

Tips for Buying Flat Panel Display Televisions

by Marla Dowell and Ed Kelley

If you have recently purchased a flat panel display television (FPD TV) and are happy with its performance, you may want to skip this article. Reading it may reduce your ability to enjoy your TV. NIST physicist Ed Kelley makes it his job to develop the best metrology possible for evaluating FPD performance. Recently, Kelley distilled his research into simple, consumer-friendly tips and made them available for download from the NIST Flat Panel Display Laboratory (FPDL) web site (<http://www.fpd.nist.gov>). These tips can be used to evaluate any type of FPD technology – plasma, liquid crystal display (LCD), or digital light processing (DLP), among others – in the environment in which it will be used.

First, Kelley suggests that you first consider your TV-room lighting and the size of your room to narrow your choices. The optimal viewing distance for a high-definition TV with 1080 pixels in the vertical direction is approximately three screen heights in order to resolve all of the pixels. That means for a 42" screen, the optimal viewing distance is just slightly more than five feet. Smaller screens will have shorter optimal viewing distances. Although viewing the screen at larger distances can still be very impressive, your ability to resolve small features will decrease. Then, Kelley recommends that you evaluate TVs in an environment as close to the one you have in your home, as the performance of different FPD technologies can be adversely affected by the amount of ambient room light. For example, some screens may have problems with specular (mirror-like) reflections from ambient lighting; as a result, such screens often look better in darker rooms. On the other hand, other screens that do a better job of controlling reflections will work better in brighter environments.

Kelley has produced a set of standard static images that can help consumers evaluate FPDs. These images can be downloaded from the NSIT FPD web site onto a CD-ROM or USB memory stick to examine specific performance aspects of different FPD technologies (see the web site for details). If you use the FPD images, Kelley recommends performing the following tests on candidate TVs.

Examine detail in dark areas of a screen image. See Figure 1.

Examine detail in bright areas of a screen image. See Figure 2.

Examine gray scale response using a standard gray scale pattern. See Figure 3.

Examine the reflection properties using a simple handheld flashlight. See Figure 4.

Trust your eyes, not the specifications. Some displays will

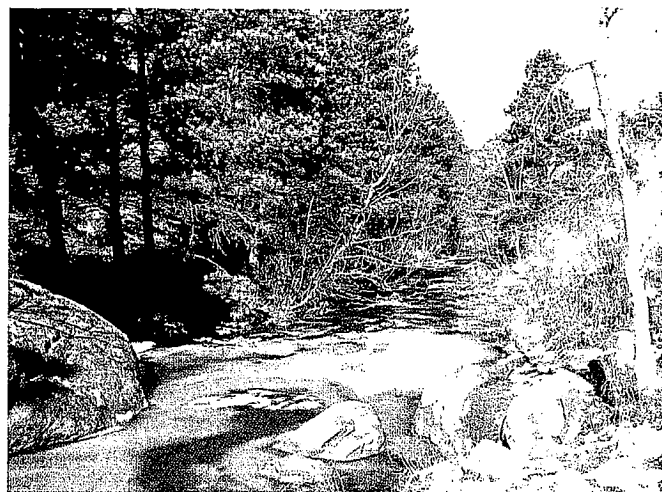


Figure 1. To evaluate the quality of dark images, look for shadow detail in the dark areas. Can you see tree trunks in the shadows?



Figure 2. To evaluate the quality of bright images, look for detail in the white areas. Do you see graduations in white in the snow?

exhibit the same luminance when they show a small white area or fill the screen with white. Other displays will show a bright white small area but become much dimmer when displaying full-screen white. So when you evaluate the display, be sure to view a wide variety of scenes.

Look for screen non-uniformities. Looking at full-screen white, black, and gray can reveal non-uniformities, e.g., non-uniform illumination, or pixel defects, e.g., individual light and/or dark pixels. Repeated human faces can also reveal problems that other patterns don't. The "eye" (the image processing in the brain) is very sensitive to facial detail. See Figure 5.

Watch out for screen loading. Sometimes the brightness of full-screen white can be much dimmer than a small rectangle of white on a black screen. This is not necessarily a bad thing, but it can affect the specifications that are quoted for comparison.

Look for viewing angle effects. The problems with viewing angle are gradually being eliminated. However, if you will have kids on the floor looking at the display while you sit on the sofa

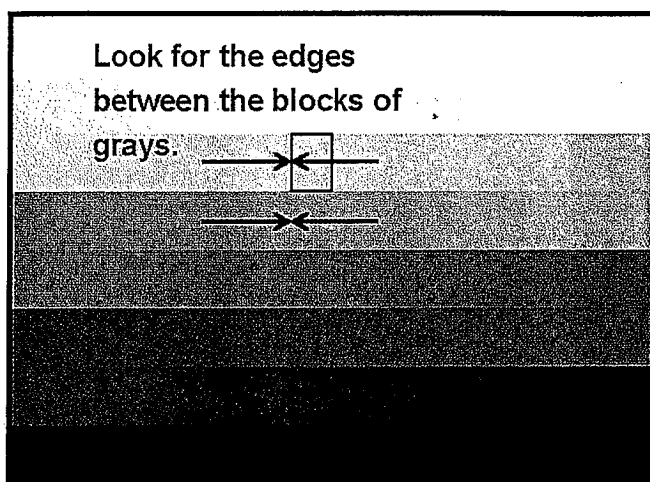


Figure 3. Standard patterns can be helpful for evaluating the entire gray scale. Each rectangle in this pattern represents a step of two gray levels. Sometimes dark grays will appear black and light grays will appear white, blurring the boundaries between individual gray levels.

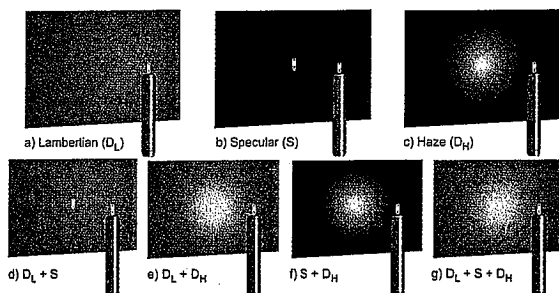


Figure 4. Example images of typical FPD reflections due to ambient lighting. You can determine FPD reflection properties by eye using the bare bulb from a flashlight. There are three components of screen reflections: a) Lamberlian is the background gray color (if present); b) specular component produces a distinct image of the source (if present); and c) haze produces a fuzzy ball (if present) instead of the distinct image. The haze component follows the specular component but gets dimmer as you pull the flashlight away from the screen whereas the specular (distinct image) retains its luminance independent of distance (for the same reasons that an image doesn't get darker as its object moves away from a mirror). These components can exist in any combination depending upon the display technology.

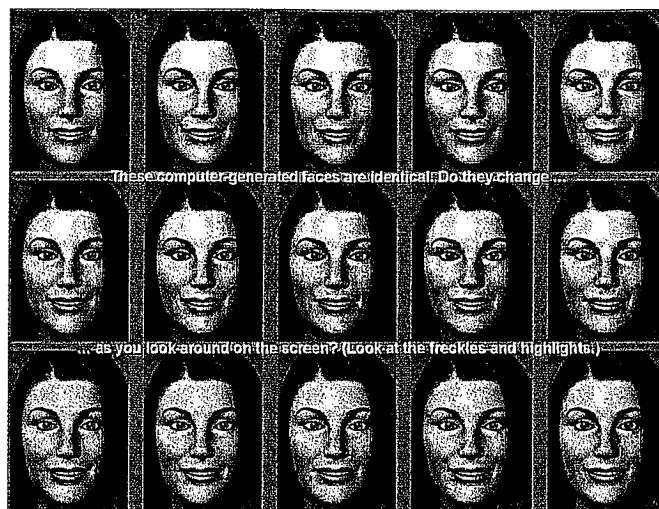


Figure 5. Repetitive patterns of identical human faces are useful for identifying screen non-uniformities as human vision is very sensitive to facial detail.

or if you have a room filled with people viewing the display from all different angles, then the display's viewing angle properties may be important to you. So, check it out. Move around and see what it does with the colors and especially the blacks. Some displays suffer most viewing angle problems when viewed from the lower right or left. Often static images are useful in such evaluations. Look for contrast reductions as well as color shifts.

Finally, there is no substitute for hands-on experience. The NIST FPDL offers a short course on display metrology at the NIST-Boulder campus several times throughout the year. The three-day course includes a day of lectures followed by two days of hands-on work illustrating some of the common measurement problems and concerns that arise when evaluating FPDs. Students also gain familiarity with photometry and colorimetry issues. The main purpose of this short course is to assist the display industry in making better measurements. The course is designed so that both newcomers as well as more seasoned display metrologists will gain valuable insight. For more details, please go to the short course web page at www.fpd.nist.gov/DMSC.html.

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