Interview with Radiant Technical Director Li Sun: Why has Radiant led the display test industry for so long?

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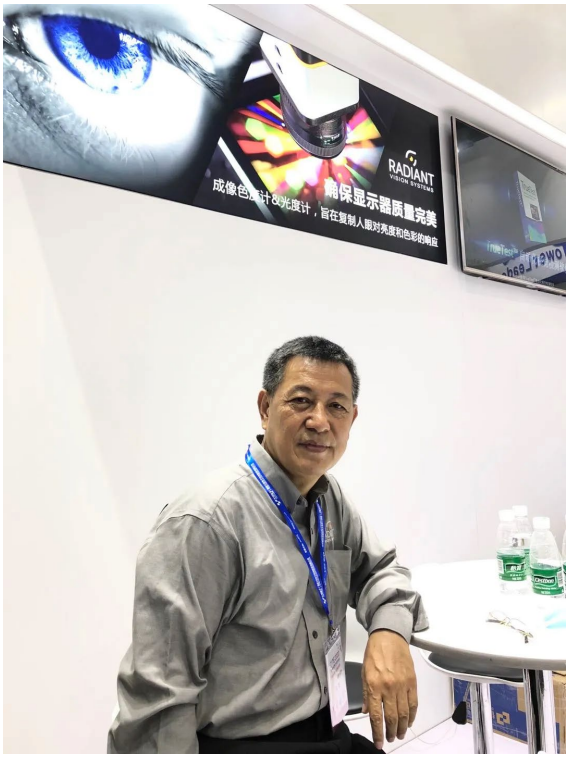


Vice General Manager of China and Technical Director of Asia at Radiant Vision Systems, Mr. Li Sun

In the process of manufacturing display screens, defects may occur at any number of steps, from pixel to panel. These include stuck-on/off pixels and lines, areas of uneven brightness or color (called "mura"), or surface defects, bubbles, and scratches—all of which have an impact on use of the screen and on product perception. The demand for test & measurement equipment in this industry is high. Radiant is one of the companies that is engaged in display test & measurement to provide solutions that ensure visual quality for the display industry.

Radiant (Radiant Vision Systems) is a Konica Minolta company and a technology manufacturer that specializes in providing advanced optical inspection equipment for precision display test & measurement to its international customer base. Radiant officially entered the Chinese market in 2011 and currently owns and operates direct offices in Shanghai, Suzhou, and Shenzhen.

Due to the impact of the coronavirus (COVID-19) pandemic, this year's 8th China Information Technology Expo (CITE 2020) was postponed from April to August. Radiant continued to exhibit on the show's new dates, with some additions to its usual product demonstrations.

At this year's CITE, Radiant exhibited solutions beyond traditional LCD panel test & measurement, showcasing demonstrations of new and unique solutions that address testing at the forefront of display technology innovation—for instance, miniLED and microLED. The company's latest keyboard inspection software developed especially for testing backlit keyboards was also one of the main products on display. Radiant commented that it was the company's first time exhibiting miniLED/microLED test solutions and backlit keyboard test software at CITE, which attracted a large crowd of visitors around the booth.

At the booth, FPDisplay had the opportunity to interview Mr. Li Sun, Technical Director, who has worked at Radiant for more than a decade. During the interview, Sun explained why Radiant has held the lead in display test & measurement within the display industry for so long.

"Follow the industry's footsteps and constantly bring forth something new"

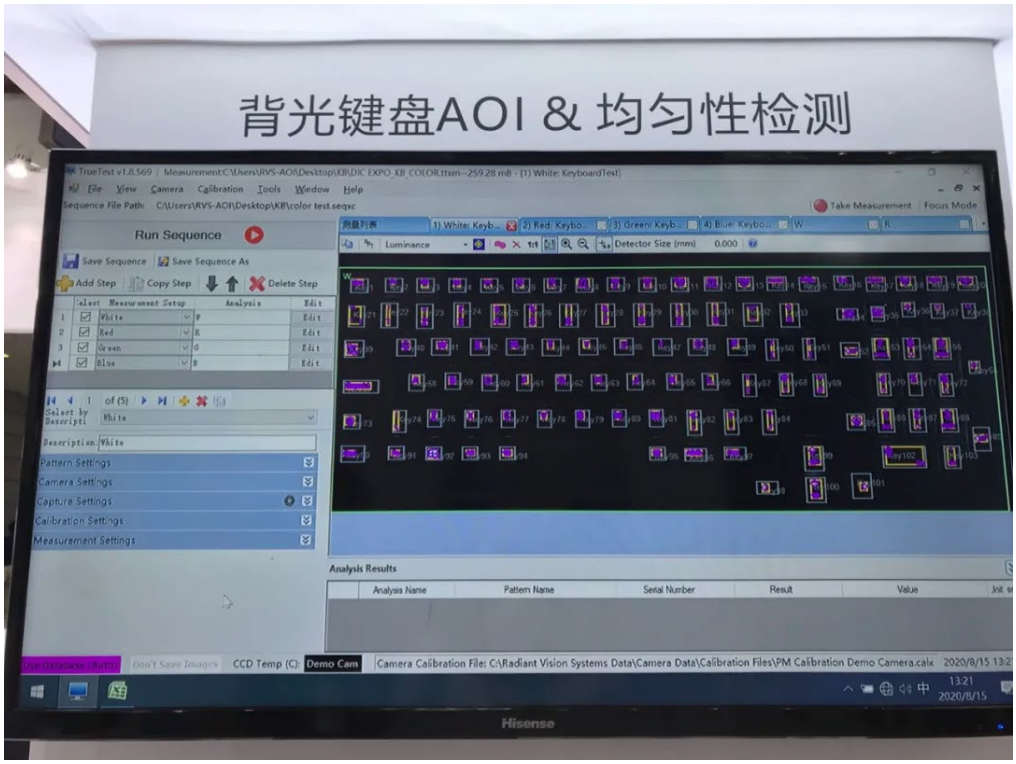
At the heart of its business, Radiant is acutely engaged in research and development as it pertains to manufacturing test & measurement solutions. In the early years at its U.S. headquarters, Radiant developed novel solutions for the display industry in age of LCDs (liquid crystal displays). With the release of its ProMetric® imaging colorimeters and photometers, Radiant had forged a pathway to success.

From their appearance, ProMetric imaging colorimeter and photometer systems seem to be your typical industrial imaging cameras. So why not simply call these systems "cameras"? Sun explained the reason: a standard imaging camera can't measure accurate values of brightness (luminance) and color (chromaticity) that match human visual perception. This is what the Radiant colorimeters and photometers are designed to do—and, these systems provide and extremely close match to standards for color measurement, as defined by CIE (the International Commission on Illumination). Thus, using these systems, absolute luminance and chromaticity values can be tested in a quantitative way. From the aspect of function, the systems go beyond the capabilities of a typical camera—"so, it is more appropriate to call them colorimeters and photometers," said Sun.

In addition to developing imaging systems, Radiant has launched a variety of lenses that pair with ProMetric imaging colorimeters and photometers to accommodate testing of different display products and optical geometries. For example, the company's FPD Conoscope Lens can be applied to test the angular output of a flat panel display (FPD) from a single point (without rotation). The AR/VR Lens is used to qualify augmented and virtual reality displays within headsets. Likewise, there are specialized lenses to measure miniLED, microLED, etc. These lenses enable connected ProMetric systems to evaluate a display as seen from different viewing conditions and characterize output accordingly, allowing manufacturers to test the unique visualization requirements of new technologies and applications in the industry.

"For example, in order to accommodate the special viewing environment of an AR/VR headset, the aperture of the Radiant AR/VR Lens was designed at the front of the lens. This enables the connected system to achieve wide-field-of-view (FOV) measurements—up to 120 degrees horizontal—from inside the headset, covering the FOV ranges of today's AR/VR devices," said Sun.

Radiant is also constantly developing new products. Its new keyboard testing software enables automated optical inspection (AOI) of backlit keys in laptops, keypads, and gaming devices. This software can test the luminance and chromaticity of each character in the keyboard array, as well as compare inter- and intra-character luminance and chromaticity to ensure the correct output of the keyboard as a whole. In addition, automated inspection routines can combine photometric analysis with dimensional checks (like those performed by machine vision) to detect defects in the mechanical assembly. For example, inspecting for missing keys, incorrect keys, incomplete characters (due to improper laser etch), exclusions, inclusions, character offset, keycap offset, keycap size defects, scratches, key gap width defects, light leakage, and more.



Radiant's keyboard inspection software demonstrated from the floor of CITE 2020. All keys and characters are measured simultaneously for brightness, color, and dimensional quality.

Beyond these innovations, Radiant is also planning to tap into new fields. Sun revealed that Radiant has been developing new CMOS imaging systems since last year. Historically, CMOS have been selected for applications that prioritize imaging speed over imaging accuracy. However, in recent years, CMOS sensor technology has demonstrated notable progress in terms of imaging performance, now surpassing CCD in a few aspects. Compared to existing CCD technology, new CMOS sensors continue to offer higher speed, with notable advantages in resolution, low power consumption, and low noise factor.

It is reported that these new Radiant products have already been applied in production lines at domestic panel factories in China.

"From adaptable test equipment to customization services"

"Radiant also has the leading edge when it comes to providing our customers with customization services," Sun remarked. "Although Radiant offers a complete set of adaptable test solutions, rapid changes in the display market mean customers have very different needs. In order to meet such needs, Radiant launched its customization services early in its business practices, which have enabled us to gain ground in the market by taking on diverse projects in direct cooperation with customers."

For instance, if a customer specifies that they only want to test at a certain position relative to a display, or calibrate to a certain set of parameters, the Radiant equipment can be customized to achieve these unique goals. "Customization services not only meet the customers' needs for qualifying their products, but also reduce costs for them," said Sun. "In order to help our customers reduce cost, Radiant customization works in three ways: First, Radiant can remove unnecessary functions of the product, keeping only those needed by the customer. Second, Radiant can potentially reduce costs in terms of product materials, as long as testing goals can continue to be reasonably achieved (i.e., a prerequisite that the customer does not have demands for full product performance). Lastly, Radiant can provide custom versions of its TrueTest™ Automated Visual Inspection Software. With customization available on both the software and hardware side, Radiant enables a complete test & measurement solution with imaging capabilities, test suite, and calibration compensation tailored to the customer's needs—this ultimately helps customers reduce a lot of time and money."

"Plan for the future, be daring, and remain vigilant"

Careful planning in anticipation of future market trends is the golden ticket for most enterprises, and this is no exception for Radiant. Radiant not only begins its application research and development well ahead of the market, but also dares to develop into new frontier, before emerging technologies have defined their test & measurement demands. This is the secret to its success as it has evolved its portfolio to support a changing display landscape from LCD to OLED to new mini- and microLED.

A test station showcasing display test & measurement solutions to address new emissive display technologies, such as OLED, miniLED, and microLED—as seen from the exhibition at CITE 2020.

As to the growing popularity of mini- and microLEDs for displays, Sun believes that the future is bright, even though these technologies have not yet reached mass production. After all, these technologies have already been proven to rival OLED in terms of performance for direct display applications (as opposed to backlit panel applications).

However, compared with LCD and OLED, miniLEDs and microLEDs are much more demanding on test equipment. These new displays are composed of arrays of millions of tiny light-emitting subpixels—each an individual emitter of its own light, enabling extremely high brightness, resolution, and color saturation.

"Radiant is currently conducting R&D work in the field of mini- and microLED testing, and some product solutions have already been delivered to the panel factories for test." Sun said. "Radiant has many years of experience testing and correcting LEDs. Mini-/microLEDs have a lot in common with LEDs in terms of how they function and the issues they exhibit. Therefore, Radiant has confidence that we can cooperate with customers to provide test solutions that work effectively for their new products."

Currently, mini- and microLED test solutions in development by Radiant operate with both standard lenses such as 50mm and 100mm as well as microscope objective lenses. The Radiant Microscope Lens magnifies small display features (like subpixels or display defects) to 5- or 10-times standard imaging resolution. At these resolutions, a Radiant imaging colorimeter or photometer can apply hundreds of sensor pixels across a mini- or microLED subpixel, ensuring the accuracy of every measurement.

In recent years, panel manufacturers in Taiwan have been keenly focused on R&D for mini- and microLED technologies, which has stirred a debate regarding the ultimate display technology for future displays—OLED or mini/microLED? Although this "debate" has not been settled yet, with the efforts of these and other manufacturers, mini/microLED is now moving from the laboratory to the product stage, and core technologies are breaking ground, which means that the gap between mini/microLED and OLED is slowly narrowing.

What's more, one of the market drivers in smart device technology innovation—Apple—has recently invested hundreds of millions of dollars in Taiwanese microLED factories, which will produce the display screens for the future iPhone, iPad, MacBook, and other devices. This is certainly a positive indicator for the future of mini- and microLEDs.

However, at present, mini- and microLED product development is limited by technological bottlenecks, particularly mass-transfer technologies. Even if the industry can make a breakthrough here, it still needs time to reduce defect rates and, ultimately, production costs. In addition, mini- and microLEDs continue to face unsolved issues like wavelength (color) consistency. To achieve viable mass production, the whole display supply chain will need to collaborate with each other closely.