

# Analyzing thermal images taken by the Fluke TiS20 thermal imager\*

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

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## 1. Introduction

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

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## 2. Hardware and Software

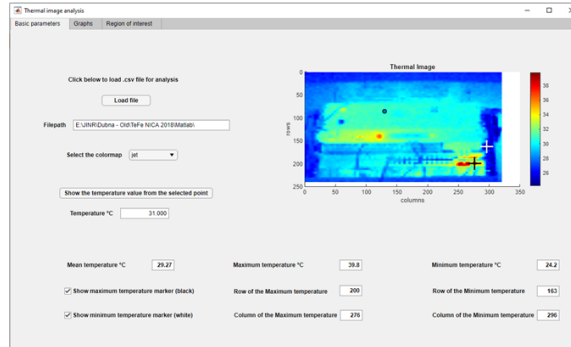
The chosen camera needed to satisfy few of the requirements. Due to the necessity to measure temperature in different buildings and laboratories, the mobility was a concern. Because of it, the camera needed to be wireless, with a wi-fi connection, preferably with an SD card and with variety of color palettes. Also, its resolution was an issue, it was necessary to differentiate components of height from 1U up to 4U mounted in the RACK. The temperature range had to be in 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 which needed to be less than 12 000 PLN. From the cameras available on the market Fluke TiS20 was chosen since it satisfied all of the mentioned conditions with very good price to performance ratio.

It was decided that the manufacturer's software will not be used in image analysis. Such decision was caused by variety of factors. The most important are necessity to download and install this software, shutdowns and freezes, lack of user friendliness and inability to export the data to the database. Due to those reason, MATLAB was chosen. Using MATLAB's Image Processing Toolbox and Computer Vision Toolbox allows for quick and efficient software development. Also, MATLAB's app designer gives an opportunity to create an .exe file the program or use it using the browser.

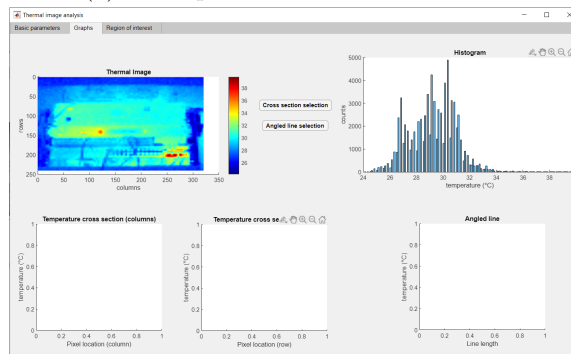
## 3. Image Analysis

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 320x240 temperature data, CSV files from the TiS20 thermal imager. Moreover, files should not contain any markers. Markers of idfferent shapes can be automatically added to the image on the step of taking the image or after, in the camera's software[2]. Next thing, considering the files is calibrating the images for the emissivity of the inspected materials. It is solely role of the camera's operator, files that can be analysed by the Matlab are supposed to have proper emissivity, because the software created software is unable to manipulate it at any stage of processing.

Fig. 1a. presents the first tab, which allows to load an image and shows the basic information about the analysed image. Drop down menu allow 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 puts the black (maximum temperature) and white marker (minimum temperature) at the image.



(a) Basic parameters tab of the GUI



(b) Graphs tab of the GUI

Fig. 1: First two tabs of the GUI

Fig. 1b. 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 let user select a point in which two straight x and y lines will cross. The temperature distribution onto those lines are shown in the two graphs below the analysed image. Angled line selection allows to draw line between two arbitrary points and show the temperature along this line's length.

Fig. 2. shows the tab responsible for 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 as well as mark 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 the Fig. 2.

All of the positions of the elements defined by the user (point, cross

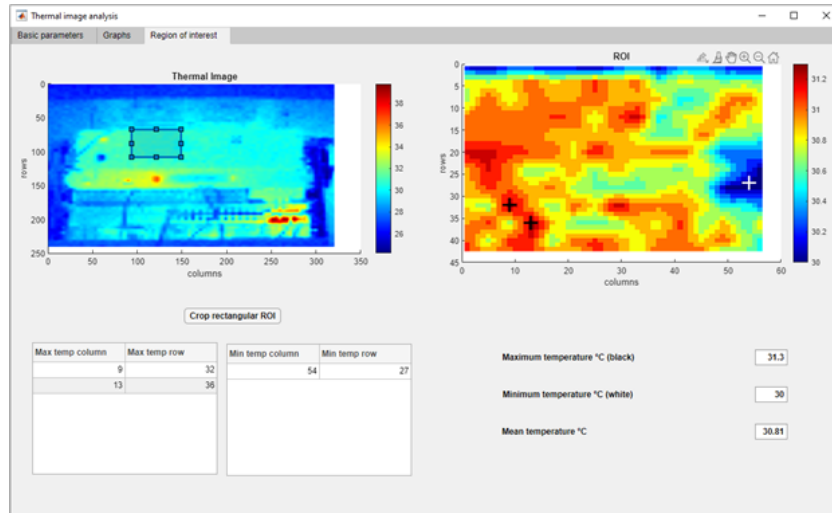


Fig. 2: Region of interest tab of the GUI

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 which is shown behaves as the graphs in the MATLAB's basic software. This means that the graphs can be moved, zoomed in zoomed out, copied or saved.

#### 4. Summary

Prepared software allow to analyse the data collected from the Fluke TiS20 thermal imager in a basic way. Its GUI is simple, which allow 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 are advantegous. However, some improvements can be applied. The two most urgent improvements are ability to change the emissivity and ability to store crucial data in the database.

#### REFERENCES

- [1] K. Roslon, D. Dabrowski, M. Peryt *Design brief of the Slow Control System for the MPD-TOF detector* Acta Physica Polonica B Proceedings Supplement No 4, Vol. 11 (2018)
- [2] S. H. Warnke, T. Heinke *System and method for analyzing a thermal image using configurable markers* US 8,911,147 B2, Dec. 16, 2014