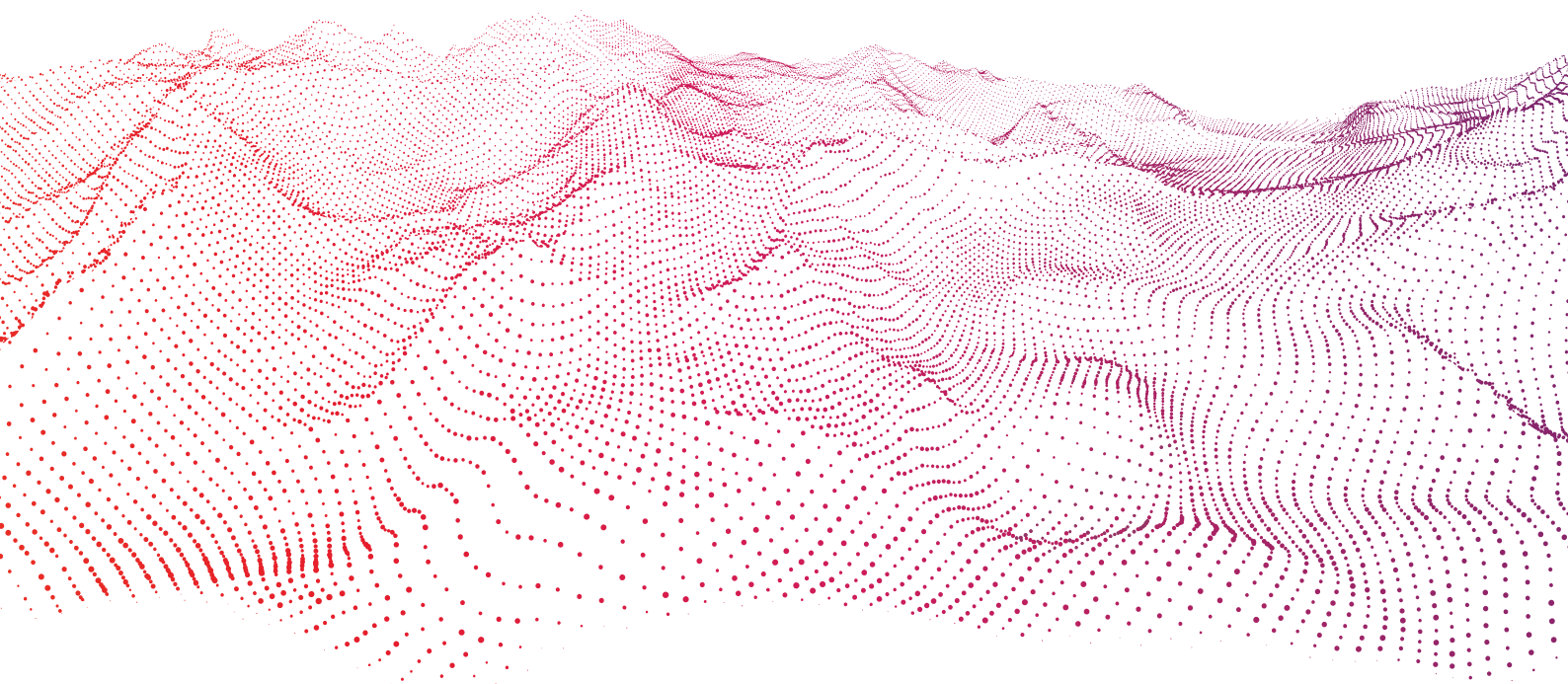


Stay focused with a small focal spot

This focus topic explores the benefits of using a smaller focal spot in X-ray technology. By reducing the size of the focal spot, geometrical un-sharpness is minimized, resulting in a sharper image with improved detail detectability.



Saving Money & Obtain Better Resolution

Often the demand for in high-throughput requires a trade-off of a larger focal spot, to boost productivity and lower costs. Unfortunately, this can also lead to geometric unsharpness, decreased resolution in the inspection area of the component.

By reducing the source-to-detector distance, a smaller focusing point can be used without causing geometric unsharpness to rise. But how does it affect throughput? By decreasing the source-to-detector distance, the dosage rate is increased which reduce the costly long exposures by as much as 90%, thus minimally affecting the throughput while obtaining better resolution.

Read on to find out how decreasing the focal spot size might improve X-ray imaging's effectiveness and efficiency.

Reduced geometrical un-sharpness

Geometric unsharpness (U_g) is the lack of sharpness in an image that results from variation in the geometry of an X-ray system set-up. Most heavily influenced by the physical size of the focal spot, U_g has a major effect on image resolution and the ability to detect defects and resolve small details, also referred to as detail detectability.

Radiation originates from the entire surface of the focal spot, not just from a single point. This causes variation in the path of individual X-rays from the source to any one point in an object. A tighter focal spot results in a sharper image, whereas a larger focal spot increases the blurring of details in the X-ray projection, fig. 1.

Fig. 1

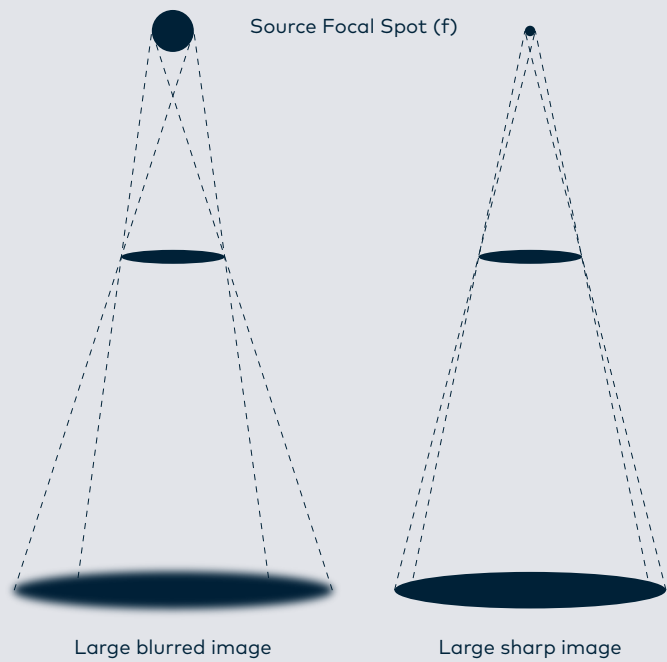
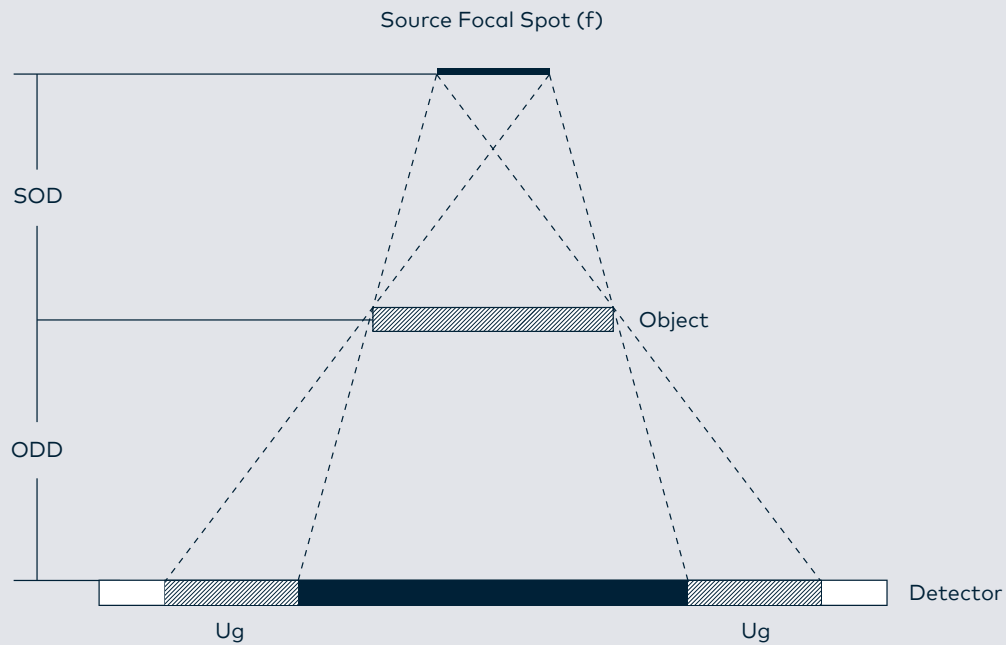


Fig. 2



$$U_g = f \cdot (ODD / SOD)$$

Unsharpness and detail detectability

This is clearly illustrated when radiation is projected through an object and onto a detector. The paths of the X-rays vary from their origin in the focal spot to the edge of the sample. This penumbra, or area of variation, is defined as the U_g , fig. 2.

Geometric unsharpness is characterized by three parameters; the size of the focal spot (f), the distance between the test object and the source (SOD), and the distance between the test object and the detector (ODD). This relationship is represented by the equation: $U_g = f \cdot (ODD / SOD)$.

Since U_g and focal spot size are directly related, a smaller focal spot leads to a smaller U_g .

It follows that as U_g decreases, detail detectability increases and smaller defects and details can be detected, and can be distinguished in closer proximity to one another. If the focal spot is reduced from 3.0 mm to 1.0 mm and the geometric unsharpness is reduced by a factor of three.

Reduced exposure time

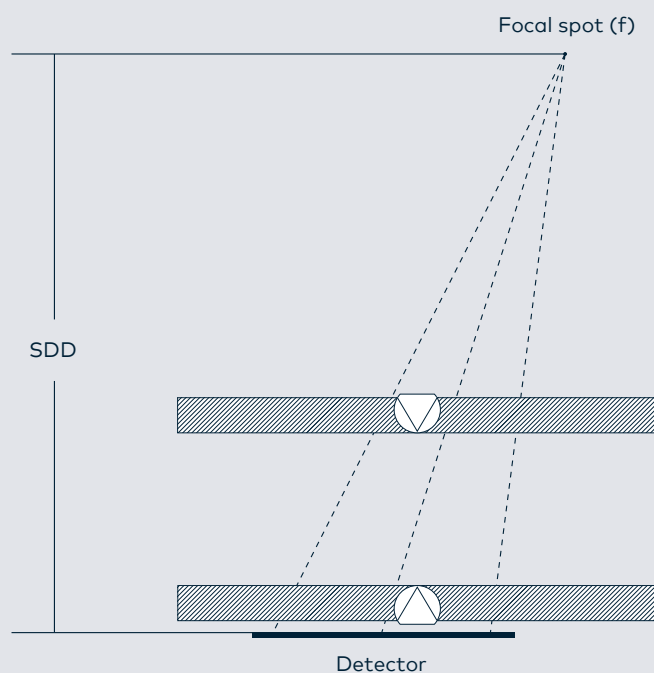
Lengthy exposure times can reduce workflow and limit the number of applications where X-ray technology can be used. Advances in X-ray tube technology can minimize the effect of long exposure times on work place efficiency.

Focal spot size (f) and source-to-detector distance (SDD), central parameters of X-ray imaging, are directly related and can be reduced without increasing geometric unsharpness (Ug) and degrading image quality. When the source-to-detector distance is decreased, the dose rate (I) increases, according to the inverse square law, by a power of two.

When the focal spot size is reduced from 3.0 mm to 1.0 mm, the source-to-detector distance can be reduced up to a third without a significant decrease in image quality. As a result, the dose rate will increase by a factor of up to nine times the original dose rate. This results in a potential reduction in exposure time of up to 90% as well.

$$I = 1 / SDD^2$$

Fig. 3



About Comet X-ray

Revealing insights

Customers trust Comet X-ray to challenge the limits of what can be revealed. By pioneering intelligent X-ray technologies, Comet X-ray provides safer, more economical, trail-blazing solutions that enable its customers to navigate their own voyage of discovery.

Accepting this challenge demands extraordinary commitment. Comet X-ray invests talent and resources in creating brighter ways of exposing hidden worlds through the application of energized light.

Please contact us for questions related to our X-ray modules with small focal spot, or visit our website for more information: www.comet-xray.com.



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