Maximizing Field of Vision

Recent evolutions in medical imaging have resulted in more complex exams, prompting radiologists to create multi-head workstations to view all of the images in a single case. Unfortunately, these configurations occupy a large footprint, often comprising a mis-matched array of displays with varying resolutions.

Viewing such a wide area of images is both time consuming and uncomfortable. The human eye actually achieves its optimal viewing performance in a relatively small field of vision, which is the most efficient approach to image reading. If display performance could be optimized for the field of vision, one could theoretically maximize productivity while minimizing occupational stress.

Defining the useful part of our vision

When we look at a workstation, we have a certain field of vision (Fig.1), which is predominantly a preference for the forward direction. Within our eyes, there are zones that favor color, shape discrimination, and motion. Our perception of color and shape is limited to about 30 degrees in each direction.

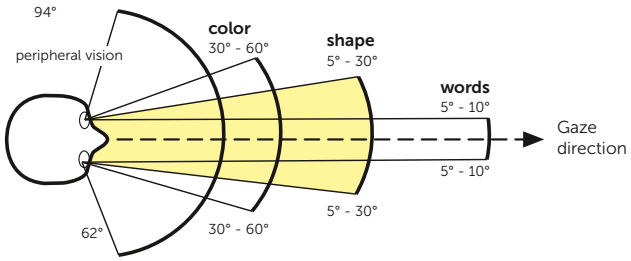
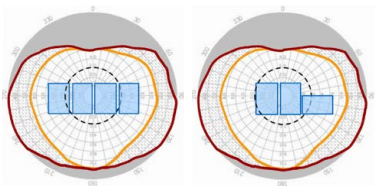


Fig. 1: Discerning shapes and details

For a medical workstation, it would be most effective to display as much diagnostic information as possible in this useful part of the field of vision, from both an ergonomic and visual acuity perspective. However, as mentioned, most diagnostic workstations utilize an array of medical displays to present all of the necessary images in a patient study, as shown in Fig 2.



The image at left shows four 3 megapixel (MP) displays and the right shows a pair of 5 MP displays with an added 2 MP color display. Because monitors are often wrapped around the viewer, more head motion is necessary to view and analyze the image.

Fig. 2:
Typical workstation set-up extends outside the useful field of vision

In contrast, the Barco Coronis Uniti fills the useful field of vision with a single, bezel-free screen to display the maximum amount of information that can be optimally read by the radiologist (Fig. 3). The display matches the spatial resolution of a 5MP display suitable for viewing both radiology and mammography images.

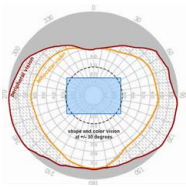


Fig. 3: The Coronis Uniti display fits ideally within the field of vision

Image quality in the field of vision

It is important for a display to have good local contrast, so that the field of vision is filled with useful, high contrast detail. Imagine we represent a detail in the lung field or a mammogram with a simple structure like the checkerboard pictured in Fig. 4. The ideal representation is shown on the left. However, the display, much like the human eye, scatters some of the light, making the real representation more like the image on the right.

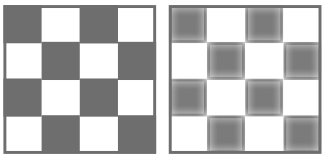


Fig. 4: Local contrast

The Coronis Uniti has good local contrast – up to 12X the real local contrast in an image – while other displays lose much of the image contrast due to scattered light, which over-brightens the dark areas (Fig. 5).

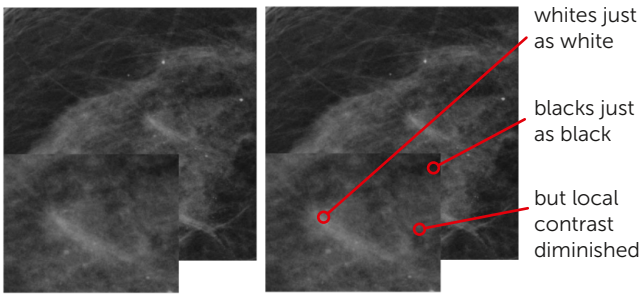


Fig. 5: Local contrast affected scatter

The role of luminance

Reflection decreases the display contrast by adding light to all the parts of the image, adversely affecting the very dark parts. The ACR recommends a minimum luminance ratio (Fig. 6), rather than a contrast ratio, meaning the ambient reflection needs to be taken into account when calculating the ratio (Norweck et al., 2013).

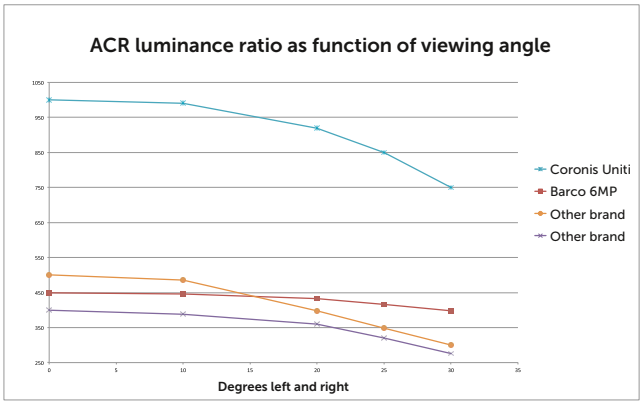


Fig. 6: ACR "luminance ratio"

Using the ACR methodology, the Coronis Uniti has the highest luminance ratio of any medical display, easily meeting the ACR minimum level of 350:1 over the entire field of vision.

Number of pixels

The more pixels on a display screen, the more realistic and accurate the resulting image. Radiologists should utilize a display with the highest number of pixels possible based on imaging modality and budget.

To obtain a crisp image, 2.5 line pairs per millimeter (lp/mm) is considered a minimum with a luminance of 350-600 cd/m2. Since acuity is proportional to the square root of luminance, with 1000 cd/m2, it makes sense to move to 3.0 lp/mm (0.168mm pixels). This prevents the artifact described in the ACR reference guide shown in Fig. 7: "If the pixel pitch of a display is too large, a fine textured pattern is visible, and oblique edges have a staircase appearance" (Hirschorn et al., 2013).

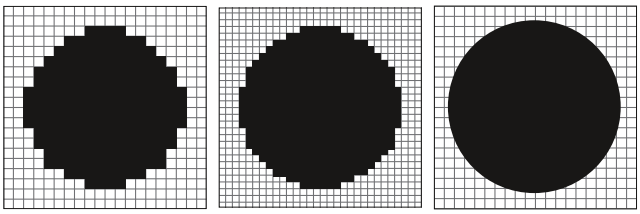


Fig. 7: Smoother curves, straighter lines with more pixels

With more pixels per inch, more images can be displayed on the screen with sufficient detail, with more detail per image.

Uniformity

LCD displays, LED backlights, even optical materials have variations that cause non-uniformity. To overcome this, manufacturers can measure and adjust non-uniformities during display production.

The Coronis Uniti utilizes the most precise method of adjusting the display, a combination of DuraLight Brilliance and Color Per Pixel Uniformity (PPU). This optimizes the entire field of vision and improves the contrast-to-noise ratio (CNR).

Viewing Angle

A single display cannot be folded or curved to compensate for viewing angle distortion. With the Coronis Uniti, Barco Optical Glass reduces blurriness while ensuring that viewing angle differences do not adversely affect the field of vision.

Conclusion

With the Coronis Uniti, radiologists can optimize their image reading experience with a display tailored to their visual "sweet spot," with features that are optimized to deliver the best image quality. Offering the latest imaging technology and ergonomic design, the Coronis Uniti is the ideal choice for managing the myriad of studies that make up the busy day of any radiologist.