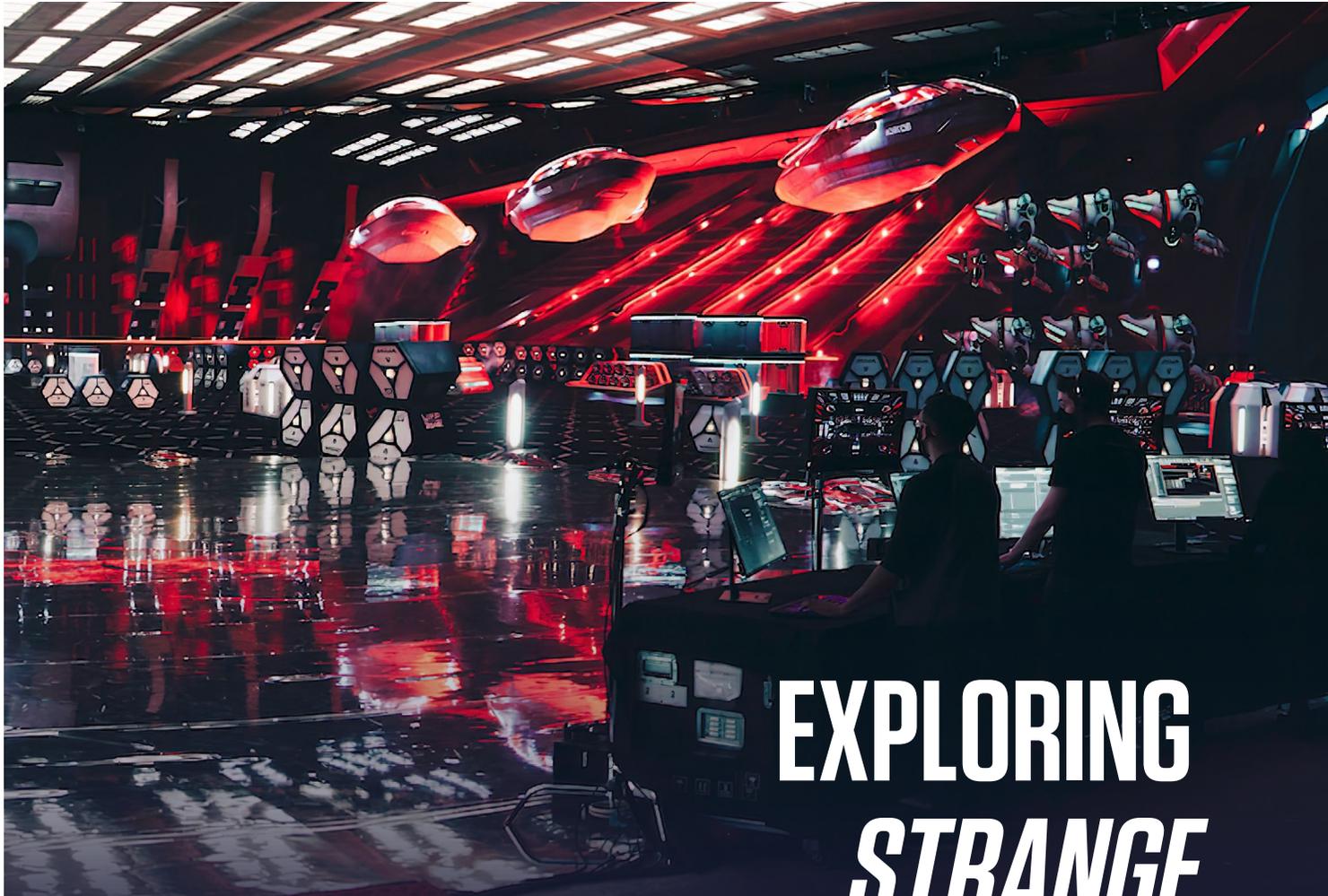


LA LAB

FILMMAKING

VIRTUAL PRODUCTION

UNREAL ENGINE



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SAILING ON THE VIRTUAL HIGH SEAS:
OUR FLAG MEANS DEATH

FOOTBALL GOES UNREAL WITH
THE CAROLINA PANTHERS

PRAZINBURK RIDGE TAKES
UNREAL ENGINE TO THE FRONT
LINES OF INDIE ANIMATION

EXPLORING *STRANGE* *NEW WORLDS* WITH VIRTUAL PRODUCTION



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We wish to thank all of the creators we interviewed for this magazine for sharing their time and great insights about virtual production.

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Front cover image courtesy of Pixomondo

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LETTER FROM THE LAB

Filmmaking is about a shared vision. The clearer that vision can be expressed, the better the resulting project. Virtual production adds an entirely new dimension to the equation by making superior imagery possible earlier and faster so that more production team members can share a clear vision.

Epic Games created the Los Angeles Lab as a creative space for its personnel to collaborate with the community and experiment with virtual production without the encumbrance of proprietary content or tools. The facility offers a soundstage with the latest technologies in LED panels, performance tracking, real-time animation, image processing, and lighting. A team of professional filmmakers, game designers, artists, visual effects supervisors, etc., also operate the Lab. Even though the Lab is located in Los Angeles and supports many nearby projects, the reach of this effort is worldwide.

Although in-camera VFX with LED volumes has recently received much attention, it is only one area of virtual production that the Lab supports. Other important disciplines include games, animation, simulation, motion capture, visualization, esports, live broadcasting, virtual and augmented reality, automotive design, human machine interface, and more. The common thread connecting so many diverse verticals is Unreal Engine.



Image courtesy of Mike Sill / Halon Entertainment

As a working laboratory and meeting space, LA Lab participates in many support activities. These include testing new virtual production workflows and technologies, including quality assurance with upcoming versions of Unreal Engine. The Lab also hosts training sessions, Fellowships, workshops, demonstrations, and test productions. LA Lab is not alone in its mission, with additional facilities like London Lab and Detroit Lab.

No one can predict how interactive entertainment will ultimately evolve in the future. The industry is at a unique historical inflection point where the worlds of filmmaking and video games are rapidly converging into the metaverse and other new formats. Part of the Lab's core mission is to help creative people explore and innovate during this exhilarating journey.

This new publication is designed to share the LA Lab with an even wider audience. In the following pages, you'll learn how virtual production empowers a diverse spectrum of creatives. Their projects range from major series like Paramount Plus' *Star Trek: Strange New Worlds* and *Our Flag Means Death* to more intimate, personal stories like Emma Needell's *Life Rendered*. You'll learn how real-time technology is changing how everything from episodic animation to sports broadcasting gets made. We've also included plenty of additional educational resources at the end of this magazine to help you comprehend the terminology and philosophies behind virtual production.

**WE CANNOT WAIT TO SHARE EVERYTHING WE'RE LEARNING
AND HOPE TO INSPIRE YOU TO FORGE YOUR OWN PATH INTO
THIS EXCITING WORLD OF ENDLESS POTENTIAL.**

—THE LA LAB TEAM

LA LAB TECH SPECS

30' diameter x 12' wall height, curved wall length is 55.75'/17m.

LED DISPLAY WALL

- ▶ 506 Roe Black Pearl BP2 V2 Studio Tiles
- ▶ Megapixel VR HELIOS processors
- ▶ BP2 V2 with Brompton processors on rolling stands for interactive lighting
- ▶ X50 Optitrak cameras for camera tracking and performance capture
- ▶ X6 render machines with dual NVIDIA RTX A6000 graphics cards
- ▶ X4 control machines with dual NVIDIA RTX A6000 graphics cards

CAMERAS

- ▶ Alexa Mini LF
- ▶ Sony Venice
- ▶ CODEX drive
- ▶ Camera jib
- ▶ Optimized for live streaming

LIGHTING

- ▶ Dynamic Practical Arri Lighting including Orbiters with Chimera light banks, SkyPanel S120-C, S60-C, and S30-C C

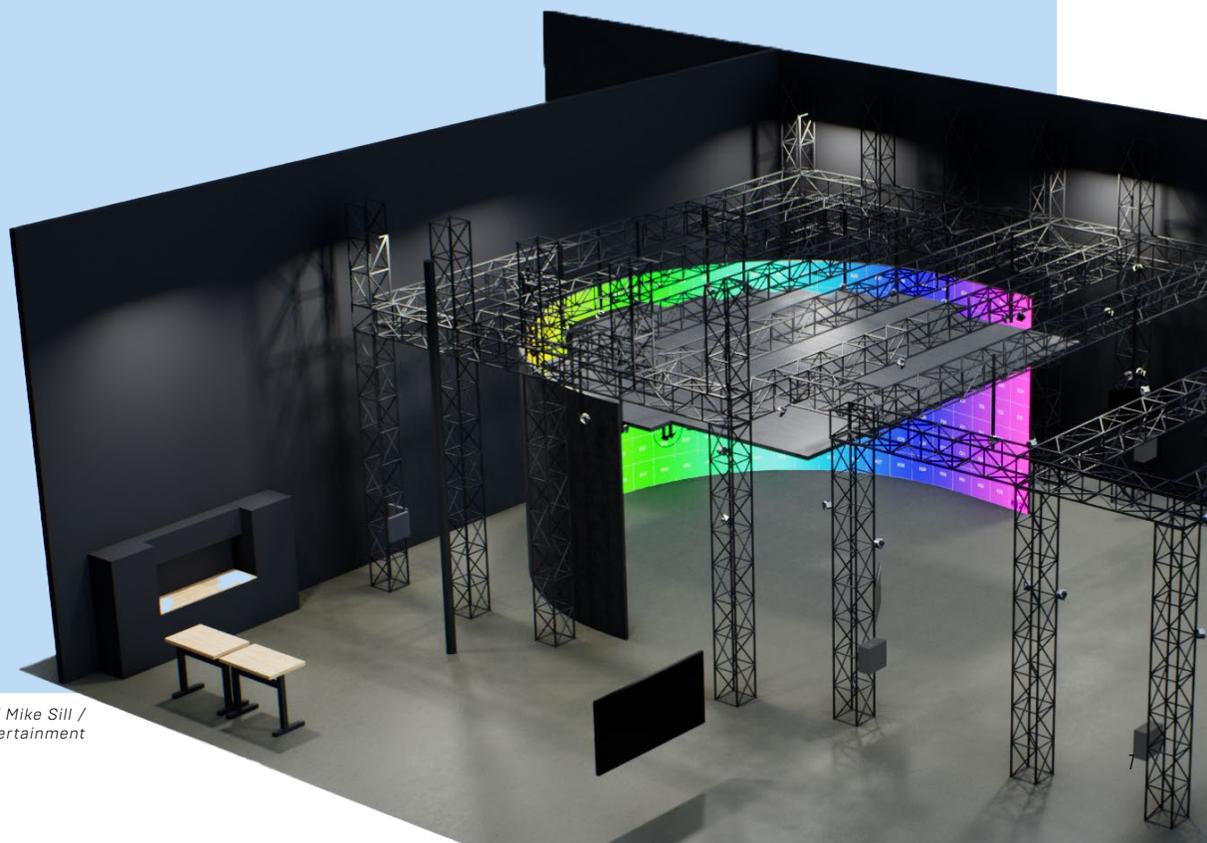
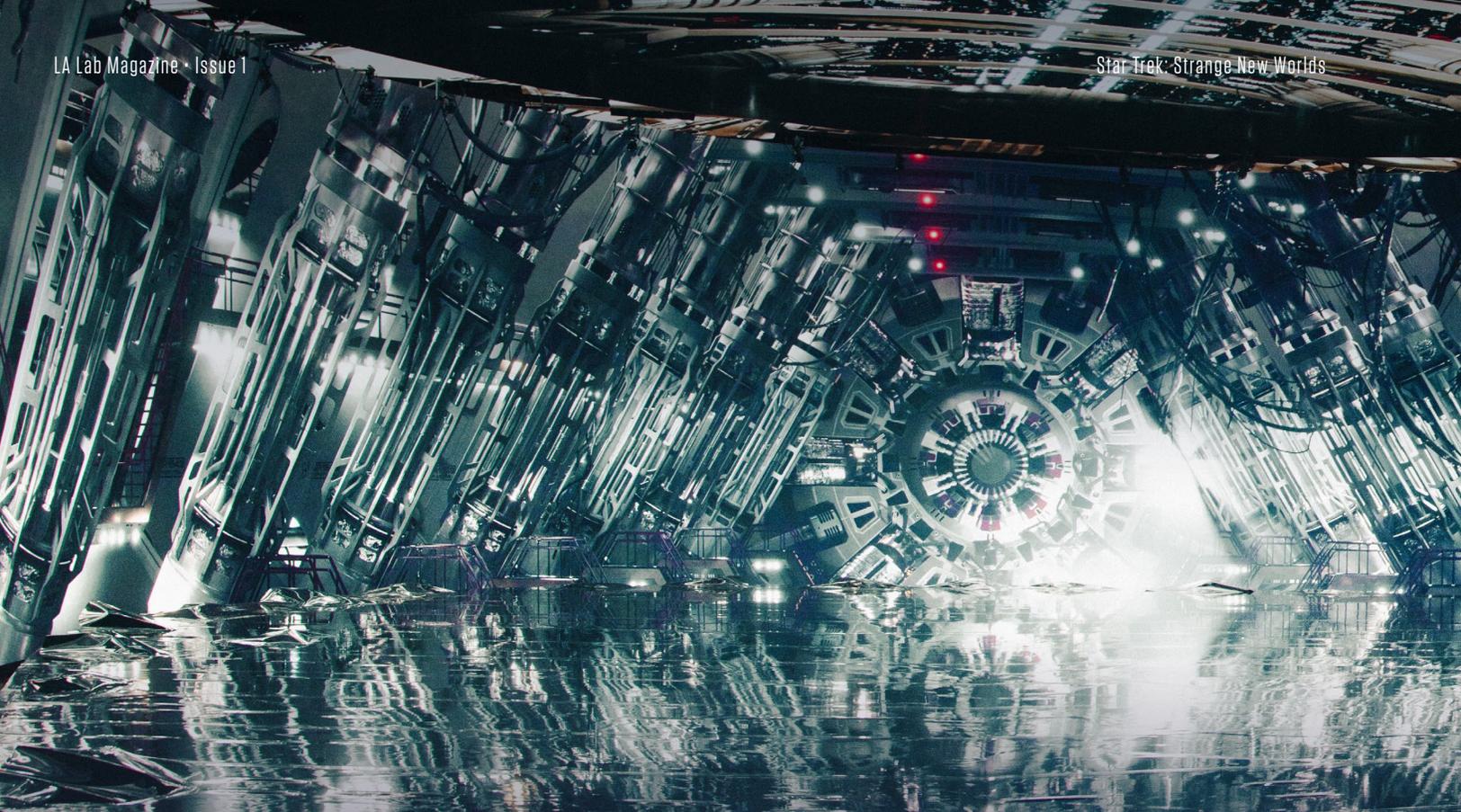


Image courtesy of Mike Sill /
Halon Entertainment



PIXOMONDO POWERS *STAR TREK: STRANGE NEW WORLDS*

Image courtesy of Kristina Zakhzhai/Pixomondo

Star Trek: Strange New Worlds is an episodic science-fiction prequel series streaming on the Paramount Plus network. The show, which premiered in May 2022, features the adventures of the USS Enterprise on a five-year mission set before the command of the famous Captain James T. Kirk. In *Strange New Worlds*, the Enterprise is commanded by Captain Christopher Pike (Anson Mount) along with First Officer Number One (Rebecca Romijn) and Science Officer Spock (Ethan Peck).

Star Trek as a property embraced virtual production and in-camera VFX with Unreal Engine starting in 2021. Sister show *Star Trek: Discovery* used an LED volume in place of a green screen and location work. Partially motivated by the restrictions of the Covid-19 pandemic, the approach proved highly successful. Virtual production added scope and scale to the show while reducing costs and increasing efficiency.



LARGEST LED VOLUME IN THE WORLD AT 22,000 SQUARE FEET

So, when it came time to conceive a show from scratch, the executive producers of *Star Trek: Strange New Worlds* determined that an LED volume would be a core element. While *Discovery* used the volume primarily to represent new locales and planets, *Strange New Worlds* incorporated the volume into standing sets like engineering and the mess hall.

Strange New Worlds films in Toronto, Canada, and is supported by full-service visual effects house, **Pixomondo**. Pixomondo's Toronto stage is a 72' x 24' horseshoe-shaped volume with Roe Black Pearl 2.8mm LED panels for the walls and Roe Visual Carbon Series 5.77mm panels for the ceiling.

Brompton Tessera SX40 12-bit, 4K LED video processors output real-time animation from Unreal Engine to the panels. The facility also uses OptiTrack motion capture cameras to handle multi-camera tracking. Pixomondo's stages, including those in Toronto and Vancouver, were built with Canadian production rental company William F. White International Inc. The Vancouver stage recently received a Guinness World Record for the largest LED volume in the world at 22,000 square feet.

To fully support projects on the scale of *Star Trek*, Pixomondo maintains a crew of volume operators and an extensive virtual art department. The team includes virtual production supervisor Nathaniel Larouche, visual effects producer Paolo Tamburrino, head of virtual production content Asad Manzoor, and head of virtual art department/art director Mujia Liao.

According to Liao, "We have two major phases to any environment: visualization and realization. For visualization, we work with the directors of photography and our VAD to block out a scene with Unreal. We're rapid-prototyping the general look and feel and painting concept art over frames exported from Unreal. The goal is to sell the idea and get approval. Then we hand everything over to Asad's team for the realization phase."



Image courtesy of Paramount+

“Our goal is to polish each environment up, optimize it for performance within the volume, and then get it onto the stage,”

explains Manzoor. “It’s a blurry line between our two departments because the concept artists are already optimizing their assets as they address creative notes. We’re training everyone involved in the process of game engine optimization.”

Pixomondo’s workflow includes building modular environments to take advantage of Blueprints and instancing in Unreal for efficiency. “Our goal is to avoid building thirty variations of an asset as we might with traditional VFX,” says Liao. “We want to keep the same asset throughout and optimize for the realization phase. It’s great for the artists because they can take ownership of an asset from concept art to production. Real-time tools like Unreal give artists the freedom to cover a wide range of tasks.”

For the first season of *Strange New Worlds*, Pixomondo delivered a variety of LED volume environments. These included the frozen planetary surface of Valeo Beta featured on this issue’s cover. Manzoor and Liao detailed the environment’s realization. “Ice and snow are notoriously tricky to pull off in real-time,” says Manzoor. “We often start with storyboards and block shots with the director so we can understand the overall geometry and proportions needed. Virtual production enables us to influence the script earlier in the process instead of deferring to post-production.”

“This is probably one of the most fun environments we worked on this season because we got to utilize real photographed miniatures,” enthuses Liao. “We’d reached out to a talented miniature artist, and collaborated with him to create some interesting ice formations. We would photograph each with different exposures and lighting setups, extracting from it the albedo pass, spec pass, etc. Then we projected those textures onto proxy geometry as a base to work off of.”



Image courtesy of Paramount+

“Next, we did a digital matte painting (DMP) pass on the environment,” Liao continues.

“Everything went into Unreal Engine, and we coordinated with the art department for the foreground set pieces. Using miniatures as a base was great because you get all these natural, realistic nuances you wouldn’t get starting from a completely CG model.”

With successful seasons of *Discovery* and *Strange New Worlds* under their belts, the Pixomondo team is already working on the next seasons of each show. The team is incorporating the takeaways from their initial experiences into increasingly complex and incredible environments. “Now we have a pretty good grasp of how and when to use a game-development approach, and how to avoid aliasing and other issues that we’ve encountered,” observes Manzoor.

“It’s still challenging to hire for virtual production because of the small talent pool and huge demand,” adds Manzoor. “But

the pool is growing, thanks to efforts like Epic’s Unreal Fellowship and other training programs. We’re also making more and more dynamic elements for the environments. It’s the rule instead of the exception now.”

Liao agrees, and appreciates how real-time significantly broadens the different apps artists can use to contribute to virtual production. “We have people modeling in Blender, Maya, Houdini, ZBrush, etc.,” she says. “Traditionally in VFX, we’ve relied on a rigid pipeline. Now we don’t mind where an asset is created. As long as it’s optimized for Unreal and looks great—we love it. Virtual production gives us so much creativity and freedom. I’ve had multiple artists tell me they enjoy the work because they get to try different things and see how their piece fits into the overall project. We’ve never been able to collaborate as efficiently before.”

**VIRTUAL
PRODUCTION
GIVES US SO MUCH
CREATIVITY AND
FREEDOM**



Image courtesy of Paramount+

SAILING ON THE VIRTUAL HIGH SEAS: *OUR FLAG MEANS DEATH*

Our Flag Means Death is a period comedy set on the Caribbean high seas in 1717 during the Golden Age of Piracy. The series chronicles the misadventures of Stede Bonnet (Rhys Darby), an aristocrat determined to be a gentleman pirate captain who encounters the infamous Blackbeard (Taika Waititi, who also directed). *Our Flag* premiered on HBO Max in March 2022, quickly became one of the streaming service's top-watched shows, and was renewed for a second season.

With the bulk of the story set aboard Bonnet's ship *Revenge*, the crew turned to virtual production and an LED volume to simulate the ocean. Veteran visual effects supervisor and cinematographer, Sam Nicholson, ASC, led the virtual production effort via his visual effects company, **Stargate Studios**.

Nicholson captured background ocean footage on the Caribbean Sea and processed it through Unreal Engine to create a convincingly immersive experience for the actors, crew, and cameras. Virtual production made it feasible to produce a show that would have been prohibitively expensive if the studio had gone for a location shoot or a green screen/post-compositing visual effects effort.

With a tight pre-production timeline and a need for entirely credible ocean vistas in nearly every scene, Nicholson began with an ocean plate shoot off the coast of Puerto Rico. The team utilized a 360-degree, eight-camera array of Blackmagic Pocket Cinema 6K cameras on a custom, stabilized rig to capture immersive plates in various weather conditions and at different times. “We tested 3D water and got it to look

360°, EIGHT CAMERA ARRAY



Image courtesy of Stargate Studios

pretty good, but you can't beat the actual ocean for realism and efficiency on a six-week turnaround,” observes Nicholson.

“We needed five minute, unbroken takes for a 20K final image, so just imagine trying to render all that for forty backgrounds in full CG versus capturing real footage,”

Nicholson continues. “Understanding your 3D pipeline is essential for virtual production. And as a bonus, we now have a massive library of backgrounds ready for reuse on the second season.”

With the plate shoot completed, Nicholson returned to Los Angeles and began the process of stitching and color grading the different angles into massive panoramic plates in preparation for production.



Image courtesy of Stargate Studios

Warner Brothers Studios in Burbank hosted a full-sized, modular mockup of the *Revenge*. A 30' x 160' LED volume constructed by NEP Sweetwater with a total resolution of 20K surrounded the ship, effectively filling the periphery with seagoing views.

To generate the live feed for the LED volume, six workstations running Davinci Resolve fed their outputs through Decklink 8K cards into Unreal Engine for display on the screens. By running the footage through Unreal Engine and leveraging Stargate's ThruView compositing process, the screen content synchronized with the live camera tracking. The approach provided completely credible parallax in the footage.

"It's not like shooting green screen," observes Nicholson. "We had all the real-time image manipulation tools in Resolve and then went through Unreal Engine for the off-axis camera tracking and 3D blending of the plate material. You learn what works well incredibly quickly, because it's a real-time feedback loop right in front of your eyes."

The production ultimately achieved its goal of providing creative freedom to Waititi, who directed the pilot episode and set the visual tone for the remaining nine episodes. "Virtual production is particularly empowering for a comedy, where you need to run long takes," says Nicholson.

"The actors constantly improvise, and you don't know what's going to happen, making the comedy feel more natural. It's not a carefully planned visual effect that has to fit into a three-second window."

Producing a project as large as *Our Flag Means Death* with virtual production was a significant gamble, but Nicholson recalls the moment he knew they had succeeded. "It was a day early in the shoot when all of the HBO execs came to visit the ship after months of planning, lots of money spent, and many careers on the line," he recalls. "The ship rocked back and forth, the horizon went up and down, the fan-driven wind was in their hair, and it just felt like you were on a ship. The execs started getting a little queasy from the realism of the open sea. It was a wonderful moment because



Image courtesy of HBO Max

everything worked on an emotional, human level; the physical sensation of standing on board the ship—it just felt completely real.”

During post-production, the team continued leveraging the benefits of virtual production to deliver the best possible version of each scene. “The editors have access to all the takes from start to finish,” says Nicholson. “You can lock and unlock the picture and not be penalized, as you would with a green screen throwing out shots that have been started three months before and will cost you money to redo. With virtual production, the irony is you’re throwing away a lot of material because every shot is a finished composite. That’s fantastic because it’s so creatively freeing. Epic Games and Unreal Engine have added fuel to this fire, and the way they integrate with all the different technologies for in-camera VFX is critical.”

Though *Our Flag Means Death* represents the state-of-the-art in virtual production, Nicholson believes the scalability of the

workflow makes it highly accessible. “If you want to do virtual production, start at a Best Buy,” he says with a smile. “With an 80-inch TV for your screen, plates shot on your phone, and Unreal Engine, which you can download for free, you can do in-camera visual effects. That’s how you start to learn that it’s the same workflow we did; it’s just at a different scale.”

Additional links

- ▶ [Virtual Production with Blackmagic Design](#)
- ▶ [ASC Article](#)
- ▶ [Our Flag Means Death Official Trailer](#)
- ▶ [Sam Nicholson presentation at NAB 2022](#)

IT'S A
REAL-TIME
FEEDBACK
LOOP RIGHT
IN FRONT OF
YOUR EYES.



Image courtesy of HBO Max

PRAZINBURK RIDGE TAKES UNREAL ENGINE TO THE FRONT LINES OF INDIE ANIMATION

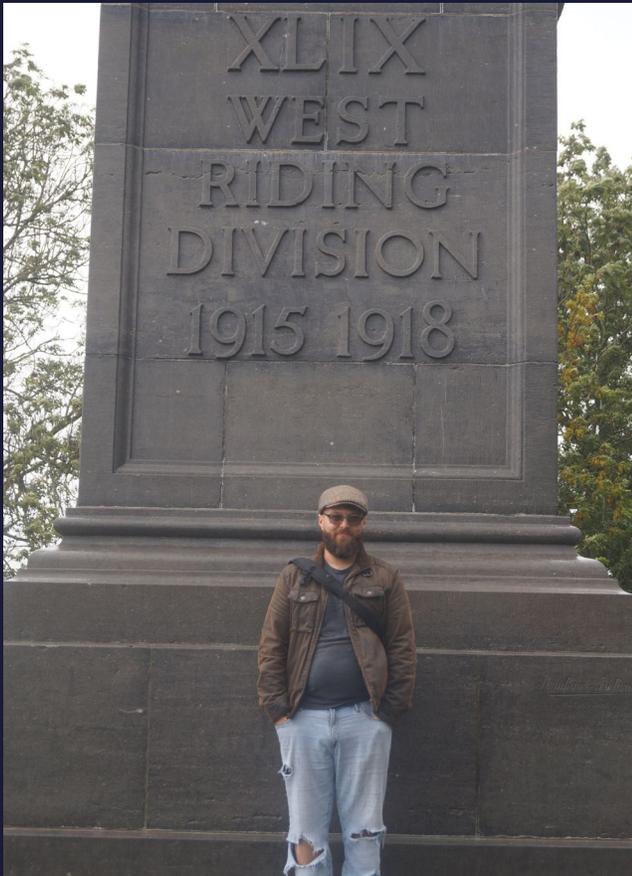
Prazinburk Ridge is an animated short created almost entirely by a single person. The impressionistically styled film tells the true story of English rugby player **Douglas “Duggy” Clark**, whose intense athleticism saved a harrowing mission during World War I. Writer/director **Martin Bell** leveraged his skills as a previs supervisor at **Proof Inc.** to create the short in **Unreal Engine**.

“I’d been looking for a personal project for years just to make something,” recalls Bell. “All I’ve ever wanted to do is make my own films, but in animation, it’s difficult because you normally need

a team. I also wanted to do something that would stand independently and not go the sci-fi route because that can be an oversaturated genre for Unreal.”

Bell turned to the war genre because of his experiences creating countless battles for previs at his day job and via a personal connection. “My brother wrote a biography about Douglas Clark, the British WWI hero,” Bell continues. “I remembered an exhilarating action sequence from the book that seemed like a simple enough story to accomplish by myself.”

Courtesy of Martin Bell



Courtesy of Martin Bell

“What finally pushed me to get it done was having downtime during the pandemic and also seeing Richard Linklater’s *Apollo 10 1/2*.”

“I realized I could adopt a similar cel-shaded style and shoot 12 frames per second. I’d get a traditional feel with fewer frames to manage.”

By leaning into technical limitations, Bell could give *Prazinburk Ridge* a unique look. “It’s the same reason Kevin Smith made *Clerks* in black and white—because he couldn’t afford color film,” Bell observes. “I knew that by applying cel-shaders

and post-processing in Unreal, I could make it look painterly. They say art is never complete, but working within the confines of what was possible ultimately freed me to finish this project.”

Although Bell prevised the entire movie and recorded all the dialogue himself, he ultimately replaced his lines with voice over actors, including Edmund C. Short, Ciaran Crawford, and Christopher Winchester. “I worked hard to direct the actors to match my speed of delivery because the movie was already running ten minutes, and I liked the pace,” he says.

To bring the characters’ physicality to life, Bell did all of his own performance captures. “I’d bought a first-generation **Noitom Perception Neuron** mocap suit on Kickstarter back in 2015,” Bell says. “It’s less advanced than their more recent models and requires more cleanup, so I got into the habit of capturing raw data



Courtesy of Martin Bell

directly into Unreal just to get the main action. I captured eye animation using an iPhone with the [MocapX app](#). Then, I would clean up each shot and hand keyframe lip-sync in Maya.”

“Because of the pandemic restrictions and the actors being in different locations, we recorded some sessions over [Google Meets](#),” Bell continues. “I had a version of the movie without lip-sync, which I then animated in Maya, matching the lip-sync up to the final voice performances.”

Bell estimates he spent more than 100 days over a couple of years completing the project. “Spending time off and on again helped to mature the project in my mind,” Bell observes. “I think it’s a better film than what it would have been had I pushed through in the Summer of 2020.”

With the movie completed, Bell released it online instead of waiting for distribution or completing an entire festival run. “The festival cycle can take two or three years, and I wanted it to be seen sooner than later,” says Bell. “I’ve had a good reaction from everyone who has clicked on it and watched it so far. I’m also applying to more festivals and getting it out there as much as possible.”

The film’s world premiere screening was at the [Wigan and Leigh Film Festival](#), not far from Clark’s birthplace, in September 2022, a BIFA (British Independent Film Award)

**PREVIS IS MUCH
FASTER TO
ACCOMPLISH IN
UNREAL ENGINE,
BUT IT ALSO HAS A
KNOCK-ON EFFECT**



Courtesy of Martin Bell



Courtesy of Martin Bell

qualifying festival. It won the Best Animation award there. Bell later presented the movie at the Epic Games London Innovation Lab. *Prazinburk Ridge* was also accepted into the **SPARK Animation Festival**, an Oscar-qualifying festival, as part of its online shorts competition. The film's debut in North America was part of a SPARK program also featuring **RIFT** by HaZ Dulull, another UK Unreal filmmaker.

As Bell promotes *Prazinburk Ridge*, he continues to work as a previs supervisor and finds his day job better informed by his experiences in real-time animation. "Previs is much faster to accomplish in Unreal Engine, but it also has a knock-on effect," says Bell. "The big limitation today is the amount of available talent who are highly skilled in Unreal. There's still some work to be done to level up enough people to make a big change in previs."

When asked for his advice to fellow budding animators looking to real-time, Bell has plenty of tips as he pivots into more projects and potentially live-action feature directing. "It's imperative to not think of Unreal just as a renderer for other applications such as Maya," stresses Bell. "You're better off getting more comfortable with Unreal and laying out everything in it. And if you want to finish your passion project, ensure it's something you need to do. If something needs to exist, you can will it into existence."

For more information about Martin Bell and *Prazinburk Ridge*, please visit:

- ▶ **Yes Commissioner**
- ▶ **Pitch Publishing**
- ▶ **Duggy Clark**

CORY STRASSBURGER LEVERAGES UNREAL FOR DIY INFLUENCER STREAMING SERIES

Image courtesy of Corey Strassburger

VTuber and YouTube influencer Cory Strassburger uses Unreal Engine to create **Xanadu**, a DIY show featuring Blu, a convivial alien on a mission to build his virtual empire. Strassburger produces the show entirely on his own, from motion capture with an **Xsens** mocap suit and **Manus** gloves to animation and post-processing with Unreal Engine.

Strassburger starts with a database of potential concepts and chooses a topic for each episode. "Once I have the script written, I start recording voiceover directly into Unreal," he explains. "Then I'll start to stage the whole script and place Blu

and a camera in an environment. It's just to see how the flow goes, and if the story is working or needs rewriting. It's like building a plane while flying it."

Once he feels a script is solid, Strassburger goes into his garage studio and records mocap with his Xsens suit, Manus gloves, and an iPhone with the Live Link Face app. "I take all the raw motion capture data and then start processing selected takes," Strassburger says. "Then I retarget those onto the character in Unreal. I end up staging the action for



IT'S LIKE BUILDING A PLANE WHILE FLYING IT

a whole scene as one linear sequence. Once I have it all arranged, I start to expand on the camera I set up originally.”

In order to achieve natural camera movement, Strassburger uses tools within Unreal instead of having to capture camera movements via mocap. “There’s a built-in handheld camera movement animation I use all the time,” he says.

“It enables you to incorporate a more organic motion procedurally. That saves me a lot of time.”

“I also have a set of lens looks I use as I try to develop more of a cinematographic style and language for the show.”

To give *Xanadu* an epic look, Strassburger created a custom film back using a 2.35 aspect ratio. “Luckily, YouTube supports 2.35 content more or less, so it looks great,” notes Strassburger. “Everything plays back in real-time at a reasonable size when I’m in the editor. It’s definitely possible to slow rendering down by cranking up a lot of the quality settings. But I’ve found a good middle ground to maximize my time.”



Image courtesy of Corey Strassburger

"I also love the look of the cinematic camera in Unreal," Strassburger adds. "You can tell a lot of professional cinematographers have been involved with the engine's development. Everything works the way you'd expect it to in terms of aperture, frame rate, depth of field, etc. I love to exaggerate the depth of field. I'm often at an aperture of 1.2, and I'll go even lower if I want to soften up the background more. It's a virtual world, so why not add some style?"

For the next step, Strassburger begins rendering sequences as shots for additional post-editing. "I'm trying to do most of the initial editing directly in Unreal, but sometimes I have to render out and edit in Adobe Premiere if I need an effect that's not available. Then once I start tightening things up and adding music, I'm more in Premiere. The music is critical because it drives the scene, and it's a challenge to figure out."

Strassburger doesn't rely much on other post-production tools for color correction. He finds it easier to design the look directly in Unreal.

"Whatever look I want, I can get it in Unreal with a post-processing volume,"

he notes. "It saves a lot of time, and I don't think it's worth the effort for all the bells and whistles to do it outside Unreal. The post-processing volume lets you do so much fine-tuning with color directly in the camera."

Asked for some of his favorite Unreal features, Strassburger replied with a long list. "The cinematic depth of field was a real game changer for me," Strassburger says. "Traditionally, that's been a prolonged element to render in software, but with Unreal, it's incredible and real-time."

"I also love Sequencer, and how well it's been integrated into the production pipeline," he adds. "As a longtime visual effects artist, capturing face, body, and audio data right onto a timeline in the engine amps up my



Image courtesy of Corey Strassburger

enjoyment. I love the constant updates to the engine. Every time there's a new version of Unreal, there are many new and useful features. It's unlike any other software on the planet I've seen, period."

With a growing number of subscribers and several episodes under his belt, Strassburger isn't slowing down. Instead, he looks forward to the future and what it may hold for virtual production. "One thing I'm excited about that's not quite here yet, is to be able to be in VR while I'm capturing scenes," he enthuses.

"That's the holy grail and true metaverse stuff," Strassburger continues. "I could be completely immersed in the virtual world and interacting with virtual crew members. I could be working as a director, but I also would see myself as the character. I'd be touching physical items and seeing them rendered as virtual props. It's basically the same way they filmed *Avatar*, but with everything rendered live in your field of view instead of in post. It will be so much fun, and just thinking about it thrills me to no end."



Image courtesy of Corey Strassburger

Additional links

- ▶ [DIY MoCap/Xsens Suit](#)
- ▶ [YouTube Channel - Xanadu](#)



Image courtesy of Corey Strassburger

INDIE SPOTLIGHT

WRITING WITH UNREAL ENGINE

Image courtesy of Emily Needell/Evil Monster Dog, Inc

Writer/director Emma Needell's short film *Life Rendered* premiered in June 2022 at the Tribeca Film Festival. Needell leaned heavily into hybrid virtual production and motion capture techniques, leveraging Unreal Engine to depict her sci-fi story.

Originally from Elbert, Colorado, Needell stepped into the spotlight when a script she wrote called *The Water Man* was made into a feature film by actor/director David Oyelowo. The Oprah Winfrey-produced project debuted at the 2020 Toronto International Film Festival and was distributed on Netflix.

The Water Man helped Needell gather support for her directing ambitions. A longtime fan of video games such as *The Sims*, *The Last of Us*, and *Far Cry*, Needell recognized that game engine technology was progressing to a quality level sufficient for filmmaking. "The cutscenes were so evocative and emotional, they made me cry," she recalls. "I'd also seen *The Mandalorian* and heard of Unreal Engine. I learned about Epic's MegaGrant and Fellowship programs, which sounded great for someone like me who is very computer literate but still in over my head."

With the support of the Fellowship and a MegaGrant, Needell conceived the story of *Life Rendered* with the idea of mixing live-action with Unreal Engine animation driven by performance capture. "Our story is about a gay man who lives in rural Colorado and is a caretaker for his disabled cowboy father, in a near future where VR is ubiquitous," Needell explains. "I didn't want to redo

Ready Player One; I wanted something grounded and human with the visual style of director Terrence Malick.”

The overall concept called for shooting some scenes in locations in Colorado and others in a virtual world via motion capture. Needell collaborated with Eric Day, an executive producer at Los Angeles motion capture studio Ryot.

“Emma’s Fellowship training helped because she could essentially previs her entire short with Unreal Engine,”

Day says. “Maybe it’s not always the final camera placement, but it was enough to get into budgeting and scheduling well before getting into the heavier and more expensive work.”

CounterPunch Studio in Los Angeles created custom avatars and specialized animation for the project. The virtual scenes were captured in two phases, the first being a motion capture pass for the actors’ bodies and facial performances using Ryot’s Vicon motion capture volume. The crew captured facial performances with Cubic Motion’s facial capture technology combined with iPhone-based, head-mounted camera rigs provided by Standard Deviation. Once the performances were captured, a second phase began with a pass for virtual camera operation.

To carry the aesthetics of the live-action part of the shoot over to the virtual world, Needell insisted on having her cinematographer Anton Fresco operate a tracked virtual camera in Ryot’s motion capture volume. “All the handheld movement you see in the virtual scenes has a real human feel,”

says Needell. “It’s a massive part of the tone and theme for the entire project.

“I also wanted to recreate the look of the anamorphic lenses we were using in the live-action shoot,” Needell continues. “Miles Perkins and Karen Dufilho at Epic Games connected us with Jason Chen at BRON Digital, who was digitally mapping Panavision anamorphic lenses for use in Unreal. So, we could recreate a similar look between the physical and virtual cinematography.”

For the virtual camera capture sessions, the Ryot team was able to use the recently released **MetaHuman Creator** to create virtual stand-ins. “It was cool because our final avatar rigs weren’t ready on the virtual camera capture day,” reveals



Image courtesy of Emily Needell/Evil Monster Dog, Inc



Image courtesy of Emily Needell/Evil Monster Dog, Inc

Day. “So, we spent an extra thirty minutes before shooting, making MetaHumans that looked similar enough to the original actors. Having that tool integrated into the Unreal ecosystem was a total lifesaver.”

With the production phase completed, Needell oversaw post-production virtually via many Zoom review calls. “CounterPunch Studios did entire scenes within Unreal,” she explains. “What we got out was the whole scene with all the cuts, so it wasn’t shot-by-shot editing in traditional editing software. That approach makes it more challenging to tweak individual shots, but if you’re going to have a lot of continuity or visual effects like wind or snow, it’s a lot easier just to load the whole scene and play it all the way through.”

As *Life Rendered* was set to premiere at Tribeca, Needell took stock of her experiences with virtual production. “Filmmaking is always creative, but that creativity often comes out of production being very unpredictable,” she observes.

“That said, what I love about working with Unreal Engine is that you can come up with whatever scene you want without worrying about any logistical nightmare or whether something is dangerous—because no one’s safety is ever worth risking over a movie.”

Beyond the convenience and freedom of virtual production, Needell also appreciates its sustainability. “Filmmaking at a professional level requires a lot of people and equipment, and it can be very ecologically damaging to do on location,” she says. “We’re in the middle of a climate emergency,



Image courtesy of Emily Needell/Evil Monster Dog, Inc

and the kind of filmmaking I want to do in remote environments could be harmful.”

Needell hopes to make additional projects using virtual production in more elaborate ways. “Tools like Unreal Engine and the Quixel library enable you to get amazing visuals quickly and ethically while factoring in a more sustainable ecological footprint,” adds Needell. “I was also very humbled by all the help I received from Epic Games as a first-time director. Hollywood is a world of barriers and hurdles, and everyone I worked with at Epic has been highly supportive, which is really unique and special.”

Additional links

- ▶ [Tribeca Panel](#)
- ▶ [Colorado story on the project](#)
- ▶ [Tribeca Screening Page](#)
- ▶ [Film Academy in Germany Reports on Virtual Production and Sustainability](#)

BEYOND THE CONVENIENCE AND FREEDOM OF VIRTUAL PRODUCTION, NEEDELL ALSO APPRECIATES ITS SUSTAINABILITY

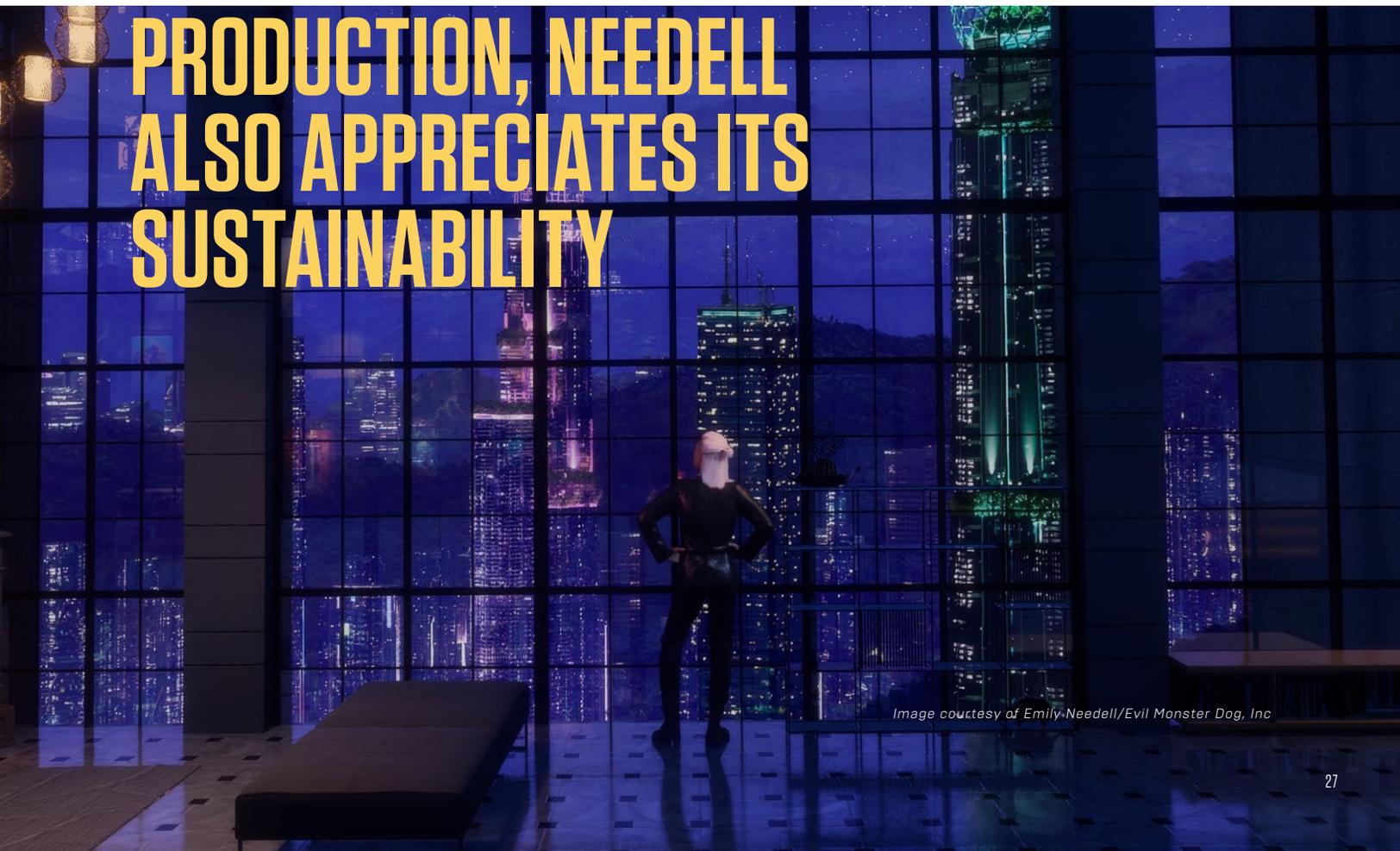


Image courtesy of Emily-Needell/Evil Monster Dog, Inc

START

THE FAMOUS GROUP ENGAGES FOOTBALL FANS WITH XR

Virtual fan experience studio **The Famous Group** created a real-time animated panther mascot in Unreal Engine for the NFL's Carolina Panthers. The mascot made its feisty mixed-reality live debut during Carolina's opening home game versus the New York Jets in September 2021. Visible within the Bank of America Stadium in Charlotte, North Carolina, on giant LED screens as captured by the stadium's camera crew, the larger-than-life panther stormed the field and jumped all around the stadium to thrill the audience.



Image courtesy of The Famous Group - Production Co.

According to The Famous Group's partner/ Chief Innovation Officer Greg Harvey, "Real-time game engine technology has opened up a whole new world for sports. The transition between two-dimensional screens and mixing content into a physical environment feels like the future. Only a small portion of fans ever make it into the physical stadium, so there's an enormous opportunity to expand the property's fan base and immerse fans worldwide."

Zoic Studios in Los Angeles built, rigged, animated, and prevised the model for

Unreal Engine. "We relied on Maya and ZBrush, and leveraged the sculpting and micro details by extracting normal maps to be used in engine," says Julien Brami, Creative Director/VFX Supervisor at Zoic. "We made shaders and textures in Substance Painter, and baked them at 4K for Unreal Engine. Unreal impressively handled the level of detail. We were able to keep most of the high-resolution topology, relying on normal maps only for the finer details."

With the model completed, the Famous Group collaborated closely with the Carolina Panthers' Game Entertainment team, led by Mike Bonner, to deliver the animated panther. "The Famous Group provides the virtual production hardware, servers, and camera tracking," Harvey explains. "We calibrate everything, and train the onsite camera crew."

Rather than using a separate crew to capture the mixed reality segments with the panther animation, the same equipment and team that films the rest of the game also films the mixed reality sequences. "It's like a live performance, and the camera operators are there to tell the story," Harvey says. "We start with a LiDAR scan of the entire stadium and start looking at everything through the cameras so we can start blocking things out. Through previs, we can show the camera operators where the panther will move. They can also see the live animation through their viewfinders via a return feed. We like to start rehearsing with them four or five days prior to game day."

The resulting footage feels more realistic to the stadium crowd because it looks highly spontaneous. "What really sells it is the natural handheld motion of the real camera crew," observes Harvey.

"Those little snap zooms, focus pulls, getting a little behind or ahead of the action and catching up, instead of a motion control camera, which would look perfect but less natural."

**IT'S LIKE A LIVE
PERFORMANCE,
AND THE CAMERA
OPERATORS ARE
THERE TO TELL
THE STORY**



Image courtesy of The Famous Group - Production Co.



Image courtesy of The Famous Group - Production Co.

As a longtime provider of traditional and real-time visual effects and related services to various feature, episodic, and commercial clients, Zoic sees plenty of opportunities to leverage real-time technology in new ways on other projects. “We’re finding more uses for Unreal Engine, from previs to advanced final pixel renders, volume contents, and even more applications in the future,” says Brami. “Our pipeline team is always developing new tools to help the communication between departments and modify our existing tools to support Zoic’s Real-Time Group’s needs. We’re also setting up secure ways to work in synchronized projects directly with our clients to streamline the overall collaboration process.”

Harvey sees additional potential in real-time content compared to canned fare. “Linear production has its place, but in the space we work in, dynamic content makes much



Image courtesy of The Famous Group - Production Co.

more sense,” he says. “Content that can react and change over time has more use for sports. It can go into an AR experience, a VR headset, a web browser, or cut up for social. It’s like having a live piece of film you can endlessly manipulate. Game engine with mixed reality is a new marketing medium for teams and stadiums that replaces static signage. There are so many synergies in being able to distribute real-time content. It’s like a technological renaissance.”

Additional links

- ▶ [Video of the panther’s debut](#)
- ▶ [The Famous Group](#)
- ▶ [Zoic Studios](#)

UPDATES FROM THE LAB

TEST DRIVING UNREAL ENGINE 5

Unreal Engine 5, released in April 2022, revolutionizes content development by making it possible to import feature quality art into the engine, giving creatives the opportunity to build big for Film and Animation. Interactive lighting tools change the way sets, characters, and props are lit in real-time. The integration of MetaHumans has launched the whole process into the next generation of production. Epic's development teams continue to stress-test the engine using the LA Lab's LED volume in El Segundo, CA, gearing up for the next version, 5.1.

Hands-on testing provides a continuous feedback loop with Epic's developers working on-site and remotely to improve engine functionality and guide our

clients on the front lines of production. The Lab's role as a testing facility is to help provide the best possible context for troubleshooting various production scenarios and development of real-world solutions for virtual production.

Our partners have also helped lead the charge by meeting the risks and challenges to implement these new features as part of the in-camera visual effects (ICVFX) pipeline for several ambitious productions. Partner feedback helps Epic's developers and artists fix bugs and improve the tools which have become fully realized and deployed as part of the new Unreal Engine 5 release.



Image courtesy of Sky Ferren/Jet Olaño

ICVFX FELLOWSHIP

The **In-Camera Visual Effects (ICVFX) Fellowship** is a hybrid program focused on workflows specific to ICVFX production. The program offers foundational knowledge on LED wall setups, In-Camera VFX workflows, and best practices. Additionally, the curriculum includes hardware and signal flow, NDisplay configuration, camera lens, node, and wall calibration, optimization of content, tools, and blueprints, and most importantly, stage operations.

The Education and Training teams presented the first ICVFX Fellowship in a three-week session from April 18 to May 6, 2022. The initial two-week portion was offered via Zoom. A one-week hands-on session followed at the LA Innovation Lab in El Segundo and the Lab’s Technical Training Stage in Culver City. Unreal Engine will become a universal platform for all virtual production processes in the future.

3LATERAL - METAHUMAN

The **Los Angeles 3Lateral Metahuman Scanning Facility** is in the final stages of design and installation for their new facial and body scanning hardware, at LA Lab. The scanning studio is the first of its kind in North America. **Quixel** makes it possible to download 50 ready-made images into Unreal Engine to try with MetaHumans.

A recent update enables a **mesh to metahuman to Unreal Engine workflow** with support for new character rigging, animation, and physics features in Unreal Engine 5. Any custom mesh can be imported and converted into a MetaHuman. You can further refine your character in MetaHuman Creator with full rigging. This update is the first major feature of the new MetaHuman plugin for Unreal Engine.

► **Metahuman Creator**





VIRTUAL PRODUCTION LANDSCAPE FILM AND TELEVISION

Image courtesy of Stargate Studios

HOUSE OF THE DRAGON

This prequel to the HBO fantasy series *Game Of Thrones* is the first major production to use Warner Brothers' virtual production stage at Leavesden, England. *House of the Dragon* takes place 200 years before *Game Of Thrones*. The series, which completed filming in January 2022, tells the story of House Targaryen at the height of its power.

LA-based Epic team members, together with the London Lab team, provided support and testing for *House of the Dragon*. The Epic team combined efforts with systems integrator

Lux Machina to provide the resources and expertise necessary for the WB team's first production to get off the ground.

The Leavesden WB stage is the largest virtual production LED facility in the UK and the upcoming live-action feature *Barbie* began filming there in early 2022.

House of the Dragon premiered on HBO in August 2022.

STATION 19

The ABC series *Station 19*, an action-drama show about first responders, utilized in-camera visual effects for driving scenes in episodes from the fifth season using a unique combination of high resolution 1.2mm LED walls, 4K OLED screens, and laser projection developed at **Stargate Studios** in Los Angeles. The main screens for the project were approximately sixteen feet wide and modular, allowing them to cover any vehicle from any angle.

“This is a sign of a successful technology integration,” reflects Sam Nicholson, ASC, Stargate’s founder. “When you say don’t change how you’re shooting; we will fit your business model, your schedule, your setups, your lenses— because we want to give you more options.”

Stargate’s ThruView real-time compositing system transforms 2D footage captured as background driving plates into 3D scenes in Unreal Engine. To facilitate interaction with the onstage camera,



Image courtesy of Stargate Studios

internal tracking was accomplished with Mo-Sys, and external tracking used OptiTrack. Remapping 2D imagery into a 3D environment provided the camera a 2.5D illusion of depth. Nicholson also created immersive, kinetic lighting synchronized to the ThruView process via DMX.



Image courtesy of Stargate Studios

REAL-TIME ANIMATION

Fables | Image courtesy of BRON Digital

FABLES

Vancouver-based animation studio **Bron Digital** is releasing its next animated project, *Fables*. The series consists of eight episodes that take place in completely different worlds with no sets or characters re-used from one episode to the next. By using Unreal Engine as the hub, all the team members could work in real-time from across the globe.

Using Unreal Engine for animation development allowed the team to quickly iterate on ideas, which led to new levels of creativity. The animation team spans Los Angeles, New York, Miami, Mexico City, New Zealand, and Australia, all via remote collaboration tools.

“We use mocap as the basis for everything,” explains Jason Chen, Executive Vice President of Digital at Bron.

“We’re taking my background from working on Avatar and making many ‘mini-Avatar’ production pipelines. We’re also working with a lot of live-action veterans. For example, Ben Davis (Captain Marvel, The King’s Man) is our cinematographer. He works in a live DI session over Zoom or Streambox and talks to our virtual camera operators and virtual lighters. Our strength is bringing fundamental filmmaking techniques into the animation space.”

Bron Digital continues to build its pipeline toward the prospect of a complete, end-to-end workflow. With the content already built in Unreal, transitioning to games and other mediums will be a much easier task compared to a traditional animation pipeline. The potential for future games, merchandise, and other auxiliaries provide endless future opportunities.

WILDWOOD

Hillsboro, Oregon- based LAIKA is in production on *Wildwood*, based on a series of novels written by Colin Meloy, the lead singer of indie band *The Decemberists*, with illustrations by Carson Ellis. The hybrid stop-motion/CG animated film adaptation is directed by LAIKA President & CEO Travis Knight (*Kubo and the Two Strings*) with Caleb Deschanel, ASC (*The Lion King*), as cinematographer. Producers are Mr. Knight and LAIKA's Head of Production Arianne Sutner (*Kubo, Missing Link*); the screenplay is written by Chris Butler (*ParaNorman, Missing Link*).

About *Wildwood*: Beyond Portland, Oregon's city limits lies Wildwood. You're not supposed to go there. You're not even supposed to know it exists. But Prue McKeel is about to enter this enchanted wonderland. Her baby brother Mac has been taken by a murder of crows into the forest's depths, and she – along with her hapless classmate Curtis – is going to get him back. Prue might think she's too old for fairytales, but she's just found herself at the center of one. One filled with strange talking animals, roguish bandits, and powerful figures with the darkest intentions. *Wildwood*

is a tale of love, loss, sacrifice and secrets, and of the magic you can find on your doorstep, if you're willing to look for it.

LAIKA's film legacy is impressive, with Oscar® nominations for each of its films. Previous titles include *Missing Link* (2019); *Kubo and the Two Strings* (2016); *The Boxtrolls* (2014); *ParaNorman* (2012), and *Coraline* (2009). *Kubo and the Two Strings* won the BAFTA® Award and *Missing Link* was awarded the Golden Globe. LAIKA's team recently enrolled in Epic's ICFVFX training to refine their knowledge of Unreal Engine 5 and virtual production workflows.



Image courtesy of LAIKA

YUKI 7

Kevin Dart, award-winning CEO and creative director of Los Angeles-based studio **Chromosphere**, created *Yuki 7*. Dart started with a traditional 2D/3D pipeline, then switched mid-series to Unreal Engine to reap the benefits of real-time while staying true to a signature 2D style. In the most recent iteration of *Yuki*, he created all the techniques in After Effects for processing the 3D lighting and applying different patterns such as halftones and raster lines to achieve a modernized, hybrid 1970s look.

The production team set out to make **episode three of *Yuki 7*** entirely in Unreal Engine. Migrating to a real-time pipeline meant each team member could see the entire episode sooner in the layout stage. They could then create and explore different options as they developed each shot.

In Unreal Engine, the episode was always available for everyone to watch in Sequencer. This allowed the artists to always understand the episode's context as a whole. *Yuki 7* was also nominated for Best Character Design and Best Production Design for the TV/Media Awards.

- ▶ Case Study
- ▶ Spotlight

**A REAL-TIME
PIPELINE MEANT
EACH TEAM
MEMBER COULD
SEE THE ENTIRE
EPISODE SOONER
IN THE LAYOUT
STAGE**

THE EYE: CALANTHEK

Located in Los Angeles, ASC (**Aaron Sims Creative**) is an award-winning Concept Design & Visual Effects Studio for Film. Lately they have been immersed in real-time filmmaking and the Unreal Engine. The alien planet story, *The Eye: CalantheK*, was recently released by ASC after only 6 weeks in development, using Unreal Engine 5 (early access) and MetaHumans.

Aaron was able to expedite the process by iterating the look and the narrative simultaneously so he could write in Unreal and save time. He accomplished previs without animators—the motion capture was done in his living room using an Xsens suit, drastically reducing the time typically required for processing and fixes.

Aaron's ideas were realized on the screen almost instantly using the powerful tools of Unreal Engine 5 to capture the realism, by using the highest resolution possible together with real-time global illumination. Shapeshifters VFX and Cubic Motion provided final facial animation to the performance capture.

The final product is an amazing success and a tribute to the power of Unreal Engine 5 to push the boundaries of what can be accomplished by essentially using the engine as a sound stage for production.

► ASC's *THE EYE: CALANTHEK*: Real-Time Filmmaking in UE5 Early Access



Image courtesy of Aaron Sims Creative



SCHOOLS AND TRAINING CENTERS

VIRTUAL PRODUCTION ACADEMY

Pixomondo's Virtual Production Academy, VPA, offers a high-end training program specializing in virtual production, real-time content creation, A.I., and machine learning. The goal is to educate artists, producers, and filmmakers. As an industry leader in virtual production, VPA's mission is to train the new generation of content creators to meet the rapidly growing demands of virtual production. The program will be available to the public in 2023.

VPA students gain access to state-of-the-art PXO facilities around the globe and learn from veteran instructors with real production experiences. Using practical examples from working productions, VPA gives students incredible opportunities to learn real production techniques. These skills range from bidding and

scheduling to creating, producing, and operating the LED Volume.

This program will include a 12-week series designed and tailored for educational institutions, colleges, and universities across the globe as an extension to their existing film, animation, gaming, and media programs. VPA also will offer specialized multi-day boot camps designed and curated for experienced artists, supervisors, directors, cinematographers, and producers.

Finally, VPA will offer a growing on-demand learning library for remote instruction. This library includes online workshops, tutorials, and master classes for beginners and industry professionals. For more information, please visit: <https://www.virtualproductionacademy.com>



Image courtesy of Professor Dane Smith/Gnomon

SAVANNAH COLLEGE OF ART AND DESIGN

The **Savannah College of Art and Design** (SCAD) in Georgia is a longtime proponent of Unreal Engine. The school's Interactive Design and Game Development department has been using Unreal Engine for over fifteen years. As part of a massive, multi-year expansion, SCAD is increasing its campus by 10.9 acres with new studios and an LED volume. With plans to open later in 2022, the stage features a 1.5mm pixel pitch and measures approximately 40' x 20' x 17'.



Image courtesy of Gnomon



Image courtesy of Gnomon

GNOMON SCHOOL OF VFX

Gnomon School of VFX is a highly regarded Los Angeles-based VFX school where students develop creative concepts into fully realized production assets via professional film and television workflows. Job placement is a crucial goal. Gnomon's curriculum includes in-person training with working industry professionals who share their knowledge of today's production pipeline demands. Unreal Engine has evolved as a critical component of Gnomon's virtual production curriculum.

Gnomon is a vital partner in Epic's quest to develop a community of support for the next level of real-time production.

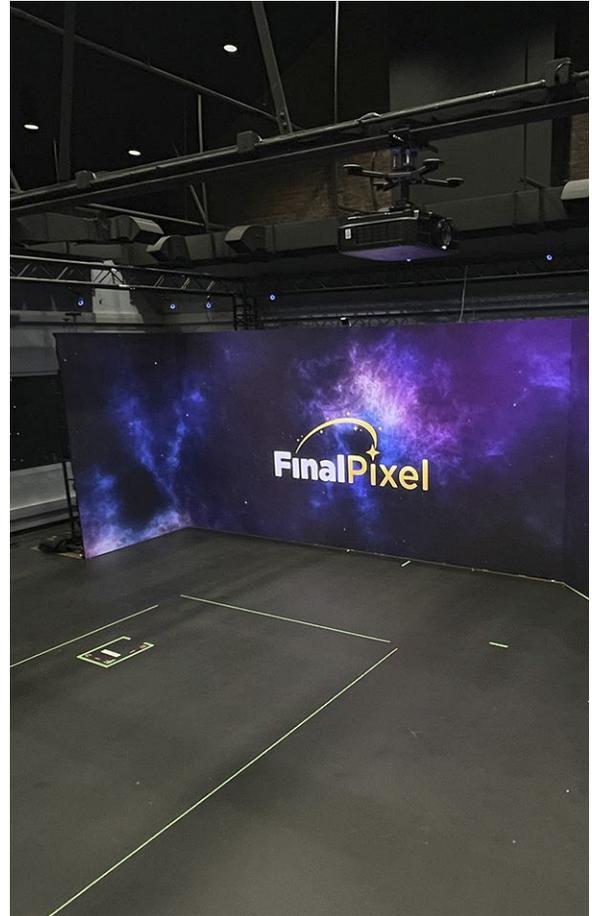


Image courtesy of Final Pixel New York Virtual Production Stage

FINAL PIXEL ACADEMY

The Los Angeles-based **Final Pixel Academy**, the training arm of Final Pixel, is helping level up the next generation of virtual production artists, technicians, producers, and directors. FPA collaborates with major virtual production vendors using the latest software and techniques. Their courses include production and content development training to improve the skills of a workforce and meet future challenges.



Image courtesy of Fathead, ETC R&D

FATHEAD

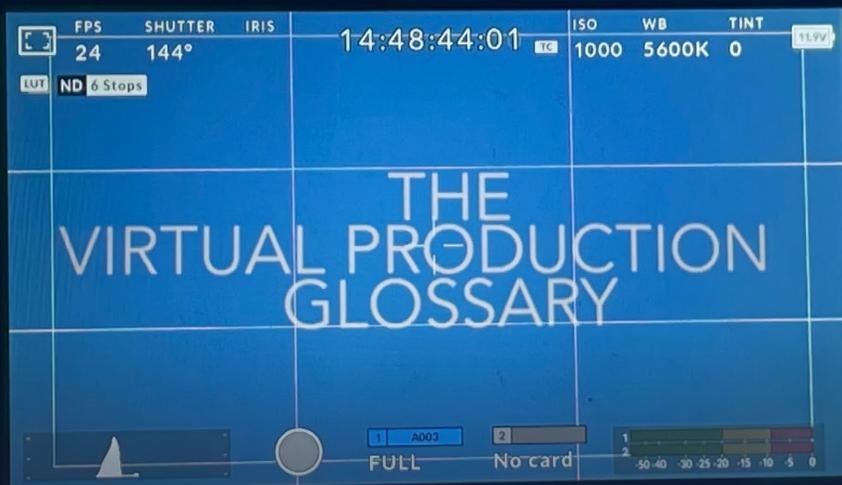
The **Entertainment Technology Center (ETC)** at the University of Southern California in Los Angeles produced Fathead, a story centered on bravery and freedom. This short film is about a young girl who must defy a menacing army of warrior children to save her brother.

According to Erik Weaver, Head of Virtual and Adaptive Production at ETC, “the team used Unreal Engine to create a virtual world full of trash, old boxcars, mountains of used tires, discarded clothing, and airplane skeletons. Over 70 custom photogrammetry assets were created from over 39,000 photographs of junkyards around the globe.”

“Some of the scenes are populated with MetaHuman characters,” Weaver adds. “The project’s team is a blend of global talent with support from award-winning talent such as Scott Squire, Rainer Gumbos, Tom Thudiyapackal, and Ben Baker. Other organizations helped with the build including **RIT**, **UME**, The Third Floor, and Happy Mushroom.”



Image courtesy of Fathead, ETC R&D



NEW RESOURCES

Image courtesy of Noah Kadner

VPGLOSSARY.COM

The [Virtual Production Glossary](#) is a collaboration between the [Visual Effects Society](#) (VES), the [American Society of Cinematographers](#) (ASC), and professionals from the production community, with support from Epic Games and Netflix.

The Glossary represents an effort to establish a shared vocabulary among professionals working in this evolving production area. Submissions for new terms and updates to existing terms are highly encouraged.

VIRTUAL PRODUCTION MARKET REPORT

The global virtual production market was USD 1.41 billion in 2020 and is expected to expand at a compound annual growth rate (CAGR) of 16.7% from 2021 to 2028.

Virtual production services are emerging as the fastest-growing segment over the forecast, owing to shortages of trained visual effects (VFX) and virtual production technology specialists. Filmmakers and studios typically hire professional service agencies to implement VFX in video and film productions. Moreover, virtual production services are needed during pre-production, production, and post-production across all types of content creation.

As the industry continues to grow, many LED stages are being built worldwide in places such as London, Vancouver, Los Angeles, and Australia. This infrastructure is vital to facilitating international growth.

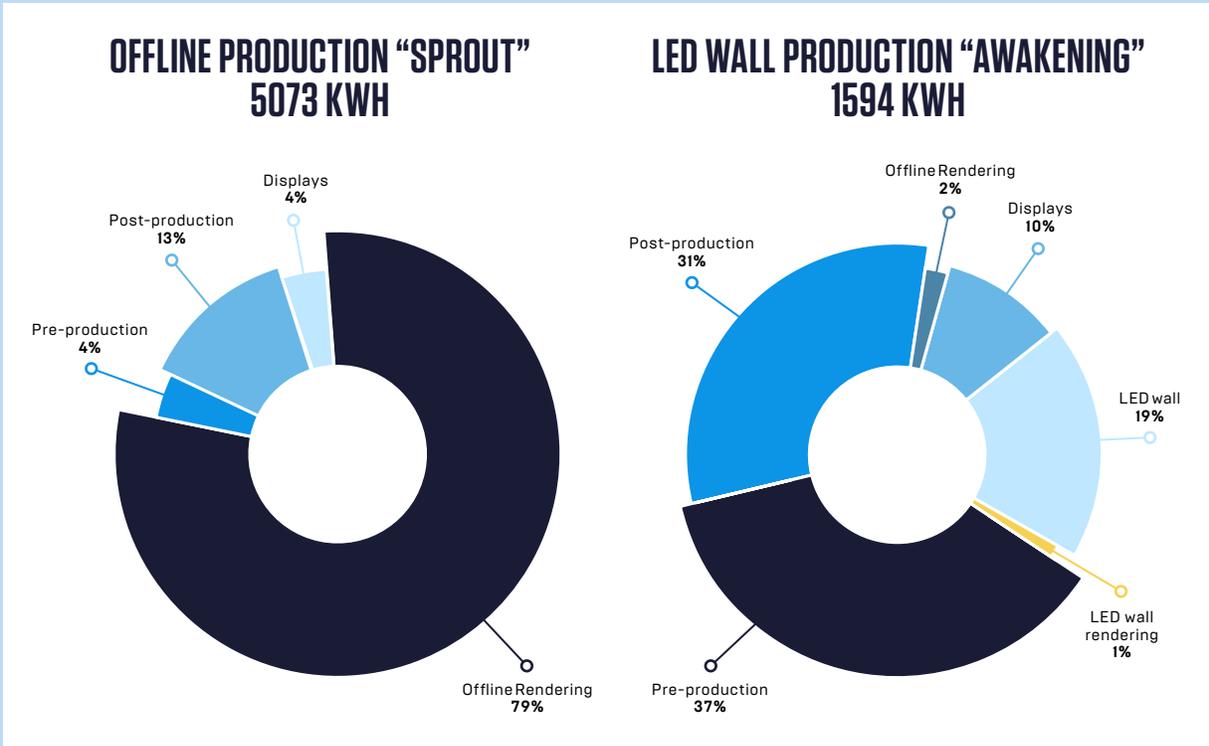


Figure 1. Offline and LED wall productions' total power consumption

FILM ACADEMY IN GERMANY REPORTS ON VIRTUAL PRODUCTION AND SUSTAINABILITY

Film Academy Baden-Württemberg in Germany published a study on the environmental aspects of virtual production and concluded it can be substantially more green and sustainable for the environment than traditional production. The study compared a virtual production captured primarily in an LED volume with a more traditional, post-rendered show. The virtual production consumed approximately one-third of the energy needed for the comparable offline rendered production.

Additional links

- ▶ [The Virtual Production Field Guide Volume 1 and Volume 2](#)
- ▶ [The Animation Field Guide](#)
- ▶ [Broadcast & Live Events Field Guide](#)
- ▶ [The Unreal Fellowship](#)
- ▶ [The Virtual Production Podcast](#)
- ▶ [Epic Games MegaGrants](#)
- ▶ [Unreal Engine Dev Community Learning Library](#)
- ▶ [White Papers](#)
- ▶ [Spotlight on five major ICVFX stages](#)
- ▶ [Educational Initiatives](#)

LA LAB

