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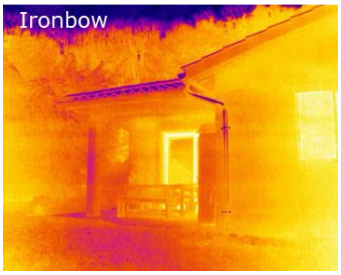
FLIR BOSON THERMAL CAMERA PERFORMANCE ANALYSIS

Technical Report - January 2021

Flir Boson 640 Pro: testing the actual performance of a market leading product !

REPORT CONTENT

- Piséo's opinion of the Flir Boson 640 Camera Module
- In-depth analysis of the user functions of the camera
- Accurate characterization and analysis of the measured performance parameters of the embedded microbolometric sensor
- Thorough analysis of the measured thermometric performance and optical architecture of the camera
- Wide and deep analysis of the sensor correction functions and algorithms
- An analysis of the image processing flow from sensor to image, as well as an assessment of image quality



Source : Piséo

HOW TO DISCRIMINATE BETWEEN PRODUCTS IN A BOOMING MARKET ?

Fueled by multiple drivers, including the need for a large number of temperature measurements of people due to COVID-19 as well as surveillance, the market for infra-red thermal imaging cameras and modules is expanding at a rapid pace. In fact, our partner Yole Développement expects an 8% compound annual growth rate from 2019 to 2025 ($CAGR_{2019-2025}$). Many new players, especially from Asia, have already started to disrupt the market. In order to make appropriate choices, therefore, users, integrators, and sensor manufacturers need to be able to discriminate between marketed products based on accurate and independent assessments of their performance and features (benchmarks).

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

Therefore, following the positive feedback of its successful first report "iRay T3S Thermal Camera Performance Analysis", Piséo's team now reveals how the successful FLIR Boson camera module performs, from sensor detection through to image production. Other reports will soon follow, including analyses of Seek Thermal, Guide sensmart, Hikvision and other manufacturers' 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…, leading to functionality assessment and image quality appreciation. Together, they make it possible for Piséo to develop its own benchmark procedure for thermal cameras, which enabled them to test independently the Flir Boson 640 Pro Camera. The Piséo team outlines its observations: although fitted with a non-top-notch sensor but thanks to great software capabilities, the FLIR Boson 640 Pro appears to be a very versatile and high performing IR camera platform for many different use cases.

Piséo greatly appreciates:

- A very open and accessible set of configuration parameters.
- The possibility to adapt the camera performance to the use conditions through both hardware and software configurations.
- The easy-to-use SDK and user-friendly GUI.
- The sophistication of the image processing algorithms.
- The wide temperature measurement range resulting in very good scene dynamic.
- The very stable performance against ambient conditions.

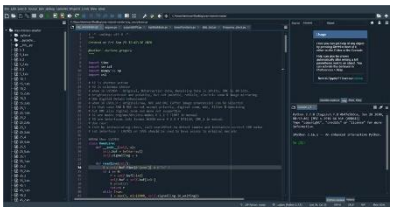
Piséo appreciates less:

- The difference between FLIR-communicated sensor performance (as per datasheet) and the actual one as tested for NETD.
- The intrinsic performance of the image sensor: NETD, bad pixels and column noise.
- The image processing algorithms are difficult to handle by the user due to their complexity and interdependency, and sometimes unclear documentation.
- The information base equalizer which didn't prove to be of any added value.

We did not investigate:

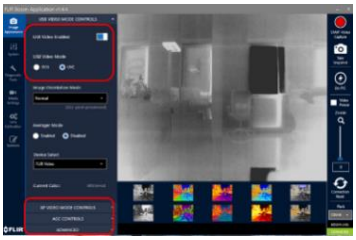
- The MRTD to assess the image quality depending on the use case.

TEST PROTOCOLS AND FINDINGS



Piséo's image processing proprietary software

IR camera being tested in Piséo's climate chamber



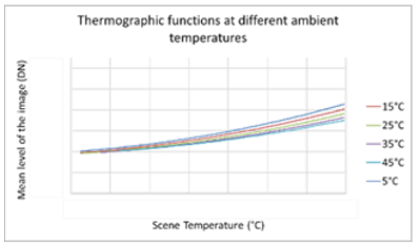
Boson's user interface analysis

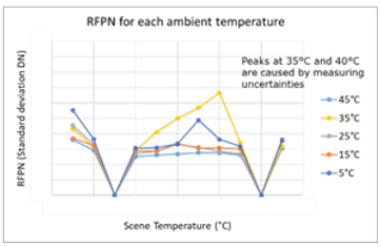
In order to characterize the camera performance, Piséo's experts use their own test protocols, software, and lab equipment, which includes a calibrated HGH black body and climate chamber able to perform tests at ambient temperatures ranging from -20°C (-4°F) up to 100°C (212°F).

The Boson camera module is available in many options: size of imaging sensor (resolution), three accuracy options, 16 optics configurations. Piséo have chosen to characterize the 640 Pro version, fitted with a 50° FOV optic, since it's a successful representative thermal camera module used across professional, industrial and defense applications, where the trends are shifting toward higher resolutions. Piseo needed to develop an extensive process to assess the performance, starting with the ability to communicate with the bolometric sensor and to produce raw images using our own code. This first step allowed a set of typical performance indicators to be produced in a reliable and consistent manner, such as responsivity, NETD, scene dynamic, operability and others. These could then be compared with the rated data supplied in the FLIR datasheet and also with other marketed cameras. It was interesting enough to find a significantly higher NETD value (from raw data, without significant image processing and correction algorithms) than the one published by the manufacturer but also a significant number of bad pixels. Below are a few examples of graphs and pictures from the report that disclose some of our findings of the microbolometer sensor performance.

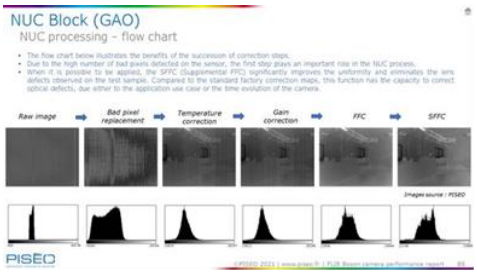
Microbolometer in the Flir Boson Thermal Camera – Sensors performance results

(Source: Flir Boson Thermal Camera Performance Analysys, Piseo, January 2021)





We also spent quite a lot of time in understanding all the different functionalities and parameter set-ups that the camera presents. They appear to be quite extensive and reveal FLIR's intention to offer to the market a very versatile platform for many different use cases. The drawback is that it requires from the user a very good understanding, therefore practice, of the features to be able to produce optimized images for specific applications. Our investigations also revealed how the correction functions and algorithms work in order to produce high quality images, despite the camera being built upon a mid-performing bolometric sensor. For instance, the signal-image is largely reworked and corrected by means of user-accessible functions, reducing thermal drift, pixel-to-pixel drift, optical and thermal environment perturbances, ultimately improving the NETD value. The ability to calibrate the sensor when equipped with different or supplementary optics or when subject to thermal out-of-field radiation effects is a great option to improve the performance when plugged into a reproducible situation. Below are a few examples of the report's content.



Altogether, there is a lot of information and much in-depth technical information available in the report which will allow you to understand in detail, from the sensor to the image, the features and performance characteristics of the FLIR Boson 640 Pro camera module and how it leads users to create optimized pictures for their own applications. This will help you to understand how the sensor works and help you to make a choice between various products, by allowing you to compare with other marketed devices.

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TABLE OF CONTENT

AUTHORS

Dr Olivier Andrieu – Innovation Leader and System Architect - Piséo
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 as well as within Philips Lighting where he acted as a system architect. He has supervised the design of numerous commercialized photonic systems for different sectors. He has also performed many technical analyses of photonic systems and has published several reports in collaboration with Yole Développement's teams.

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 ENSATT 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, as well as imaging sensors.

RELATED REPORTS

- iRAY T3S Thermal Camera Performance Analysis *by Piséo*
- Thermal Imagers and Detectors 2020 *by Yole Développement*
- Guide Infrared's 17µm Microbolometer Module *by System Plus Consulting*
- iRay Technology 12µm and 17µm Thermal Sensors *by System Plus Consulting*

More information and details about our offers and bundles opportunities on www.i-micronews.com

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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, 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 components 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
- Photobiological and laser risk assessment

System design and Realization

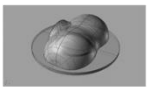
- Application requirements of photonic systems (UV, VIS, IR)
- Concept generation
- Feasibility studies
- Optical, mechanical, electronic and software design
- Simulations
- Thermal management
- System integration
- Prototyping, pre-series and small volume production with partners
- Redesign to cost,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

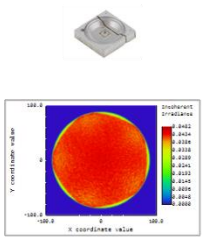
Test lab

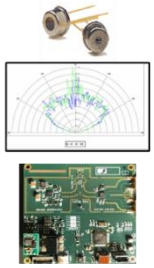
- Photometric and colorimetric measurements (accredited)
- Spectral and radiometric measurements (UV, VIS, IR)
- Photobiological risk assessment (accredited)
- Luminance and color maps of displays, light panels, etc.…
- Electrical measurements
- Temperature measurements
- Characterization of cameras,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

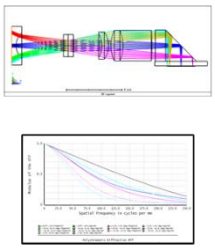
Piséo can test any sensor/module/camera or help you with similar systems' benchmarks.
All you have to do is contact us!

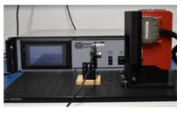
Examples of completed projects and services:


Freeform optic design and realization for streetlighting


UV-C illuminator design and realization

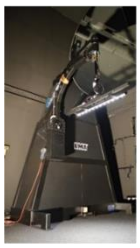

VCSEL based system design and realization


Imaging optical system design and realization


IR camera performance analysis



UV measurements and photobiological risk assessment


Goniophotometry

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