



White Paper

Independent Sub-pixel Drive Technology

Table of Contents

.....

1. Long-awaited resolution enhancement of monitors
2. Independent Sub-pixel Drive (ISD) technology
3. Improvement of image quality
4. Conclusion

.....

1. Long-awaited resolution enhancement of displays

Resolution of modality devices has already achieved a pixel size of approximately 25 to 100 μm and a pixel number of 4 to 67 mega-pixels(MP). However, even 5MP monitors with 165 μm that can provide the current maximum resolution, still do not have enough resolution properties to meet the modality devices' resolution.

Table1 Resolution of major mammo systems and a 5MP monitor

Mammo system	Pixel size (μm)	Resolution (pixel)
A	50	3540 X 4740 (16.77MP)
B	25	7080 X 9480 (67.12MP)
C	100	1914 X 2294 (4.39MP)
D	70	2560 X 3328 (8.52MP)
5MP Monitor	165	2048 X 2560 (5.24MP)

When an image is captured by a modality device, most times the native resolution is higher than the monitor is able to reproduce. Consequently, either the overall image is converted to a lower-resolution image with reduced quality, which is executed by viewer software (sub-sampling processing) or only a portion of the image is depicted with the original resolution. Fig.1 shows that the overall image is depicted on the display by only 31% of the information contained in the original image.

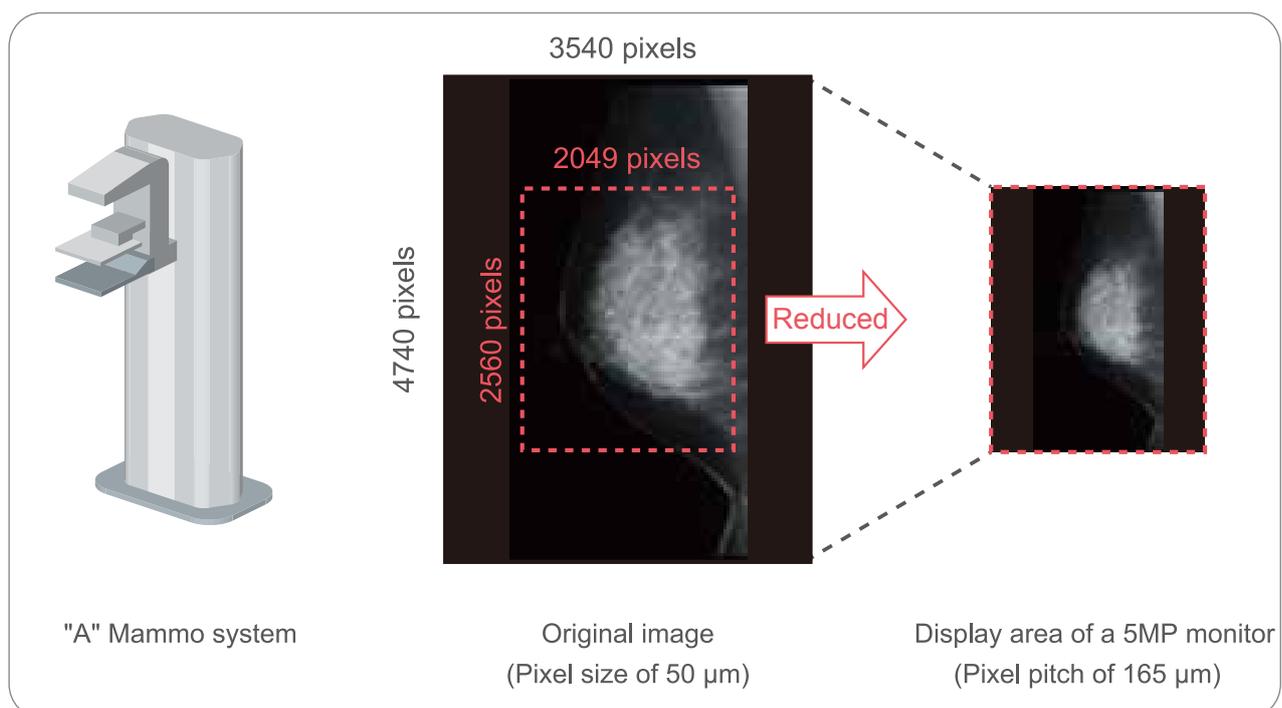


Fig.1 Depiction image when an original image consists of more pixels than a monitor in full-screen. It is reduced to only 31% of the original.

2. Independent Sub-pixel Drive (ISD) technology

A monochrome display has a large number of pixel elements and each pixel element consists of three sub-pixels, which are driven as one pixel in conventional monochrome displays. The technology we developed, Independent Sub-pixel Drive (ISD) composed of a monitor that comes with the ISD algorithm and special viewer software enables each sub pixel to be driven independently, and consequently the monitor provides superior, lossless image reproduction.

Fig. 2 shows mechanism of resolution enhancement by the ISD and comparison of captured images on a conventional monitor and a monitor with ISD technology. By the ISD function, the image is depicted more accurately.

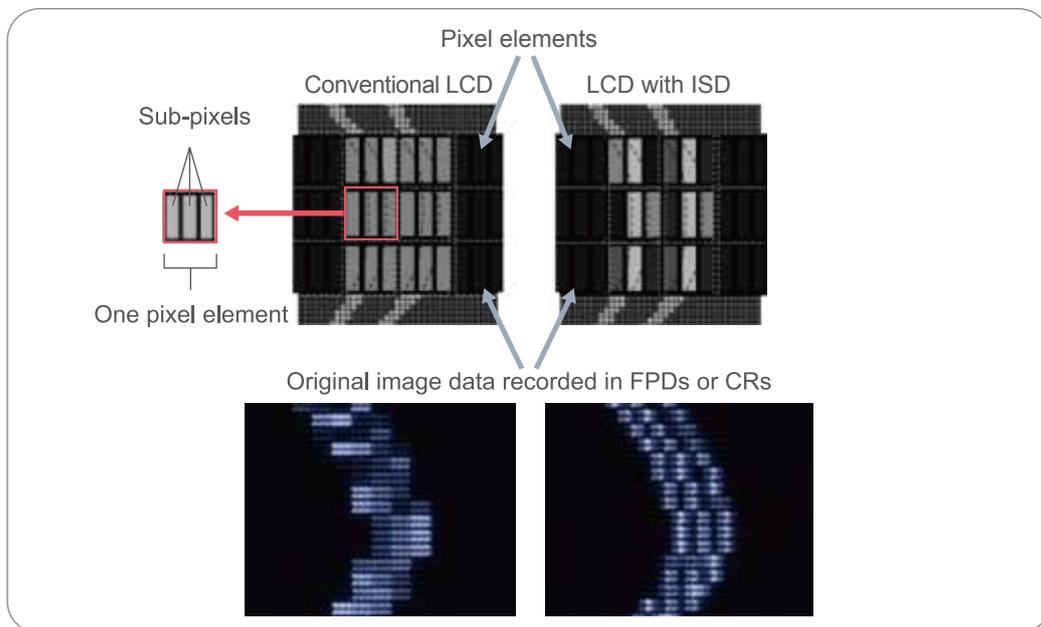


Fig.2 Mechanism of ISD and comparison of the images of three fine lines

3. Improvement of image quality

Fig. 3 and 4 show captured images on a conventional 5MP LCD and MS-S500 that was developed out of a conventional 5MP LCD with ISD technology. The depiction detail was greatly improved on MS-S500 and Fig. 4 shows its excellent depiction ability of the micro calcifications, especially the edges.

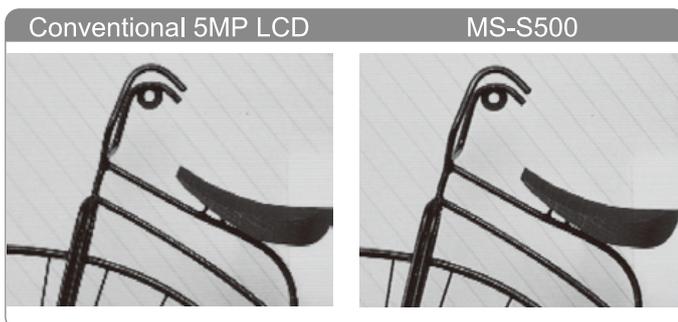


Fig. 3 Image comparison

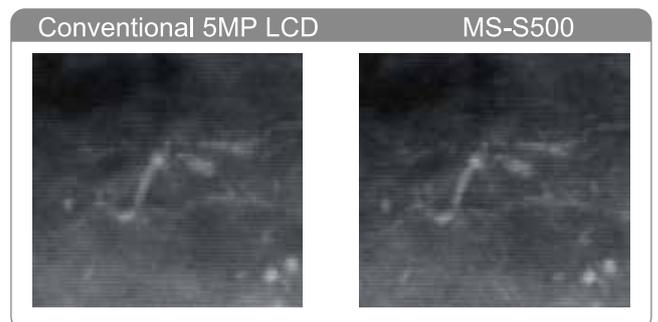


Fig. 4 Image comparison

Fig. 5 shows the comparison of measured MTFs of the conventional 5MP LCD and the MS-S500 that employ the same LCD panels of 5MP. As shown in the graph, the MTF of MS-S500 was improved obviously by the ISD function.

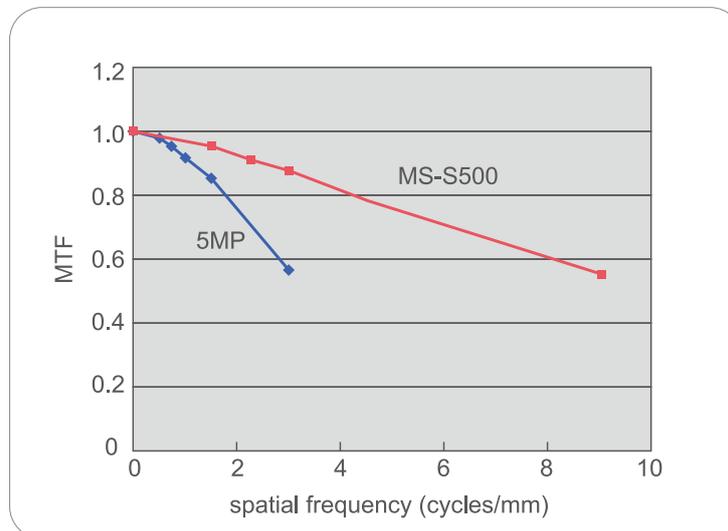


Fig. 5 Measured MTFs of horizontal direction (the sub-pixel chain direction) on MS-S500 and a conventional 5MP LCD

Furthermore, comparative evaluations performed by radiologists substantiated the clinical benefits of the MS-S500 over the conventional 5MP LCD.

4. Conclusion

- Pixel pitch of one-third in horizontal direction (the sub-pixel chain direction) actualizes the accurate depiction of the images.
- The faithful image depiction to its original with less image degradation is realized.
- Image quality is significantly improved without changing the pixel structure of conventional displays, and it does not have any adverse impact on luminance and contrast characteristics.

While image quality of the medical displays such as luminance, contrast, viewing angle, and grayscale features has been improved, resolution enhancement was not actualized because of its cost.

From the physical measurements and perceptual comparisons, this new resolution enhancement technology by the ISD, which actualizes excellent depiction ability inexpensively, would be very important in softcopy diagnostic environment.

JVCKENWOOD Corporation

Healthcare Business Division

3-12, Moriya-cho, Kanagawa-ku, Yokohama-shi, Kanagawa, 221-0022 Japan

<http://healthcare.jvc.com/>