WHITE PAPER

P-Iris.

New iris control improves image quality in megapixel and HDTV network cameras.

AXIS COMMUNICATIONS

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1. Introduction

The introduction of megapixel or HDTV fixed network cameras has meant greater resolution images but not always better image quality. Maintaining image sharpness, particularly in varying outdoor lighting conditions, has proved challenging. It is a problem that has highlighted the limitations of existing lens alternatives and the need for a better solution.

Axis Communications' search for a solution has now led to the introduction of a new and revolutionary precise iris control, P-Iris.

P-Iris not only benefits megapixel cameras but all fixed network cameras. The system optimizes the iris opening under all lighting conditions and the result is images with better contrast, clarity, resolution and depth of field. In short, P-Iris means improved image sharpness and increased image usability for network video surveillance operators.

2. The role of an iris

The P-Iris system involves a new approach to looking at the role of an iris and is the result of a joint development effort between Axis Communications of Sweden and the Japanese lens manufacturer Kowa.

The system comprises of a P-Iris lens and specialized software in the camera. The software steers a motor in the P-Iris lens, enabling automatic and precise control of the iris opening. The key to understanding P-Iris is to look at how the iris affects image quality.

The iris of a lens regulates the size of a lens' aperture or opening and the amount of light that passes through it so that an image can be correctly exposed. Without an iris, an image can become too light in a very bright environment, or it can be dark if the lens opening is not big enough to let available light in.

The size of the iris opening also has an effect on image sharpness and depth of field. Depth of field refers to the distance in front of and beyond the point of focus where objects appear to be sharp simultaneously. A wide iris opening reduces depth of field while a smaller opening increases it. Having good depth of field is important in many surveillance applications as it allows more of a scene to be clearly visible. It is particularly useful in the video monitoring of, for example, a long corridor or parking lot. Image sharpness generally improves with a smaller iris opening because optical errors can often be reduced. All lenses create some form of image aberrations when the full lens surface is used.

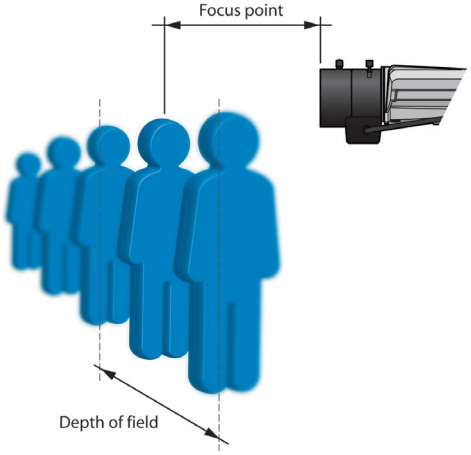

Fig. 1 Having good depth of field—where objects at different distances from the camera are in focus simultaneously—is important in many surveillance applications as it allows more of a scene to be clearly visible.

While it is true that a smaller iris opening often means sharper images, too small an opening may blur an image due to an optical effect called diffraction. This problem can be seen in bright outdoor situations when a camera closes the iris too much and light is diffracted or spread over many pixels. The smaller each pixel is on an image sensor, the more of a problem diffraction becomes as the diffracted light affects more pixels. This can typically happen in cameras that use an automatic DC-iris lens in combination especially with megapixel sensors that have small pixels. (While a megapixel sensor has more pixels than a standard VGA 640x480 image sensor, the size of each pixel on a megapixel sensor is often smaller than the size of each pixel on a VGA image sensor.)

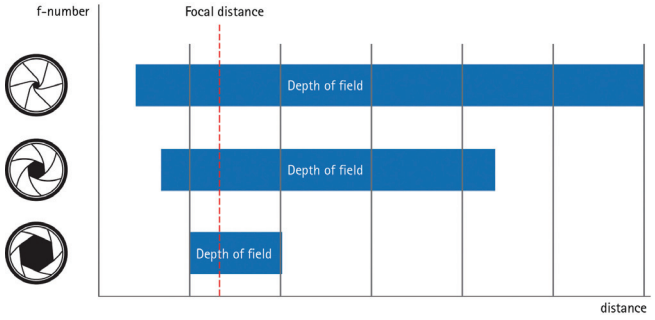

Fig. 2 This illustration is an example of the depth of field for different size iris openings, expressed as f-numbers. A smaller iris opening, that is a larger f-number, enables objects to be in focus over a longer range. Depending on the sensor's pixel size, very small openings may cause image blur (diffraction).

3. Existing lens options

Until the introduction of P-Iris, the types of iris control on lens options for fixed surveillance cameras have been fixed, manual and automatic. Fixed iris lenses have no ability to adjust the iris opening. With manual iris lenses, the iris opening must be adjusted by hand. Auto-iris lenses, either DC iris or video iris, automatically adjust the iris opening in response to changes in light levels.

For indoor applications where light levels are constant, fixed or manual iris lenses may be suitable since there is no need to constantly adjust the iris opening.

In situations with varying light levels, for example, outdoor camera installations, the preferred lens option is an automatically adjustable iris. This is commonly a DC-iris lens. A DC-iris lens responds only to light levels and does not take into account the impact of the iris opening on other image qualities such as depth of field. With a DC-iris lens, the camera only knows if the iris opens or closes in response to the level of light; it doesn't provide the camera with information about the position of the iris. Without this information, the camera is not able to effectively steer the iris opening in order to optimize image quality. This is a drawback that P-Iris is designed to overcome.

4. How P-Iris works

P-Iris is a new type of iris control that is both automatic and precise. Unlike a DC-iris lens, the main task of the P-Iris control is not to continuously adjust the flow of light through the lens. The primary objective of P-Iris is to improve image quality by enabling the optimal iris position to be set so that the central and best-performing part of the lens is used most of the time. This position, expressed as a specific f-number, is where the lens performs optimally, where many optical errors are reduced, and where image quality (with regards to contrast, resolution and depth of field) is at its best. This is the default setting in a network camera with P-Iris.

When the whole lens surface area is used, maximum light reaches the image sensor, depth of field is shallow and the use of the full lens surface may create image aberrations.

When the central part of the lens is used, unwanted optical effects are reduced, good depth of field is achieved and image quality is optimized. This is the preferred iris position in a P-Iris camera.

When the very center of the lens is used, diffraction may occur, which results in blurriness. Image quality will not be optimal since the resolution and contrast are low.

Fig. 3 This diagram illustrates the impact of setting the iris to use different areas of a lens surface.

Working in conjunction with P-Iris is the use of electronic means—gain (amplification of the signal level) and exposure time—to manage slight changes in lighting conditions and to further optimize an image. This allows the optimal iris position to be maintained as long as possible. In situations when the preferred iris position and the camera's electronic processing capabilities cannot adequately correct the exposure, a P-Iris camera will automatically instruct the iris to move to a different position. In dark conditions, for example, the iris will fully open. In bright situations, a camera with P-Iris is programmed to limit the closing of the iris to a position that avoids diffraction or blurring, as explained earlier. Hence, in all lighting conditions, P-Iris can automatically make adjustments to deliver optimal image quality.

Old technology

P-Iris

Fig. 4 Note the great depth of field in the picture to the right taken by a P-Iris camera.

Old technology (cropped view)

P-Iris (cropped view)

Fig. 5 Note the sharp contrast in the picture to the right taken by a P-Iris camera.

5. Redefining video quality

P-Iris is an innovative solution that truly allows a network camera—particularly a megapixel or HDTV network camera—to perform optimally in all lighting conditions. It enables the delivery of crisp, high-resolution images with good depth of field. It can also avoid diffraction in bright situations. Furthermore, it does it all automatically, which is highly valued in outdoor video surveillance applications.

Although the P-Iris control is initially available only in Axis network cameras, the technique has the potential of becoming a new industry standard as Axis and Kowa have decided to make P-Iris accessible to the whole industry.

P-Iris is a revolutionary development for video surveillance cameras and is a testament to Axis' commitment to providing the surveillance industry with superior video quality and greater image usability.

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About Axis Communications

Axis is an IT company offering network video solutions for professional installations. The company is the global market leader in network video, driving the ongoing shift from analog to digital video surveillance. Axis products and solutions focus on security surveillance and remote monitoring, and are based on innovative, open technology platforms.

Axis is a Swedish-based company, operating worldwide with offices in more than 20 countries and cooperating with partners in more than 70 countries. Founded in 1984, Axis is listed on the NASDAQ OMX Stockholm under the ticker AXIS. For more information about Axis, please visit our website at www.axis.com

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