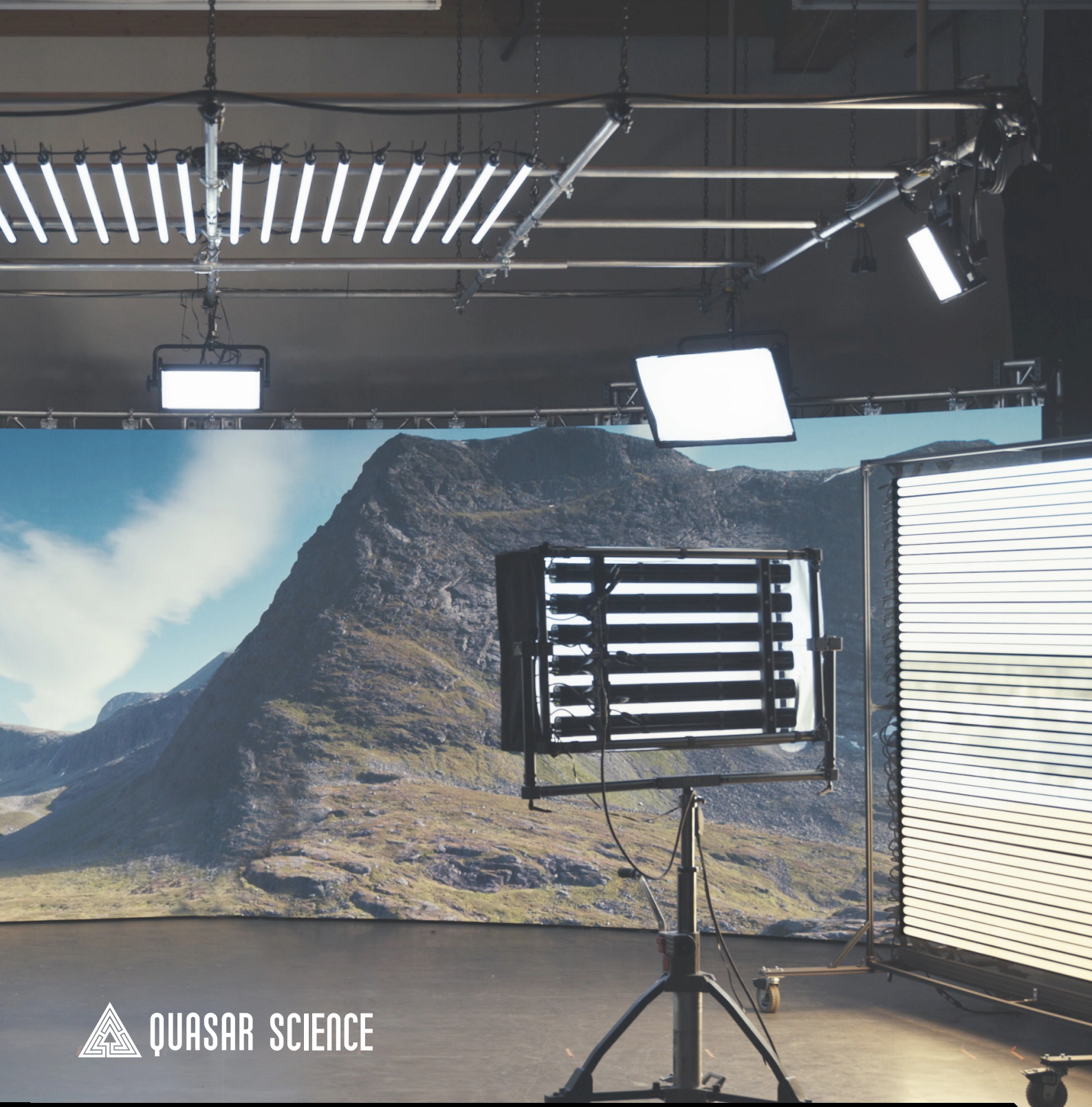


Introduction to Image-Based Lighting

Credit: Eon Productions - James Bond: Doctor No

THE BEGINNING OF IN-CAMERA EFFECTS

The idea of putting an actor in front of a picture of the scene goes back almost as far as synchronized sound. Projected, full-motion backgrounds became workable using much the same synchronization technology that was developed to add sound to films like The Jazz Singer. The technique might have come of age on 2001: A Space Odyssey in 1968, with Cameron's 1986 work on Aliens often cited as a high point. Projection in general remains in use, with famous examples including Oblivion, in 2013, simply because it offers such clean integration, particularly of transparent and reflective foreground objects.

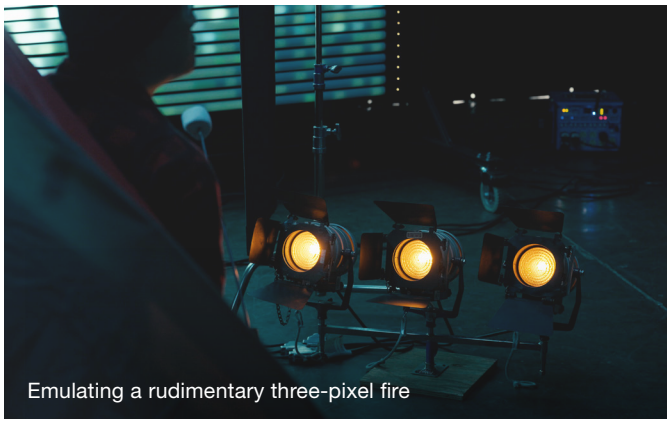
Credit: Stanley Kubrick Productions - 2001 A Space Odyssey

Virtual production enjoys the same benefits, but massively extends the capabilities of legacy projection techniques – and not just because of camera tracking lets us create a three-dimensional virtual world. The enormous contrast and brightness of LED video walls minimizes the milkiness and grayish blacks that legacy projection could suffer, but that's not the only reason it makes for a more convincing in-camera effect. That sheer power also means that the screen can contribute a worthwhile amount of highly convincing interactive lighting, and we can have LED-based film and TV production lighting devices also controlled by the video system to create changing light on the foreground scene.

Credit: Universal Pictures - Oblivion

INTERACTIVE LIGHTING

In the past, that sort of interactive lighting was often designed on a case-by-case basis using production lighting equipment. A flickering orange light could simulate fire. TV gags, mimicking the cool, blue, varying light of a television, are another familiar trick. Moving light sources around, not just panning the light across the scene but physically moving the light itself, is a trick mostly reserved for simulating car journeys or the sun sweeping across a fighter cockpit during a dogfight.



Emulating a rudimentary three-pixel fire

It wasn't until around the time of Tron: Legacy in 2010 that the idea of using LED video walls as lighting began to find mainstream use. Gravity, which emerged in 2013 around the same time as Oblivion, used the technique extensively. By 2017, Logan applied LED panels as lighting to create – among other things – moving reflections in a static vehicle, allowing a young actor to perform in a night exterior that children's working tizme rules would prohibit shooting on location.

Credit: Sky News

LED panels had been used, in-vision, for broadcast applications since the early 2000s. Sky News featured a big video wall in its recently decommissioned London news studio as early as 2005. That early installation, which wasn't intended to create a photo-realistic background, used a layer of diffusion to mitigate the comparatively low resolution and avoid aliasing and moire patterns.

Before the late 2010s, though, the intent for single-camera drama production was not usually that the video wall would appear in frame. It was used to create light sources and reflections to augment things which would later be inserted using traditional visual effects. It wasn't until almost 2020 that the LED panels had enough resolution to create photo-realistic backgrounds without too many compromises. It will always be possible to see the dots by using long enough lenses with focus set near the wall, but modern panels can have high enough resolution to work in a wide range of situations.

Utilizing image-based lighting to improve realism of effects

IMAGE-BASED LIGHTING AND LED VIDEO WALLS MEET

Since the video wall displays images, using one as a lighting device has a lot in common with image-based lighting as used in computer generated imaging. Anyone who's seen a visual effects specialist photographing chrome and gray spheres on a film set has seen an image-based lighting source being acquired, creating a record of how light falls on the scene from every angle. That approach could be applied to virtual productions, though there is a problem: the light emitted by an LED video wall has poor color quality, and might make some subjects, particularly people, look strange.

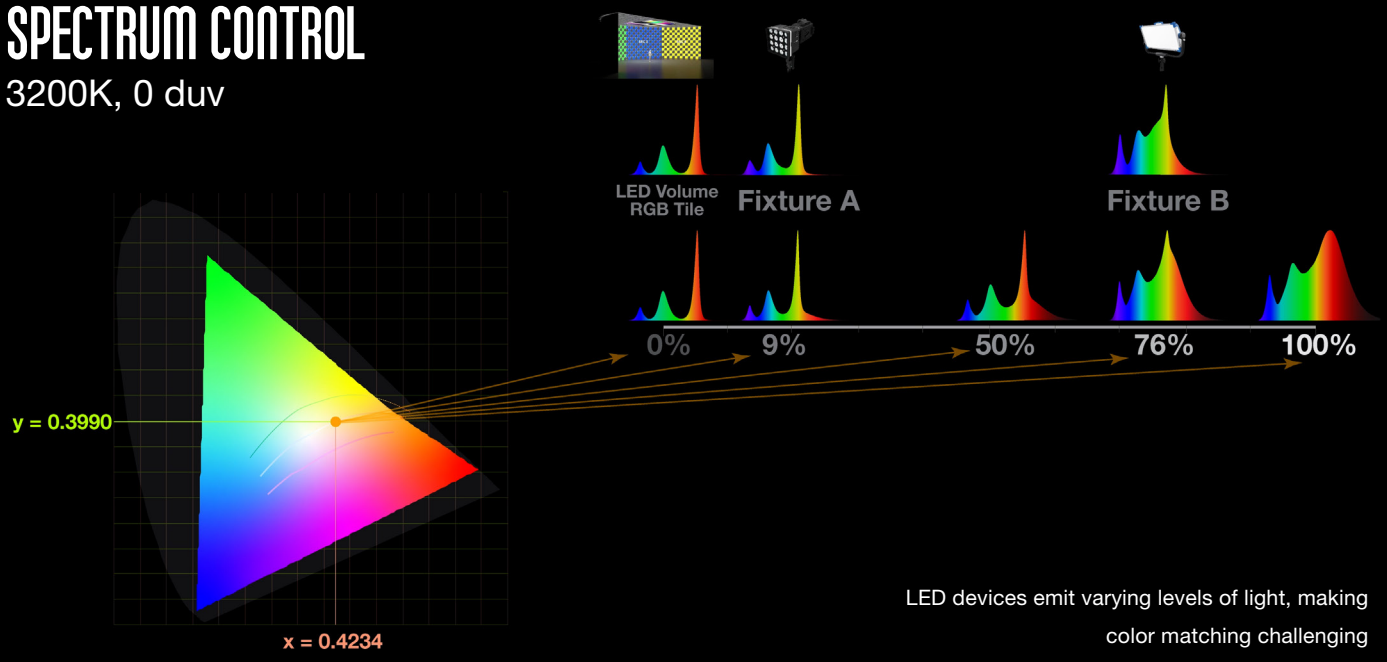
LED-based production lighting built for film and TV work invariably uses technologies which are very different to the red, green, and blue emitters of the video wall. That simple arrangement can successfully persuade both human eyes and cameras to perceive a full color image, but if we split its white-looking light using a prism, the result will not be the familiar, continuous rainbow; instead, there will be three stripes of red, green, and blue. If we use that light to illuminate an object that reflects (for instance) a saturated turquoise, that object may appear dull and under-saturated, or even just dark blue.

Those problems are solved in production lighting using a variety of different emitter selections which create higher color quality. Bringing those production lights into a virtual production setup might mean they're controlled by a selected area of the video image. An array of production lights, meanwhile, might together form a pixel-based display capable of advanced effects. Often, those effects will be lower resolution than the video wall, but with the higher color quality of dedicated production lights. Operating them using control data from an image-based lighting source lets us combine high color quality with the interactivity of light from a video wall, for the best of both worlds.

With IBL, you can recreate any environment's light signature and use it to light your subject in a hyper-realistic way.

SPECTRUM CONTROL

3200K, 0 duv



LED devices emit varying levels of light, making color matching challenging

MATCHING COLORS

While the color quality of production lighting is good, a key concern is that the different design approaches used by various LED devices, with different configurations of different emitter types, make matching difficult. It is unlikely two different devices driven with the same control data will produce identical results, unless, as with some modern designs, they are specifically designed to do so, or unless special techniques are used. Partly, that's because color mixing lighting devices have never been well standardized; designers were free to use whatever light sources and colored filters were most convenient.

Many designs for color-mixing film and television production lighting simply followed that example, using any convenient red, green, and blue emitters. In the same way, there will be some colors in reality that at least some LED color-mixing devices won't be able to match; the deepest available green, for instance, is limited by the color of the green emitter itself.

More recent production lights developed with virtual production in mind have begun to implement standards for color based on those developed for all types of video display. LED video walls are video displays, just as much as a monitor, and because they implement video display standards, implementing those same standards on production lights allow for easier matching between video wall and production lighting. Even so, many setups will involve a variety of equipment with varying capabilities, and some degree of manual intervention is likely to remain necessary for some time.

The unique RGBX Spectral Science Color Engine (RGBX SSCE) in the Rainbow series delivers a choice of more than one billion colors with greater spectrum control to match colors.

THE NATURE OF REALITY

Making two LED light sources match each other is one concern; making them match reality is another. Bright though a video wall may be, it can't match the output of the sun, if the sun happens to appear in the displayed image. As we've seen, there are also limits in the range of colors available from an LED-based light source. That isn't necessarily a problem, but it means that a conversion must occur between the color and brightness of the real world (or a computer-generated world) and the color and brightness of a virtual production environment.

In most respects, that's very similar to the familiar conversion between a real scene and the way it appears on a cinema screen, and many of the same conventions apply. The relationship between the brightness of a scene, the value of the resulting digital signal, and the brightness of the display has always been complicated. Experiments began with Philo Farnsworth's first work in electronic imaging during the early twentieth century, but current standards only emerged in 2011.

In modern practice, cameras (real or virtual) can turn images into signal levels according to a number of different standards. Both lighting and display devices might support just as many. Proper setup can create a virtual production environment where the image on the screen, as well as the output of production lighting, has appropriate color and intensity, creates realistically bright highlights and realistically dark shadows, and leverages all the benefits of image-based lighting, virtual production, and in-camera effects work.

TAKING CONTROL

Current virtual production setups will involve a variety of different systems working together, including rendering servers and software, video wall processors, camera tracking devices, lighting control desks and the lights themselves, not to mention the taking camera, its lens, and monitors. While combining all those systems inevitably creates complexity, it also provides opportunities to make adjustments and solve problems.

Recent developments in rendering and display technology, as well as lighting and video processing, have made it easier than ever to match lighting to virtual production displays, as well as virtual production environments to reality. Doing that allows us to bring aspects of image-based lighting to the real world and leverage the enormous capability of virtual production to create convincing effects. In our series exploring image-based lighting, we will discuss several of these issues in more detail, as well as covering some common goals and the issues that can arise.

QUASAR SCIENCE SOLUTIONS

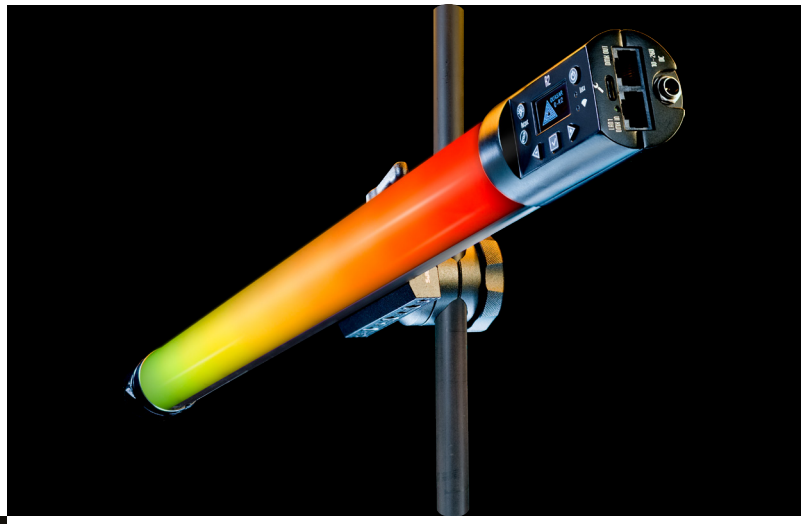
Image-based Lighting (IBL) is transforming the way DPs, console programmers, and technicians approach set lighting. Using the same assets projected onto the volume wall, IBL creates pixel mapped lighting that adds heightened realism to the virtual set. Subtle nuances in light texture, movement, and spectral characteristics create dramatic effect, elevating the storytelling potential of virtual production.

IBL is paving the way for a new level of creativity and excitement in visual storytelling, but not without some challenges that we solve with Quasar Science solutions.

RAINBOW 2

The premier linear LED for motion picture and content creation. High quality tunable white light and the highest RGB color saturation with multiple pixels to maintain super smooth, flicker free dimming, the R2 will be your workhorse. This linear LED light offers incredible data connectivity whether wired or wireless and can be powered anywhere via AC and DC power inputs. Integrated Ossium Mounting System (OMS) allows for rigging in ways previously unobtainable.

Available in: 2’ 4’ 8’



DOUBLE RAINBOW

The Double Rainbow (RR) Linear LED, with its two rows of high fidelity RGBX pixels, creates realistic lighting with vibrant saturated colors and intense white light. A unique shape provides a powerful light source using little space. Wireless and wired data connections mean no data boxes, receivers or transmitters. Built in network switch for simple native connectivity. Integrated Ossium Mounting System (OMS)rigging adapts to everything. AC/DC inputs for continuous power whenever and wherever.

Available in: 2’ 4’

OSSIUM FRAMES

Combine Rainbow tubes into stacked arrays to create a wall of light. Both Rainbow 2 and Double Rainbow bolt on using the integrated Ossium Rail, supported by the solid Ossium Frame. Power up with the included multibank adaptor, and add data for dynamic control of your lighting array. Direct Connect of every industry standard wired and wireless control option from DMX and Bluetooth through to sACN. Simple to set up, with the power to be complex in all the right ways.

Available in: 2’ 4’

Arrays for up to six Double Rainbows or twelve Rainbow 2’s. Please enquire for bespoke 8’ installations.

quasarscience.com/virtually-unlimited

Quasar Science
A Videndum plc Brand