LET'S WORKFLOW IT SIMPLIFYING THE REMOTE POST-PRODUCTION PIPELINE

THE FUTURE OF VIDEO PRODUCTION

A LIGHT ON THE TRUTH

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A retrospective on the stunning optics from TV & film last year

VIRTUAL INSANITY PT 2 AI INFLUENCES, COLOURIMETRY AND THE DEMOCRATISATION OF LED VOLUMES

Mixing realities

Seven experts on the virtual production landscape reveal how AI can evolve the technology, how colourimetry between camera and display can be mastered – and why LED volumes are becoming democratised and accepted by the industry

INTERVIEW. Chelsea Fearnley

FEBRUARY 2022 25.

Part 2

ZERO PRODUCTION INTERFERENCE

In part one of a three-part series, we get into what makes Megapixel's HELIOS[®] LED Processing Platform so production-friendly for ICVFX

MEGAPIXEL'S PROPRIETARY PROCESSING technology extends from the video input, all the way to ultra-powerful tileside processing. Leveraging sub-pixel calibration and off-axis colour metadata, coupled with the most advanced LED refresh algorithm, the patented technology allows for sophisticated virtual production stages. The HELIOS LED Processing Platform sits at the centre of the pipeline and features camera-friendly performance, cinema-grade colour accuracy, and a future-proof native 8K workflow via upgradeable and modular inputs.

Starting with what makes the technology so camera-friendly for DOPs, *Definition* will analyse the specifics over a three-part series. But first, it's important to recognise what makes working in a virtual production volume challenging. Megapixel CEO Jeremy Hochman explains: "Cameras capture in bursts and LEDs pulse on and off – sometimes at 1000 times per second – and if that refresh of the LED is not perfectly time-aligned to what the camera is doing, you're going to see artefacts."

"With HELIOS, we can reduce this interference between assets and screen that's not visible on camera... due to the refresh rates at which we run the panels" This interference pattern is called scan lines. It's the same phenomenon that occurs when car wheels appear as if moving backwards at high speed on video. This happens because cameras don't capture continuous footage, but rather images per second. Our brains work to fill the void by creating an illusion of continuous movement – even if it's not in the right direction!

"It's the single most problematic thing about pointing a camera at an LED screen, because when these artefacts occur, the only way to remove them is to rotoscope the entire scene to trace over footage and produce realistic action – and this is costly," says Hochman. "With HELIOS, we can reduce this interference between assets and screen that's not visible on camera. A lot of this is due to the refresh rates at which we run the panels."

THINKING OUTSIDE THE BOX

Instead of just having a data processing box that sends information to the LED tiles, Megapixel also makes the magic happen on the tiles themselves. "We have mini processors, called PX1s, that go inside each individual tile - and then our HELIOS unit acts like a traffic cop, taking in all the incoming data and dispatching that over native fibre to go from tile to tile. What's nice about this is that, rather than having a rack unit as your choke point processing tens of millions of pixels, it can take all that metadata and interpret it properly - giving you all the management and control to pass it along in little chunks, for the tiles to do their own processing."



LOOKING AHEAD Future-proof your virtual production workflow with HELIOS, using existing infrastructure – while maintaining the ability to upgrade processor inputs and LED displays



WITH NANOSYNC

Part 1

SYNCHRONISED OUTPUT The light from the LED is timed with the video or genlock source, and offsets can be dialled in by the nanosecond – giving the best control options

This, in turn, allows for the tiles to be run at higher refresh rates, to avoid interference. With more granularity over timings, light can be emitted from the LEDs when the camera is at full capture – and is ready to start receiving light. Using Megapixel's groundbreaking NanoSync™ technology, this can be done down to the nanosecond, even over 10km fibre links.

"I know a lot of DOPs who've had a poor experience working in LED volumes – because of this interference. It doesn't matter what LED you buy. Although it may look interesting to the eye, it's not necessarily going to work on camera without the proper processing – and we've got that covered," concludes Hochman.

Next month, we discuss HELIOS' cinema-grade colour accuracy, and go into detail about benefits of storing sub-pixel colour metadata on the LED module itself.



megapixelvr.com



MARK PILBOROUGH-SKINNER VP supervisor, Garden Studios

After graduating with a computer programming degree from SAE Institute London, Pilborough-Skinner was lead Unreal developer at Satore Tech for three years, before joining Garden Studios, which boasts a 4800 sq ft virtual production stage.



JONNY HUNT Technical director, VSS

Hunt studied computer science, before applying his practical mind to the video market. He is now responsible for the management and delivery of every technical aspect of VSS's project work in the UK, Europe and Middle East.



CHRISTIAN KAESTNER VFX supervisor, Framestore

Kaestner is currently working as overall VFX supervisor on *1899* for Netflix – the newest project from the creators of *Dark* – which is the first show to make use of Dark Bay, the largest LED volume facility in Europe.



JEREMY HOCHMAN CEO, Megapixel VR

Hochman is an entrepreneur and designer, who made tech history in 2002 when co-founding Element Labs, the company that gave birth to the creative LED industry.



DAVID LEVY Director of business development, global solutions, Arri

Levy comes from a creative background, and was lead camera and lighting specialist at Al Jazeera for 11 years, before joining Arri Rental in 2017.



MARINA PRAK Marketing manager, Roe Visual

With over 30 years in the entertainment industry, 20 of which were in marketing, Prak is currently responsible for growing Roe Visual's brand in Europe and the Middle East.



DAN HAMILL *Co-founder and commercial director*, 80six

Hamill co-founded 80six, with a passion for providing spectacular visual events, utilising over 15 years of professional experience in production.

How are machine learning and AI techniques evolving virtual production technology?

MARK PILBOROUGH-SKINNER: We are seeing AI used more and more in realtime rendering pipelines. Nvidia DLSS uses machine learning to render frames at a lower resolution, then upscales them with minimal difference to the visual quality. This has already been leveraged in the games industry, for more realistic lighting and atmospheric effects, while still maintaining a high frame rate. 3D content creation and scene design are also being pushed forward using this technology - from AI-assisted scene development, to procedural asset creation and authoring. As the techniques continue to develop, I believe we're going to see an overlap between real-time rendering and classic, offline VFX in the next five to ten years.

JONNY HUNT: Taking techniques from other industries – such as machine learning and photogrammetry – and applying these to virtual production has moved us closer to achieving fully 'live', final VFX shots. It's already happening, but the possibilities for the future are incredible, albeit with a massive change to workflow/pipeline.

CHRISTIAN KAESTNER: Machine learning is rapidly making its way into the visual effects world. This means it will inevitably find its place in virtual production. At the moment, the most applicable areas of machine learning are in the noise reduction of real-time ray tracing, allowing for better quality renders at higher refresh rates – with more visual and photorealistic complexity. There are many more areas of game engine technology that will surface within the next couple of years, continuing to enhance visuals for virtual production.

JEREMY HOCHMAN: We're a bit outside of this realm, but I see a ton of work happening with motion capture and person/object replacement in scenes. The fact that this can happen in near real time is absolutely incredible.

DAVID LEVY: As with all technological growth in this area, it allows for faster, higher-quality worldbuilding. It's amazing to see Moore's law happening in front of us. Each day, we see incremental – sometimes huge – advances to computer power that drives these systems.

DAN HAMILL: AI machine learning gives more control to filmmakers. They can capture in-camera visual effects (ICVFX) by allowing post-production to begin



as the director says cut, immediately enhancing the shot with image correction, through to full background replacements. Foundry has just launched an innovation in this area, which it demoed at our studios – as seen at the RealTime Conference in December.

How is colourimetry between camera and display being mastered as the technology develops? In other words, how can metamerism be avoided?

PILBOROUGH-SKINNER: Metering LED fixtures using the standard colour rendering index (CRI) is not a poor metric for overall colour reproduction when viewed through a camera. New standards such as the television lighting consistency index (TLCI) provide a better representation of the quality of light relative to the sensor's perspective. Additionally, new advancements such as HDR and RGBA are allowing for a greater range of colours, helping to fill in the orange-red area of the spectrum, which is typically lacking in LED fixtures.

HUNT: We're still mostly working in a world where the LED screens we're using weren't designed specifically for virtual production. The next real leap in terms

"New advancements such as HDR and RGBA are allowing for a greater range of colours, helping to fill in the orange-red area of the spectrum"

of LED panel technology is to address colourimetry issues, adding processing tools to help with that. With the right scientific approach, it is absolutely possible to use the current generation of panels to reproduce accurate colour in camera. Brompton Technology has put a lot of work into maintaining good colour accuracy – and this is our favoured processing platform.

KAESTNER: Understanding the colour science and spectral light response of a virtual production project is key to successful visuals. In the end, every project is unique in its methodology and visual requirements. If we are talking about a scene inside a car, the set-up may be completely different to that of an outside landscape. Ultimately, the collaboration between DOP, DIT and the virtual production/visual effects team will define the parameters for which

aspects are lit by the LED wall, and which are lit by practical lights.

HOCHMAN: Metamerism is quite a large issue to work through using today's equipment. LED displays come from a perspective of high efficiency and being visible by human eyes - this means narrow band emitters at saturated wavelengths. Cameras are generally tuned for good skin tones and natural accuracy with sunlight, as examples. Many VFX companies have come up with specialised workflows, calibrating the display and camera systems to create accurate and reproducible colours. However, a processing system such as ours helps bridge the gap between display and capture systems, by working in known colour gamuts and giving users feedback about the actual chromaticity the tiles are achieving. It's a much better starting basis.

LEVY: This is one of the most discussed topics for mixed reality productions currently. We observe many of the studios, OTT platforms, post/VFX houses doing a lot of work on the topic – even Arri has been innovating here. I hope to see a standardised, automated process to achieve the desired result of matching the foreground with the LED backgrounds.

MARINA PRAK: LED panels having a large colour gamut/space will deliver better accuracy, simply because they can reproduce more colours. For on-camera purposes, the LED panels are the limiting factor. By knowing the colour gamut the panels reproduce (and not touching or changing these), you can solve colour accuracy in the render. The best solution is to send out your video with a white level as high as possible, and not change the colours in the LED processing.

HAMILL: In simple terms, we are recording huge monitors mixed with live action, though this differs if completely in Unreal. Matching the screens to the camera sensor to achieve consistent colour is a challenge (one of many). Calibration of the screens is one area - colour science, LUTs and more all add to the equation – and a dedicated mature colour pipeline would be essential. The areas are evolving, and achieving a consistent colour workflow from in-camera VFX to LED walls will require further development. Custom LUTs, inverse LUTs, decisions on gamuts, cameras, sensors, resolution, HDR/SDR and colour space for both areas impact each other. They are getting closer, and it is a field that is growing and maturing.

Which areas of virtual production still need work? And how will these problems be resolved?

PILBOROUGH-SKINNER: Virtual production isn't for every shot. It's a fantastic tool in our arsenal, but we're very open with film crews about what shots should be done on location, sound stage or green screen. Something we offer at Garden Studios is a hybrid approach, where we can look at a script and recommend which technique would be best to achieve the result productions are looking for. This transparency about the technology is helping to foster more confidence in using it when it's right.



HUNT: There are plenty of technical challenges being identified and solved as time goes on, but one of the biggest tasks is changing the way people work – and how virtual production affects other departments. We've used LED screens in film and drama since before the term virtual production was coined, so we've seen how well some productions have embraced it, and how others have struggled. Both produce great lessons. The role of a good VP producer is key: someone on the production side, independent of suppliers, who can navigate challenges and liaise with every department leads to a much smoother experience for all. I still see a shortage of good people in this role.

KAESTNER: Virtual production is opening up a whole new world of possibilities for filmmakers and visual effects designers. Job roles and responsibilities are shifting, and new skill sets are being created on every show. I am certain that over the next five years, there will be a whole new set of job descriptions across the industry.

"Over the next five years, there will be a whole new set of job descriptions across the industry. Training and education will be a huge part" Training and education will play a huge part in making these newly created roles a success.

HOCHMAN: Lighting is a big one. Lately, we've seen a few articles showing how RGB versus RGBW or RGBWW lighting is fundamentally different for illuminating people. We'd like to see more wideband emitters used as part of volumes, especially since Helios is prepared to drive these multi-primary pixels natively.

LEVY: Generally speaking, the current process of achieving ICVFX using LED volumes is very complex and expensive. Eventually, the price of LED technology will come down, and the simplification and automation of many of the processes involved will reduce the associated difficulty and risk. The other important step which needs to happen - and is ongoing - is education: from higher education, to DOPs, producers, VFX supervisors, and our friends in the gaming, live events and broadcast world. A lot of continuing education on how technology and workflows are developing will be essential.

HAMILL: While VP technology advances at high speed, we are facing an education and training gap for this sector. More technical education about real-time technologies is required – and the only way to address such skills shortages is for universities, unions, industry organisations and VP practitioners to facilitate hands-on training. We're already seeing interest from film universities, coming to us to integrate LED volumes as part of their on-site teaching. So we're hopeful it will be addressed quite quickly, and the new generation of filmmakers will have learnt such techniques straight from school.

What's next for virtual production? And how will it become more democratised and accepted by the industry?

PILBOROUGH-SKINNER: One of the most exciting things about the evolution of VP is the sheer number of new ideas and collaborations. Unlike traditional VFX or other on-set roles, all the tools and technologies are available to download and experiment with for free. We're seeing filmmakers, directors and students creating their own VP shoots at home using Unreal, consumer tracking systems and monitors/projectors. There's no longer a large time or monetary commitment to get into the space. As VP is new tech, it's been fantastic seeing everyone's contributions to best practices, technically and creatively, to understand how far we can push this new medium.

HUNT: With virtual production already accepted in the industry, there needs to be a period of establishing good talent, with training and exposure to the technology key. Virtual production is still a new sector, currently taking its people from

"Once we all understand a common workflow language, departments will evolve in the same direction – and the pace of innovation will grow"

other departments and industries. If it is to grow, we need to develop good people first and foremost. In terms of technology, we are still two to three years away from the next groundbreaking wave of LED innovation. I look forward to working with manufacturers over the next two years, developing products aimed purely at VP.

KAESTNER: More and more successful virtual production projects will emerge. Filmmakers and studios will embrace this further, once it becomes clear how best to utilise and apply the potential of the technology. The more creatives understand it, the more they can leverage its cost-effectiveness. And, as a result, it has the potential to become a fully accepted and integrated part of storytelling. Not every project necessarily lends itself towards virtual production, but it can be extremely powerful when understood and used correctly.

HOCHMAN: Realistically, it will take some time and effort. But, once there are common teachable workflows with a shared vocabulary, teams will be able to approach this process as a normal part of the filmmaking job. Today, content creators, DOPs, directors, producers,



VFX companies... they all care about different aspects of a particular process of moviemaking. Volumes and virtual production somewhat force all of these roles to converge on a single topic, and must intelligently know what the other is doing technically, so everyone can be successful. Once we all understand a common workflow language, departments will evolve together in the same direction – and the pace of innovation will grow even faster.

LEVY: Our industry will continue to improve the robustness, efficiency, cost, control and quality of producing content using virtual production techniques. What's next? Lots of opinion at the moment, and plenty of talk about the metaverse. What I *can* say is that I'm very excited to see what we do next.

PRAK: What we see evolving is the way video content is sent from the render engine to the LED processing platform. The video content will not be rendered on site, but another location – like delivering render nodes on demand. The whole concept of virtual production is accepted and used by a wider part of the industry, and will be embraced by more and more production types. It will become available for more applications – not only high-end, but also lower end. This is a fast-paced process.

HAMILL: Looking at the technical advancements in VP happening now, we believe that in five to ten years, 80 to 90% of visual effects could be captured in camera. However, for that to be vastly accepted in the industry, we need to work on a uniform set of VP practices, tools and approaches. Through such collaboration at industry level - and support from film schools and universities - there will be a greater application in the very near future. As more experts in this niche field emerge, the technique will become more commercially viable for indie filmmaking, too. We look forward to seeing the sustainability data regarding VP from industry organisations like the British Film Commission. They are now compiling in-depth research, and the results will certify its acceptance as a more viable - and sustainable - method of production.