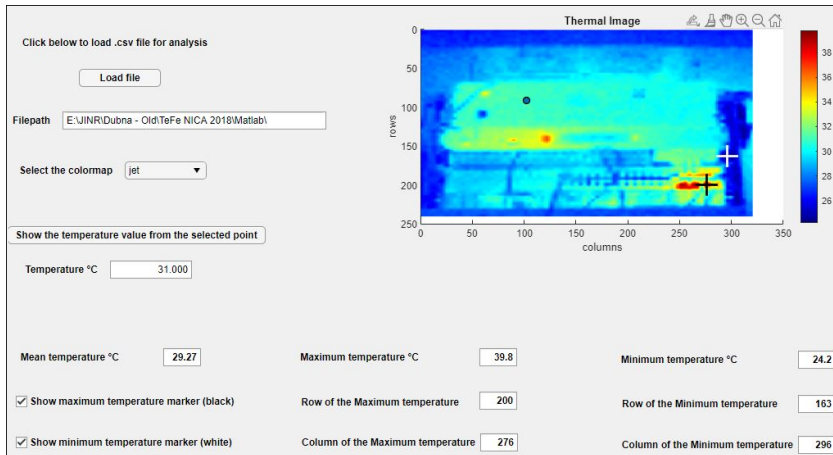


Fig. 1. Basic parameters tab of the GUI.

Figure 2 shows the graph tab, which focuses on graphs and visualizing collected data. The histogram is automatically generated according to the range of temperatures presented on an image. The cross-section selection lets the user select a point in which two straight x and y lines will cross. The temperature distribution onto those lines is shown in the two graphs below the analysed image. The angled line selection allows to draw a line between two arbitrary points and show the temperature along this line's length.

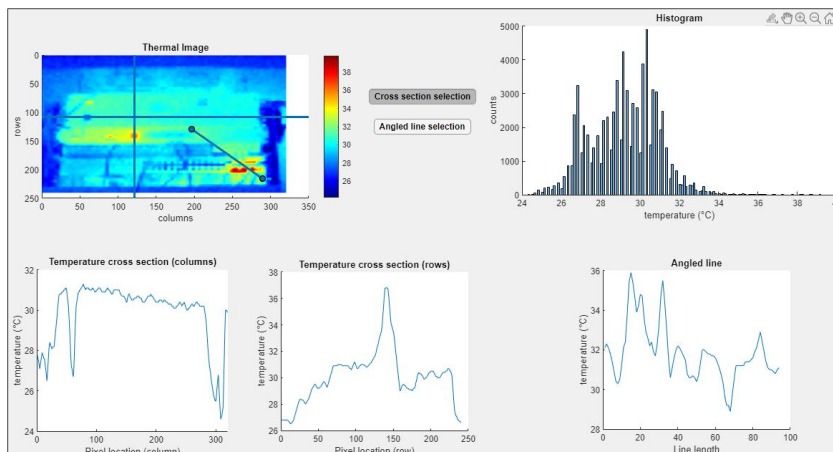


Fig. 2. Graphs tab of the GUI.

Figure 3 shows the tab responsible for the region of interest (ROI). Its sole purpose is to select the ROI on the initial image and then show its zoomed version. It also shows the average, and extreme temperature of the

snipped part and marks them on an image. What is also important in this tab, if there is more than one area of the same extreme temperature, the software will mark all of them, as it can be seen in the upper right corner in Fig. 3.

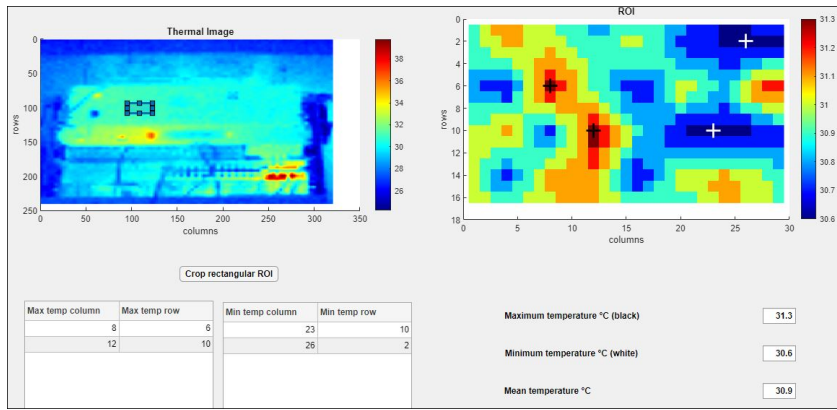


Fig. 3. Region of interest tab of the GUI.

All of the positions of the elements defined by the user (point, cross section, angled line, ROI) can be moved, their size can be changed and the data will be updated in real-time according to the performed changes. Also, while selecting the colormap, its selection will apply to all of the tabs. Each graph that is shown behaves as the graphs in MATLAB’s basic software. This means that the graphs can be moved, zoomed in, zoomed out, copied or saved.

4. Summary

The prepared software allows to analyse the data collected from the Fluke TiS20 thermal imager in a basic way. Its GUI is simple, which allows it to be used by an inexperienced user. The ability to share it, launch it without previous installation and use CSV files instead of files that occupy more disk space is advantageous. However, some improvements can be applied. The two most urgent improvements are changing the emissivity and the ability to store crucial data in the database.

REFERENCES

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