# Alliance IRIS' sensitivity

Technical note on key sensitivity features
for Alliance IRIS system

## Introduction

Imaging high concentrations of nucleic acids or proteins is typically straightforward for most documentation systems. However, accurately capturing images of these biomolecules at low concentrations presents a significant challenge. In these cases, a sensitive instrument is crucial for imaging low concentrations, ensuring accurate detection and analysis.

This note reviews how Alliance IRIS system smartly blends specifications to reach a superior sensitivity performance.

## 16 bits CCD camera

Known for its high sensitivity, a CCD camera can detect low levels of light with great precision **(1).** Each pixel on the sensor receives information in the form of light intensity, which is graded and represented by a numerical value. In a 16-bit camera, each pixel of the image can display a light intensity among 65,535 gray levels—enabling very fine accuracy and depth of nuance in capturing image details.

In molecular biology, this ability to distinguish fine differences in brightness allows for **more precise quantification**, as the captured gray levels will be directly proportional to the concentration of the proteins of interest. Three major factors influence camera sensitivity in molecular imaging.

1. Lens Aperture

The smaller the value, the wider the lens aperture. Its importance: significantly greater number of photons go through the lens, boosting the image captured and allowing for lower concentration bands to be revealed in a given exposure time. Today, Alliance IRIS has a **f/0.75 aperture** whilst most systems today continue to use a standard aperture of f/0.95.

This difference allows IRIS to collect more light uncovering a broader spectrum of bands **(Fig. 1.).**

***Figure 1. Comparison of a chemiluminescent western blot captured with an aperture of f/0.75 and an aperture of f/0.95***

## 2. Cooling

The **Peltier cooling** is a technology that uses thermoelectric devices to control and maintain the camera sensor temperature at optimal levels **(2,3).** By actively cooling the sensor, Peltier modules reduce camera-generated noise, thereby improving the camera's sensitivity and the quality of captured images. The cooling efficiency is proportional to the number of Peltier modules used in the system. Equipped with a **3-stage Peltier air cooling** system, the Alliance IRIS camera can cool down to **-60°C** in just a few minutes, enabling the detection of low signals that a standard 2-stage Peltier cooling camera cannot achieve.

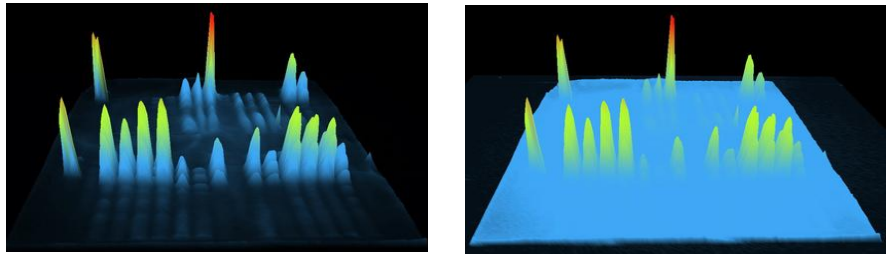

***Figure 2. Comparison of a western blotting blot acquired with different Peltier cooling systems.*** *(Left) the blot is captured with Alliance IRIS camera equipped with a 3-Module Peltier cooling system (Right) the blot is captured with another imaging system using a 2-Module Peltier cooling system. The blue square represents the background noise, covering the weakest protein signals.*

## 3. Native Resolution

With a **9.2 MP** camera, we strive to offer the highest native resolution currently available on the market. Ideal for publication-level results, superior resolution allows for clearer and sharper pictures, with a much higher level of details. In the imaging field, native resolution and image resolution are often confused. It is important to clarify this distinction.

**The native camera resolution** refers to the physical resolution of the image sensor (total number of pixels inside the camera) itself. In other words, it is the maximum resolution at which the sensor can capture an image without any enlargement or reduction. This is the resolution at which the image was acquired. Native resolution is considered better for maintaining the original quality and detail (data) of an image for downfield quantification.

**The image resolution** can be higher than the native resolution through a process called interpolation **(4).** This involves estimating new data points within a range of known data. This is the image produced after processing and can be increased by increasing the size of the image in an editing program **(5).**

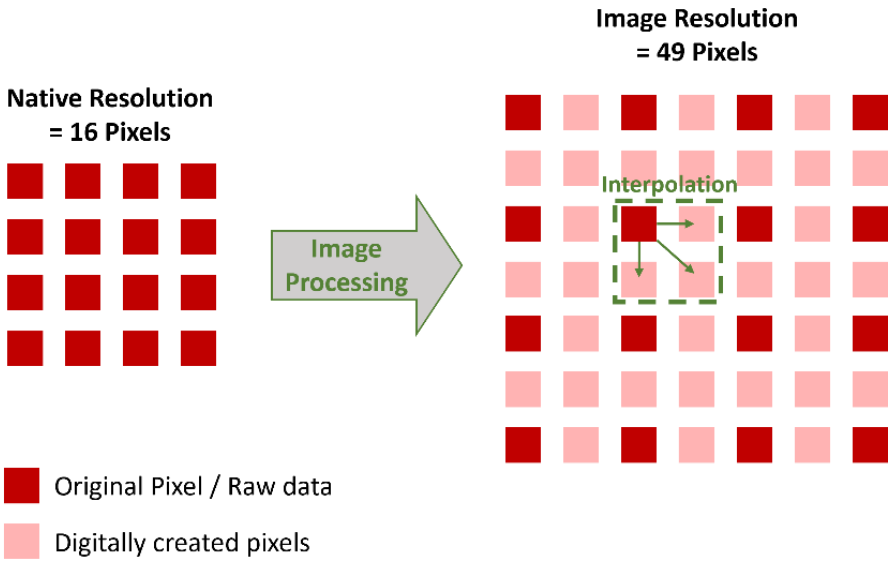


***Figure 3. Native to Image Resolution.*** *Interpolation applied to an image captured by a camera with 16 physical sensors (pixels). The native resolution of the image is 16 pixels, but due to the interpolation processing, the display resolution is increased to 49 pixels.*

In summary, in native resolution, **you're experiencing the image as it was captured without any distortion** while image resolution is the result of digital creation of new data.

## Grey level identification

The dynamic range represents the achieved image amplitude relative to the potential image depth.

A higher dynamic range, without reaching saturation, results in better image quality as it provides more detailed and quantitative data. This means that even the smallest variations in signal intensity are accurately displayed when the dynamic range is large.

Alliance IRIS system features an innovative functionality that represents grayscale levels as a percentage of the total to quickly allow the user **to assess the image detail and richness.** For example, if 32,768 grey levels are present in an image, the system will indicate that 50% of the grayscale levels are represented as the total for a 16-bit camera is 65,536 values.


***Figure 4: Percentage representation of greyscale levels****. Out of 65,536 grey values, 91% are represented ensuring user that quantification is precise and reliable.*

By displaying grayscale levels as percentages, researchers can easily determine the extent of the captured signal range, which is crucial for analyzing **the quality and quantity of imaging data.**

If the indicated percentage is too low, it signals to the user that the photo may require a retake with adjusted exposure parameters to achieve a better image. This **proactive indication** helps optimize image acquisition conditions, ensuring more accurate and actionable results. This feature enhances the efficiency of analysis and decision-making based on imaging data.

## Conclusion

The Alliance IRIS system sets a new standard in molecular biology imaging by combining advanced specifications to achieve superior sensitivity performance. With its 16-bit CCD camera, the system captures low light levels with high precision, essential for accurate detection and analysis of biomolecules at low concentrations. Key features such as the wide f/0.75 lens aperture, a robust 3-stage Peltier cooling system, and a high native resolution of 9.2 MP collectively enhance the system's sensitivity and image quality. Additionally, the innovative grayscale percentage display assists researchers in quickly assessing image quality, optimizing acquisition conditions, and ensuring precise results. This comprehensive approach to enhancing sensitivity makes the Alliance IRIS system an indispensable tool for molecular biology research.

Finally, it is important to keep in mind that it is not just the camera that impacts image quality; the membrane preparation protocol also plays a crucial role, with factors such as protein concentration, incubation time, washing conditions, type of reagents used, and transfer efficiency all influencing the results.

## References


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