INSTRUMENT SYSTEMS' EVOLUTION AND ADAPTATION IN THE LIGHTING INDUSTRY

by Prachi Patel

EMISSIVE DEVICES SUCH AS LIGHT-EMITTING DIODES (LEDS) HAVE SEEN AN exciting evolution over the past six decades. Starting as dim red lights in indicator lamps and numeric displays, they have gone on to light up TV screens and to become white lights that illuminate homes and streets. From the start, Munich-based Instrument Systems has supported the development of LEDs and their burgeoning areas of application.

Founded in 1986 as a result of Richard Distl winning a German youth research competition, Instrument Systems is now a leading manufacturer of high-precision spectrometers, customized systems, and software solutions for spectral light measurement. Top display and LED manufacturers rely on the company's innovative photometry systems, technical expertise, and market know-how to solve measurement challenges during R&D and production.

Under CEO Markus Ehbrecht, who took the reins in 2014, the company has grown in size and customer base (**Fig. 1**). Instrument Systems continues to provide optical metrology solutions to newer technologies such as microLEDs for augmented and virtual reality (AR/VR) devices.

From Research Competition to Business Venture

Distl's entry for the research competition was a system to accurately determine the wavelength of light by measuring the rotation of the polarization of light when it passed through a quartz block. The idea had been published, but he built a tabletop system and accompanying software to execute it. Distl used the cash award to start his business. Based on market research, "He thought that light and the precise measurement of light would become more and more important over the next decades," said Günther Leschhorn, business researcher at Instrument Systems. "That was his vision, and he was basically right."

Things moved slowly in the company's early years, mainly because the company consisted of engineers without sales knowledge or marketing strategies. Then in 1991, it launched its first product: the Spectro 320 spectroradiometer to measure luminous flux, luminous intensity, and luminance. It boasted short measurement times, high accuracy, large signal dynamic range, and a broad spectral range of 190–5,000 nm.

Fig. 1.

CEO Markus Ehbrecht (left) with founder Richard Distl.

The company started to grow steadily, and Distl worked on diversifying the product portfolio and entering new markets. His goal was to deliver complete measurement systems that served as turnkey solutions for the LED, automotive, and aerospace industries.

In 2000, Instrument Systems started working on imaging photometry, and they incorporated machine vision functions. The company saw a market need for consistent testing of the whole optical appearance—color, luminance, and shape—of indicators and small displays used in automotive and aerospace applications. The result was the LumiCam camera system, "that was able to measure color based on color filters that are sequentially rotated in the beam path," Ehbrecht explained. The system creates a test object image in a single measurement, which requires integrating data analysis and image analysis algorithms into the system. The company continues to develop these algorithms today using deep learning techniques to detect defects and mura.

A key turning point came in 2006 with the launch of the Compact Array Spectrometer series, CAS-140. The instrument, based on well-known

crossed Czerny–Turner spectrographs with a cooled charge-coupled device (CCD) detector, captures and evaluates light spectra within a few milliseconds with extremely high accuracy (**Fig. 2**). "These are really the workhorses of our product portfolio," Ehbrecht said. "They are the defacto standards in the industry if you want to measure light with an array spectrometer." The instruments can be combined with various input optics, from fibers or integrating spheres to cameras, making them useful for many applications, be it for R&D in laboratories or 24/7 use in production lines. More than 20,000 units have been installed worldwide.

Waves of Change

The past decade has been one of change at Instrument Systems. At the end of 2012, Distl sold the company to Konica Minolta Optics. For the Japanese group, this was a way to expand its sensing division with Instrument System's specialty lighting measurement systems. Instrument Systems retained its brand and locations in Berlin and Munich.

Distl saw Konica Minolta as a perfect match. "The founder wanted to give the company to somebody who understands the business and who treats the company as his child, and also where employees would have a great future," Ehbrecht said. "He found that in the Konica Minolta group."

The decision worked out well. Becoming a part of Konica Minolta has helped the company achieve significant growth and improvement in display metrology, all without losing the character of the company. "All the operational decisions can still be made locally in close contact and close discussions with the department managers internally," Ehbrecht said. "We are therefore still quite a reactive and agile mid-sized company, and can read the market in our own way."

The sale happened just before Ehbrecht took over from Distl in 2014. He faced the task of growing the company in terms of employees and customers, and venturing into new technologies and markets. This required creating management structures that allowed a transition from a founder-managed company to one that worked more seamlessly as part of a larger group.

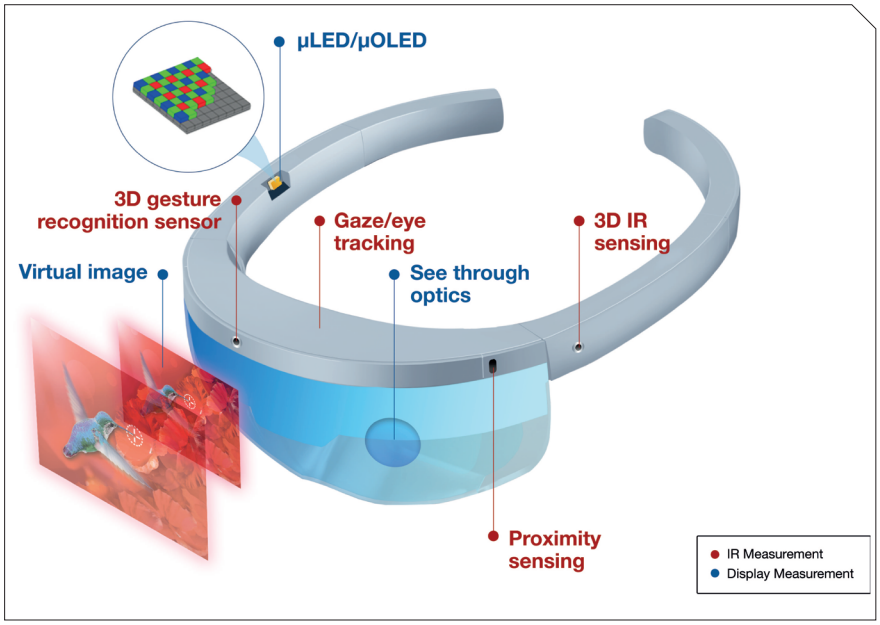

Fig. 2.

Instrument Systems' portfolio includes infrared and display measurement solutions for near-eye displays.

Ehbrecht has helped transform the company into a successful global enterprise. Today, Instrument Systems has a workforce of more than 300 employees spread across two German sites, a metrology lab in Shanghai, and a new subsidiary in Vietnam for onsite customer support. In 2022, the company acquired Kimsoptec, a technical consultant and manufacturer and 17-year partner that has distributed Instrument Systems' products and integrated the products into their own solutions. Besides enhancing Kimsoptec's support, Ehbrecht said this should bring Instrument Systems a step closer to customers in Korea, a vital LED and display market.

Setting Itself Apart

For Instrument Systems, it has been a tale of adaptation and evolution with the lighting industry. Its engineers continue to innovate new metrological and calibration techniques tailored to rapidly emerging OLED and microLED markets (**Fig. 3**).

Ehbrecht is proud of the company's LumiTop 4000 imaging colorimeters as "our most versatile instrument for display production testing," which have allowed the company to foray into new areas. The LumiTop is a spectrally enhanced imaging colorimeter and combines three sensors into one system: a CAS series spectroradiometer, a high-resolution RGB camera sensor, and a fast photodiode.

The system benefits from the speed of a camera and the accuracy of a spectroradiometer. An ultrahigh-resolution version allows single pixel analysis, so customers can use it to test microLED and microOLED displays. By adding a special lens that simulates the optics of the human eye, it measures angle-based color and luminance just as a person would. As a result, the LumiTop system can be used to test head-mounted AR/VR displays.

A measurement technology must deal with the properties of different light sources, Ehbrecht said. Instrument Systems is dedicated to the deep understanding of these sources, along with many iterations, finetuning, and optimizing of its technologies. This is what sets them apart and makes their products unique, he said. "There is a high emphasis on all the details necessary to optimize the system continuously, with many small improvements. In the end, the devil is in the details, and you have to improve each and every detail over a long period of time, continuously, to come to these high levels of accuracy and stability."

The biggest factor in Instrument Systems' success is keeping up with the fast-chang-

Fig. 3.

Spectroradiometer laboratory setup in 2003.

ing display industry. Being a partner to their customers from ground zero, the company's development teams will take customer input, consider their special needs, provide valuable advice on how to measure correctly, and also take feedback and incorporate that into the next generation of prototypes. "We offer an agile hardware development process," Ehbrecht said. "Agile development is usually famous in software, but we extend that model even into hardware development."

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