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iRAY T3S Thermal Camera Performance Analysis

Technical Report - November 2020

iRAY T3S thermal camera for COVID detection: performance analysis now released!

REPORT CONTENT

- Piséo's opinion of the iRay T3S Camera
- Functionalities and use analysis
- Image production flow analysis
- Imaging characterization protocols and results at various temperatures:
  - Responsivity
  - NETD
  - Scene dynamic
  - Operability
  - Dependance on ambient temperature
  - FPA temperature stability
  - Flat field correction
  - FFC comparison with 2-point NUC
  - Residual fixed pattern noise
  - Thermographic response
  - Shutter activation
  - Image quality in extreme temperature cases
- Temperature sensing analysis
- Optical analysis
- Image processing and tone mapping analysis

FIRST TIME EVER PERFORMANCE ANALYSIS REPORT

Thanks to multiple drivers, a.o. the need for large number of temperature measurements of people due to COVID, the market for infra-red thermal imaging cameras and modules is expanding at a rapid pace. Therefore, there is a need for users, integrators, and sensor manufacturers to be able to discriminate between marketed products based on accurate and independent assessment of their performance and features.

As there is hardly any independent infra-red camera or module performance data available, purchasers of such systems are left with datasheet values that can be right or not or provide only limited information.

Therefore, this technical report, which, to Piséo's knowledge, is a first time ever providing independent, accurate and detailed performance data. It will be followed soon by other reports which will include analyses of Flir, Seek Thermal, Guide, HIK Vision… cameras and modules.

Carried out by a team of experienced optical and system engineers, this technical report relies on robust and comprehensive test protocols and thorough analyses of the test results. The outcome of this process is a set of typical performance indicators, such as responsivity, NETD, scene dynamic, operability… and functionalities assessment. Together, they made it possible for Piséo to develop its own opinion of the iRay T3S Camera: it has shown to be a good value for money product but with some improvements necessary.

We have greatly appreciated:

- The good correspondence of the datasheet values with our own measurements
- The good image quality provided thanks to a very good bolometric sensor and a performant 3-step tone mapping process
- Xtherm's user-friendly interface

We have less appreciated:

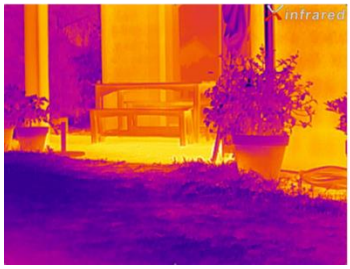
- The manual focus which requires the user to often search for the focal point
- The need to de-assemble the lens from the camera for packing purpose, which allows for dust to be deposited on the sensor
- The risk of making large temperature measurement errors if the user has no background in thermal measurement principles

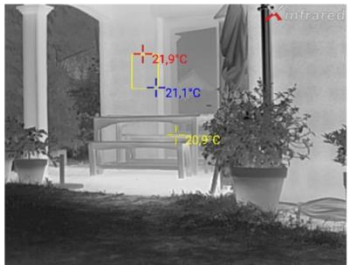
We did not explore:

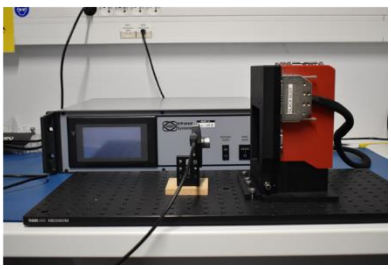
- The thermal measurement algorithm

T3S images and Piséo's black body

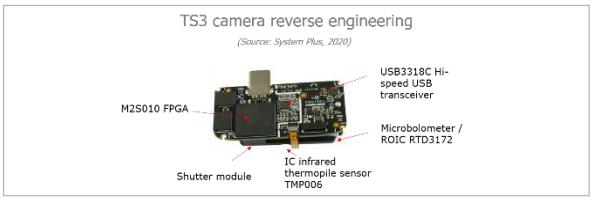
(Source: Piséo, November 2020)





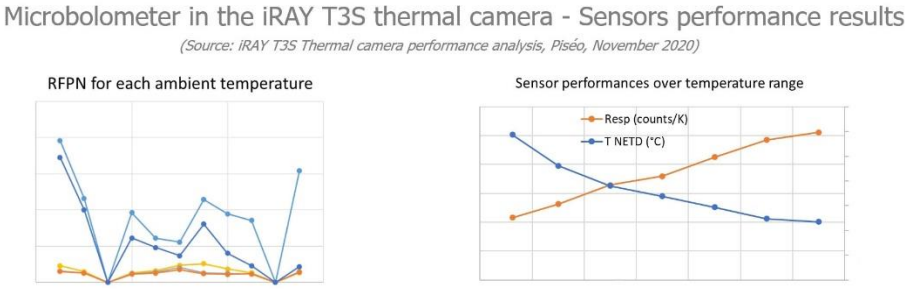


TEST PROTOCOLS AND FINDINGS



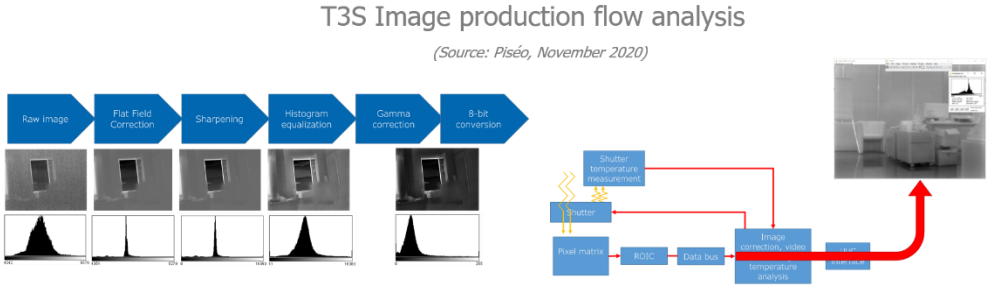
As a starting point, Piséo looked into the technical characteristics of the camera and analyzed the functions offered by extensive use testing. Then, thanks to System Plus Consulting's (www.systemplus.fr) reverse engineering analysis of the T3S camera, which we have access to, Piséo has been able to accurately determine the microbolometer characteristics and camera construction. This first was essential to carry out the performance tests. Indeed, for the latter, Piséo developed its own test protocols and software interfaces which, through proper connection with and use of the camera, enabled them to gather data at sensor pixel level at various temperatures.

By using their own stabilized HGH black body, climate chamber and specific protocols and software Piséo's team was able to perform numerous tests at various temperatures ranging from -20°C (-4°F) to 100°C (212°F). By doing so they have been able to compare the rated data displayed in the iRay datasheet with their own test results. Thus, the report presents a detailed overview of our characterization process and a collection of performance indicators of the embedded sensor expressed in values and graphs. Below are a few examples of graphs of the report that disclose some of our findings of the microbolometer sensor performance.



Through its test protocols Piséo also assessed the temperature measurement function which is a particularly sensitive topic when attempting to measure with this type of device, particularly in this time of the Covid-19 epidemic. Results are clearly dependent on the emissivity of the object measured. Our analysis shows that non-trivial understanding of thermal management principles is required to measure temperatures accurately with such a device and that precautions need to be taken with the temperature values displayed by the T3S camera on an attached terminal.

Last but not least Piséo's team made a full analysis of the image processing and tone mapping. The report presents the different steps and algorithms used to produce the final image and an assessment of its quality.



Altogether, there is much in-depth technical information available in the report which will allow you to understand in detail how the T3S camera from iRay performs, from the sensor characteristics to the image production, as well as the user experience.

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TABLE OF CONTENT

AUTHORS

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Olivier ANDRIEU is in charge of technical expertise and innovation projects at PISEO. He holds a degree in Engineering and a PhD in physics. His career has allowed him to carry out various responsibilities in innovation in the automotive sector in connection with sensors and battery management systems but also within Philips Lighting where he acted as system architect. He has supervised the design of numerous photonic systems for different sectors actually commercialized. He also performed lots of technical analyses of photonic systems and published several reports in collaboration with Yole Développement's

Grégory Duchêne - Sr Optical Designer, illumination, detection and imaging systems - Piséo

Grégory Duchêne is in charge of advanced optical systems studies and analyses at PISEO. He holds an engineering degree from the Institut d'Optique Graduate School (IOGS). He has completed with success the optical design of many innovative photonic systems for Piséos' customers. Further to his strong optical design skills he has deep know-how of optical metrology of illumination and imaging systems. Grégory Duchêne is our Zemax expert and also teaches optical system design at IOGS.

Lionel Artinyan – Photonic Systems Test Engineer - Piséo

Lionel Artinyan holds a degree from the ENSSAT Graduate School and has a strong background in photonic component and system characterization. At Piséo he is in charge of custom test bench engineering and test realization. He has participated in the design of many different test benches that include optical devices and control programs. He has tested with success many systems that integrate pulsed light sources such as xenon lamps, LED's and laser diodes, and imaging sensors as well.

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ABOUT PISÉO

Piséo is a French independent Innovation Center which helps industrial companies to innovate by providing analysis, design, realization and characterization services for illumination, detection, and imaging systems.

Created in 2011 under the leadership of Yole Développement, its main shareholder, the company has carried out with success 200+ customer projects and 4000+ characterization tests in its accredited lab. Active in many application fields, such as personal devices, domestic appliances, defense and security, automotive and transportation, general lighting or healthcare and well-being, Piseo has about 150 regular customers including global leaders and high-tech start-ups.

Application and technical analyses

- Reverse engineering of photonic components and systems
- Performance analysis reports of component and systems
- Application and technical reports of photonic components and systems
- Benchmarking of component and system performance and construction
- Regulatory and normative intelligence
- Technology intelligence
- Patent intelligence

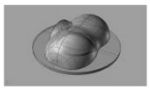
System design and Realization

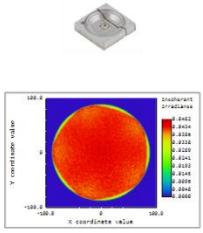
- Application requirements of photonic systems (UV, VIS, IR)
- Concept generation
- Feasibility studies
- Optical, mechanical, electronic and software design
- Simulations
- Thermal management
- System integration
- Prototyping, pre-series and small volume production with partners
- Redesign to cost, to quality

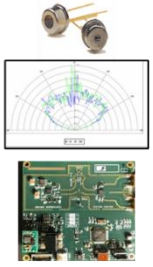
Test lab

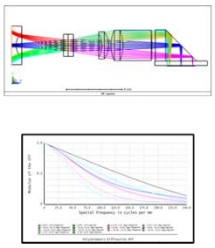
- Photometric and colorimetric measurements (accredited)
- Spectral and radiometric measurements (UV, VIS, IR)
- Photobiological risk assessment (accredited)
- Luminance and color maps of displays, light panels, etc.…
- Electrical measurements
- Temperature measurements
- Characterization of cameras, modules and imaging sensors (VIS, IR): NUC, NETD, responsiveness, MTF …)

Examples of completed projects and services:


Freeform optic design and realization for streetlighting

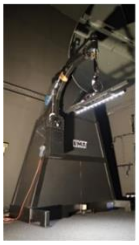

UV-C illuminator design and realization


VCSEL based system design and realization


Imaging optical system design and realization

IR camera performance analysis


UV measurements and photobiological risk assessment


Goniophotometry

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