



# Welcome to the New Era of Film

Five ways virtual production is  
revolutionising filmmaking

Discover the power of disguise: [www.disguise.one](http://www.disguise.one)

Image credit:  
Final Pixel, Creative Technology

## What you'll learn

This e-book explores the tremendous growth of virtual production and discusses how it unlocks complete control in filmmaking when powered by the disguise workflow. Here is what you'll discover:

- Why virtual production is redefining filmmaking
- The rise of virtual production
- The technology that makes virtual production possible
- Five ways virtual production will revolutionise film
- The disguise solution for virtual production
- Case study: Greater collaboration and faster results for Framestore
- Ten key takeaways
- Next steps



# Virtual production is redefining filmmaking

Due to a demand for incredibly high-quality film and TV production, at a fraction of the time and cost, filmmaking timelines need to be reviewed, bringing creative decisions much earlier into the production process.

Virtual production enables filmmakers to render photorealistic computer-generated scenes on an LED background and interactively visualise them in real-time. Together with high-power graphics cards, camera tracking, as well as augmented and mixed reality, these technologies marry the virtual and physical world, where what you see in camera is what you get.

Here at disguise, we envisioned a solution where all these technologies integrate into one core workflow, breaking down barriers between creative and technical implementation.

This enables production teams to bring the creative magic of working together into the virtual world, just as they would with physical sets.

We are seeing a new industry shift towards more agile and collaborative ways of working, enabled by virtual production. This is already creating new roles and skills on the market and a huge opportunity that filmmakers should be jumping at because it stands to be the future of film.

## **Addy Ghani**

VP of Virtual Production, disguise



# The rise of virtual production - an industry overview

Virtual production has been a developing trend for years now, with blockbusters like Avatar and The Lord of the Rings trilogy early innovators in the field. Using state-of-the-art technology as specially-adapted sets that enable real-time visuals to be shown live for actors and crew to respond to, virtual production opens up a world of opportunities that will only grow as time passes.

**The global virtual production market size was valued at \$1.41 billion in 2020 and is projected to register a compound annual growth rate of 16.7% from 2021 to 2028.**

Source: Grand View Research, 2021



Image credit: Streamliner



Image credit: XR Stage

The past year saw a wealth of high-profile releases that used virtual production techniques. Netflix's The Midnight Sky, starring George Clooney, was able to realise a post-apocalyptic world in the studio and the second series of Disney's The Mandalorian continued the show's groundbreaking use of the technology, with principal photography completed entirely within a virtual production-optimised set.

The coming year promises some of the biggest titles yet to utilise the technology, with TV series like Westworld embracing its possibilities. Superhero films The Batman and Thor: Love and Thunder are both making the most of the potential it affords. Taika Waititi, who will be directing his second Thor film, first discovered the technology when he directed The Mandalorian season one finale in 2019. It's clear virtual production is fast becoming the first port of call for big ideas and out-of-this-world visuals.

# Moving from post-production to real-time production

Traditionally, film production occurs in discrete, consecutive phases: scenes are story-boarded, actors are filmed either on set, on-location or in front of a green screen, and after the filming is complete, post-production begins where VFX and graphics are added to the mix.

Virtual production, on the other hand, is pervasive in the process: from pre-production to post, and fully integrated into the filming process.

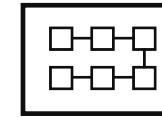
At its most basic level, virtual production is what happens when a combination of technologies lets filmmakers replace their green or blue screens with walls made up of LED panels. With the help of a graphics engine, these LED walls display real-time environments and visual effects. By seeing their scenes play out in real-time, directors and DPs can make better creative decisions while filming and apply edits to their content in the moment.

With virtual production, there's no linear succession of defined production phases anymore. Everything flows together in parallel - scenes are rendered in real-time, reflections are captured in real-time, actors are able to interact with their environments more naturally, meanwhile the entire crew enjoys a more efficient, flexible and collaborative filming experience.

## Pre-Production

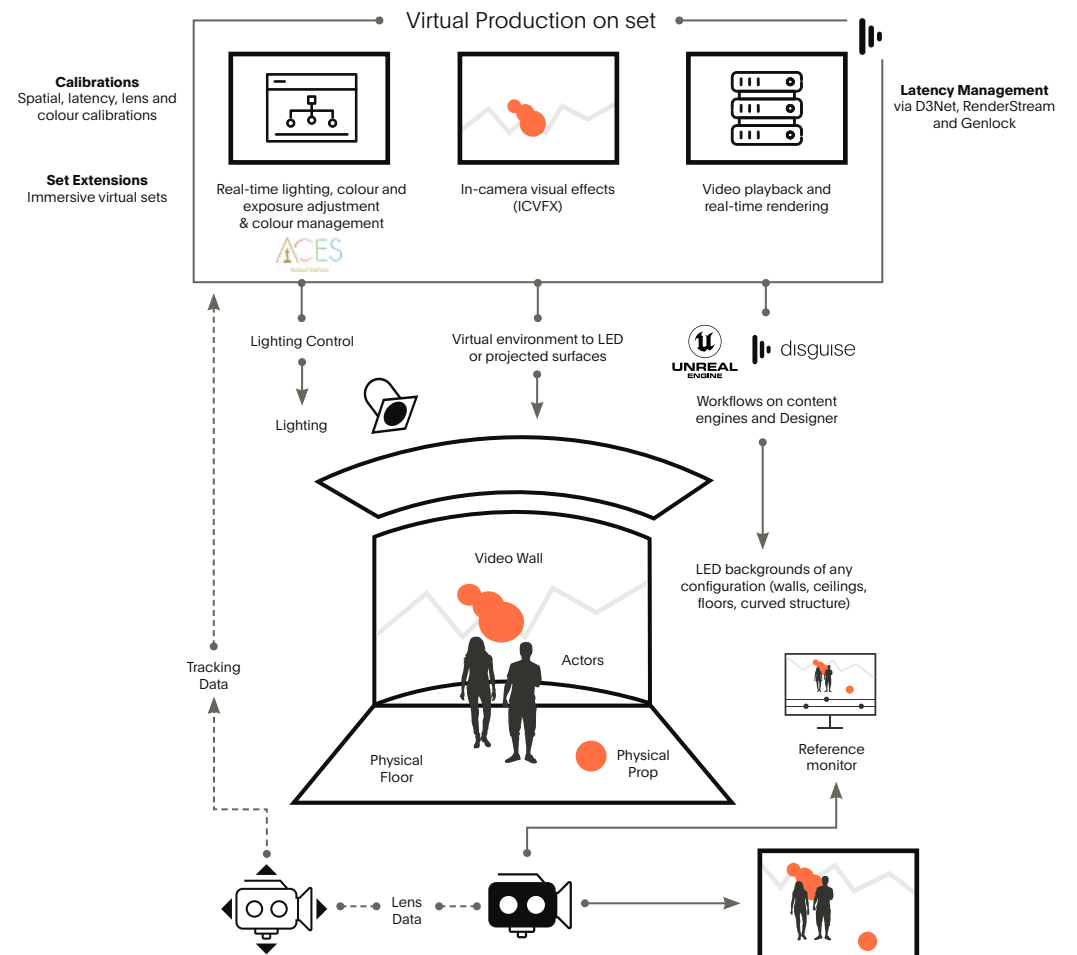


**VFX & Computer Graphics**  
Colour consistency across all departments



**Previs & Shot Planning**  
Previsualise real-time content in disguise and validate ideas

## The disguise Production Workflow



# The technology that makes it all possible

## Virtual production set components:

### LED panels

These surfaces can be as bright as 1000 nits and can cover a wide colour gamut, like Rec.2020 and P3. They also have a high contrast ratio to reproduce deeper blacks and bright highlights, giving you a wider canvas for creative expression. In the early days of LED virtual production, many stage layouts looked like an open-faced cube with an LED floor and walls. Modern LED stages—or volumes—now typically have a Mandalorian-style curved screen and can come in huge sizes. With industry-leading LED manufacturers such as ROE Visual, and LED processing features from the likes of Brompton Technology, this technology is ideal for creating lifelike 3D sets.

### Tracked cameras

Each camera will have a tracking device on top of it such as Ncam, stYpe RedSpy, or Mo-Sys StarTracker. Camera tracking technology means that virtual scenes rendered on the LED panels will change based on camera movements - making the environment fully immersive for actors on set and also compensating for the parallax to simulate the real world.

### Generative or real-time content

Game engines like Unreal Engine can generate high-quality, photorealistic real-time content that will then feed into the LED screens. This content can be rendered either in the back or front plate in Augmented Reality(AR).

### Content mapping software and hardware

These will help to render the visuals out of the game engine and accurately map them onto the stage with minimum latency. The disguise Extended Reality (xR) workflow orchestrates LED, real-time content and camera tracking to power virtual production environments, ensuring the LED visuals always adapt to where the camera is in three-dimensional space. Content can also be fed through an ACES pipeline to make sure that the creative intent is not lost during file exchange.

→ **Learn more about the disguise xR workflow**

disguise's proprietary hardware, including the vx compositing servers and rx render nodes have been engineered to support a 10-bit HDR workflow.

→ **Discover the disguise hardware range**

# Five ways virtual production will revolutionise film

Think of real-time content rendering as a video assist to your filming - you see the LED background, the actors and props all in-camera - and get a realistic idea of what the shot would look like.

Here are five ways in which LED virtual production will enhance the filmmaking experience for you and your crew:

## 1. Enjoy complete creative freedom and control for better storytelling

Storytellers gain more than control with virtual production: they reclaim instinct. Because DPs and directors can watch a scene play out in real-time on the LED screen, which immerses all actors and props on set, they can evaluate shots on the fly and make quick creative decisions on what a scene or sequence needs. They can inhabit a digital world in the moment and apply intuitive creativity so their stories can better reflect their narrative vision. Iterations in pre-production design and visualising assets in real-time provide more creative clarity upfront, reducing the need for expensive iteration in post-production. More cohesive stories mean landing more work when your next pitch rolls around.

Working with virtual scenes also allows teams to control the environment they are shooting. A perfect sunset can last a whole day, for as many reshoots as deemed necessary, and weather conditions can change at the touch of a button.



Image credit:  
Studio Lab

## 2. Immerse actors in your scene to encourage a more natural performance

When actors perform against an LED screen that's displaying an entire virtual world, they are able to respond to their surroundings as though they are real, because they are, in fact, immersed in that reality. There are other advantages to this: natural sightlines to objects, scenery and events within the set, and the ability for performers to react instinctively rather than by what they've been told will be happening on the set. This brings about more convincing performances.

## 3. Collaborate more closely for better outcomes

Previsualisation is a necessary part of the pitch process for your workflow and VFX team, allowing them to see their concept for a scene perfectly played out in a 3D simulated set.

This wholly immersive production process enables directors, DPs, and other decision makers to explore creative options more easily on set, with more control and faster calibration workflows. Creative decisions made on set are informed and can be made fast, collaboration is improved which increases the creative quality of the final product and reduces the need for costly retakes later on.



Image credit:  
MGX Film



#### 4. Capture realistic reflections and achieve natural scene lighting

If you want to capture real-time reflections in your LED volume, you don't have to place out your camera based on the dimensions of your volume. You can augment part of the background, or even a foreground object, opening up how the real-world camera can be placed out on set. You can reap the benefits of having that LED volume, while generating some real-world reflections and natural skintones which are then captured in-camera.


#### 5. A future-proof solution for the industry... and the planet

The benefit of virtual production workflows is that they completely reduce the need to travel for location scouting, while also limiting how many people are required on set.

When the COVID-19 pandemic halted much of the TV and film production across the globe in 2020/2021, it was virtual production that offered crews the quickest and easiest path back to set. The main reason behind this was the ability to confine recording to a single, easily manageable set. Shoots that might otherwise have required several different locations, and the transport to and from those locations for cast and crew alike, were instead able to achieve everything they wanted with minimal fuss. Limiting the travel of the production crew also limits the exposure risk for everyone involved.



Image credit:  
80Six



"The elegant end-to-end solution disguise provide – from system deployment through to programming and operation, ensures 100% of efforts can go towards shooting the best-looking content as efficiently as possible."

**Gary Marshall**

Director of Virtual Production at Nant Studios

Image credit:  
Nant Studios

# Five reasons why you should choose disguise for your next project

## 1. A trusted partner of Epic Games and Unreal Engine

In 2020 Epic Games awarded disguise a MegaGrant to revolutionise production workflows and enhance the interoperability between disguise and Epic's Unreal Engine.

This partnership with Epic allowed disguise to embark on groundbreaking new research to **dramatically empower how real-time video content is delivered** across various applications.

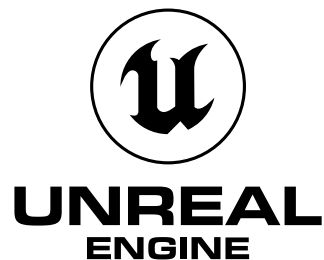
Working closely with Epic has enabled disguise to develop its Extended Reality (xR) workflow, including cutting-edge software features such as cluster rendering and support for the ACES colour management pipeline, already impacting virtual production.

disguise also developed its free, open-sourced RenderStream plug-in, allowing users to **quickly and seamlessly integrate Unreal Engine's latest releases** into their workflow, to make real-time content changes directly from disguise's software interface.



// Unreal Engine equips storytellers with more creative control than ever before, and the fully integrated and complementary disguise solution is ready to help filmmakers take their productions to the next level."

Marc Petit, VP and General Manager, Unreal Engine, Epic Games



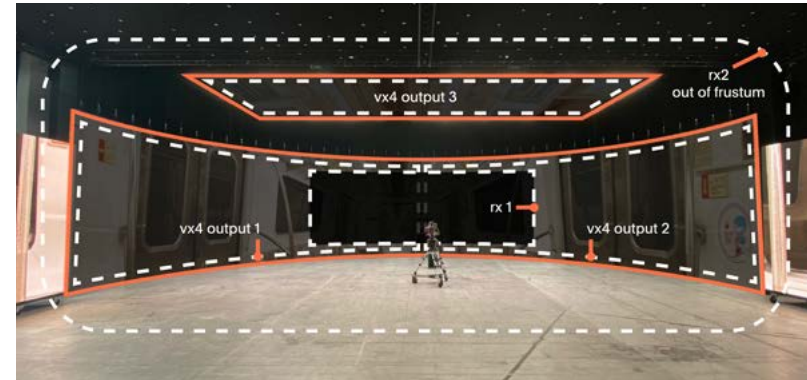
## 2. Cluster rendering unlocks high-quality real-time scenes at scale

Producers are always looking for ways to deliver scenes of the highest quality, detail and frame rate but this is often constrained by the finite GPU power of their real-time rendering system.

**disguise unlocks the limitations of your virtual production studio by scaling out real-time content up to an unlimited capacity**, with the help of its cluster rendering feature. It allows you to render vast, photorealistic scenes on your LED surface, by spreading the load of your content across multiple render output nodes, as each node will render a fragment of your final output to increase the render power.

disguise cluster rendering is an integration solution for Unreal Engine's nDisplay, opening up **new opportunities for scaling out uncompressed content**. You can simplify the configuration of render clusters and separate them out from the final pixel delivery machines. By separating those two, you are able to scale them independently so you can add more disguise rx render nodes for more render power or add more disguise vx output nodes if you have a bigger canvas.

→ **Learn more in our cluster rendering e-book**



// Cluster rendering is the beginning of the evolution of the work we have done so far. This is the perfect solution for cinema and big productions where big scale LED is standard. An epic step."

Tazio Simoncioni, Technical Manager, Netick

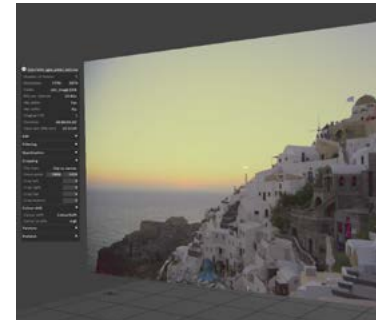
### 3. A leading workflow for colour management

The Academy Color Encoding System (ACES) has become the standard in the film industry. As all production workflows have material that has to transition from one software environment to another, ACES provides teams with the confidence that no information is being lost in translation.

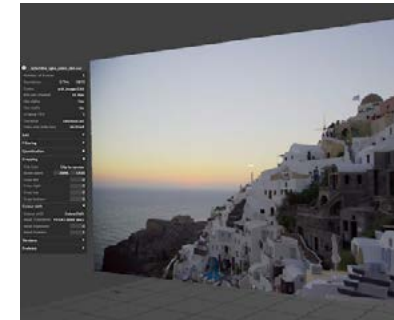
**disguise fully supports the ACES protocol.** Its software effectively composites any video, live camera, or virtually rendered content onto LED screens, without the need to re-render the content into a specific colour space. disguise's colour calibration feature will also run through the full colour gamut of the LED screen and learn the response of the camera's sensor so it can **adapt content and achieve seamless synchronisation across the physical and virtual sets.**

Combining the ACES integration with the legacy power of the disguise workflow, you can transform and compose content from multiple ACES sources, creating consistency when colour spaces are mixed.

→ **Discover how you can enjoy complete colour control with disguise and ACES**



**Without ACES transform**



**With ACES transform**

// "With a trusted, open standard such as ACES in place, filmmakers can focus on creating and shaping their images and have confidence that their intent will be maintained through the entire production process."

Carol Payne, Imaging Technologist, Netflix

#### 4. Set extension unlocks limitless possibilities for smaller scale studios

Not every virtual production studio will be the size of the Mandalorian's. But that doesn't mean a small LED volume is not fit for shooting vast and expansive scenes. The screens within your space only need to be as large as the performance area. **The disguise software facilitates virtual set extension, placing the actors in virtual environments much larger than the available studio environment**, opening up worlds of opportunity.

The goal of extended reality within disguise is to create more compelling scenes and a more engaged audience. xR generates a seemingly limitless environment within a physically small space.

// disguise is very flexible to work with. Through its RenderStream infrastructure [that connects the disguise software to Unreal Engine] you can implement set extension and edit your scene from the disguise timeline, which will also update everywhere across your whole production."

Fatih Eke, Chief Technology Officer, MGX Studios



Without set extension



With set extension

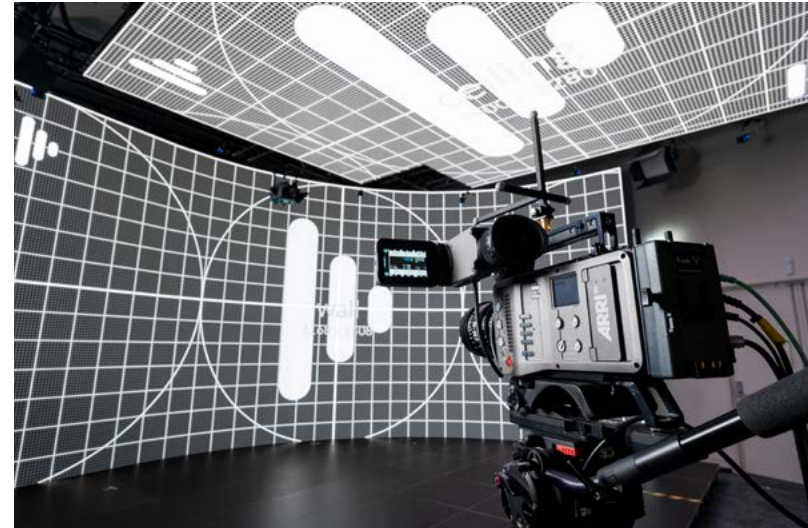
## 5. An all-in-one solution to run your virtual production set

Think of the disguise workflow as the glue that holds your virtual production workflow together. **disguise integrates with all key technologies that drive a virtual production** - from content render engines and camera tracking systems to the LED panels. This opens up unparalleled opportunities for collaboration and streamlines your production pipeline, giving you complete control from one central location. disguise offers critical support needed before and during shoots and through production. As downtime and lost shoot days can be very expensive, the disguise system uptime and tech support provide significant ROI when compared against the entire production budget.

**Trusted for over 20 years** on some of the world's biggest, most complex live shows and broadcasts, the disguise software is a powerful toolkit for winning pitches, developing storyboards, creating camera fly-throughs, validating content, testing technical setups, and designing entire projects. Its timeline-based user interface allows you to build a 3D model of your LED volume, then bring in your real-time content and map it onto the simulated LED environment.

The **disguise timeline leaves no room for error**, as you can pre-visualise all the camera moves and the content that is going to be on those walls ahead of time, you can even get a sense of spatial restrictions.

The disguise software will also take care of spatial and colour calibrations, ensuring **your physical world perfectly aligns with your real-time rendered virtual world** so you can observe a vast, photorealistic 3D environment in-camera, from any angle. It will also track any changes you make to your content or 3D set-up in the workflow so your post-production team will have complete visibility over how much your scene has deviated from the original plan.



// With many previous projects, when we had to set up our LED stage in the studio, we spent a lot of time making sure that everything was running smoothly. But with disguise, we never felt more confident that, once everything gets plugged in, it just works. It's that element of repeatability and a well-established and well-understood workflow."

Michael McKenna, CEO and Co-Founder,  
Final Pixel

# Case study: Framestore achieves greater collaboration on set and faster results

Leading VFX studio Framestore, famous for the out-of-this-world visual effects seen in blockbuster films such as the Avengers: Endgame and Fantastic Beasts, had its first foray into LED virtual production late last year when VFX Supervisor Michael Ralla came across the disguise extended reality (xR) workflow and used the disguise software to put a test shoot together with a cinematic narrative.

## The concept

Shot at XR Stage's LED studio in Pacoima, California, the aim for Framestore's Blink virtual production pilot project was to photorealistically and seamlessly marry a practical set with a virtual set extension. The short film took actors through various photorealistic virtual scenes from a fairytale-like forest all the way to the surface of Mars, all loaded up onto the LEDs at the touch of a button.



Image credit: Framestore, All of it Now, XR Stage



Image credit: Framestore, All of it Now, XR Stage

## The process

Unlike traditional production workflows, the team first built the virtual environments in Unreal Engine and later integrated live-action elements into the shot.

Framestore worked with disguise xR specialists All of it Now to deliver their Unreal Engine content on the LED wall reliably and in real-time with the lowest possible latency. It provided an end-to-end workflow where assets could be placed on the LED wall and shot directly - enabling more creative control. disguise also ensured spatial and colour calibration for the LED stage, as well as lens calibration, eliminating any concerns for Moiree and LED line glitches.



## The results

The virtual production workflow, powered by disguise, gave the team the tools to bring their vision to life faster and more seamlessly, transitioning between virtual sets at the touch of a button and making real-time edits to content on-the-fly.

"The whole process is a huge collaboration," Ralla explains. "Essentially we are creating set extension VFX shots in-camera."

// While you still have to work with the image to make it look photorealistic, you don't have the many iterations over a longer period of time that you would have with traditional blue screen shots. You are put on the spot - committing to a decision that needs to be made within minutes. The advantage is that you are not making those decisions alone. You have the DP, director and production designer right next to you to tackle certain issues synergistically."

Michael Ralla, VFX Supervisor at Framestore



Image credit: Framestore, All of it Now, XR Stage

→ **Find out more about Framestore's experience in this interview with Michael Ralla**

# Conclusion

Virtual production is a wild new frontier but there already exists a wealth of evidence of its significant pipeline, productivity, and bottom-line benefits that might just change your studio forever.

Traditional pipelines don't offer the benefits of on-set interaction and collaborative ideation can be complex. In virtual production, **departments come together to work more organically** - all in the moment, in real-time.

Virtual production is a wholesale departure from traditional filmmaking methods. Although it will invite costs in some areas, **it will also dramatically reduce overheads in others, while also unlocking new skills for the future of the industry.**

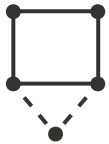
From delivering realistic worlds of infinite detail and beauty, to the more pragmatic benefits of accelerated time to market and clarity in planning, **virtual production hands complete control over to the filmmaker.**

// With disguise, filmmakers can capture the creative magic of working together as they would with physical sets, while minimising the amount of time, money, and uncertainty of conventional post-production. Our industry-leading developments in content pre-visualisation, cluster rendering, ACES colour management and powerful hardware to support real-time content of the highest quality unlocks unparalleled flexibility, creative freedom and collaboration."

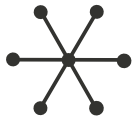
Raed Al Tikriti, Chief Product Officer, disguise



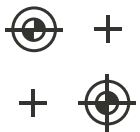
# 10 key benefits of virtual production and disguise



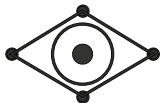
Render photorealistic, computer-generated scenes on an LED background and **interactively visualise and edit them in real-time.**



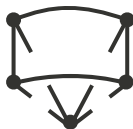
Unlock **complete control in filmmaking** - from creating worlds of infinite detail and beauty, to increased budget reliability and clarity in planning.



Remove linear production phases and enjoy a **more efficient, flexible and collaborative** filming experience.



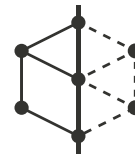
Immerse actors in your scene to encourage a **more natural and instinctive performance.**



Capture **realistic reflections and natural scene lighting** within your LED volume.



disguise seamlessly integrates with leading 3D graphics engines like Unreal Engine so you can focus on creating your best story, with minimal set-up requirements.



Scale out your real-time content with disguise cluster rendering to **render vast, photorealistic scenes** of the highest quality and framerate **without compromise.**



Transform your productions with ACES industry-standard colour control, available in disguise, giving you the power to create photorealistic scenes **without worrying about colour consistency.**



Create a **seemingly limitless environment** within a physically small studio space with the help of disguise's virtual set extension.



Unlock the skills that will place you at the forefront of the industry and **future-proof your next productions.**

# Get started today!

**Create spectacular virtual productions without limitations.**

- **Book a disguise demo**
- **Download the disguise software - free for a limited time**
- **Learn the disguise virtual production workflow on our free elearning platform**

## About disguise

The disguise technology platform enables creative and technical professionals to imagine, create and deliver spectacular live visual experiences at the highest level.

Combining real-time 3D visualisation-based software with high performance hardware, disguise delivers challenging creative projects at scale and with confidence. Its new award-winning Extended Reality (xR) workflow is empowering users to bring to life immersive visual experiences that inspire and engage remote audiences everywhere.