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ounded by George Lucas in 1975, Industrial Light & Magic (ILM) set a new standard for visual effects with

*Star Wars: A New Hope*, and has continued to innovate ever since. At heart a technology company, ILM exists to turn filmmakers' wildest dreams into visual reality, no matter what it takes. That can mean pushing existing tech to its limits—kit-bashing disparate tools together—and even inventing brand new ways of doing things.

For *Rogue One: A Star Wars Story*, ILM made extensive use of one of its own creations—the ILMvCAM—and added new capabilities to its repertoire. Mike Jutan of ILM's Research and Development team worked closely with *Rogue One* director Gareth Edwards on the ILMvCAM scenes, and offered to shed a little industrial light on the magic for the benefit of *Insider* readers.

**What is the ILMvCAM?**

**Mike Jutan:** The ILMvCAM is a handheld device used for interacting with a virtual world, driven by the Virtual Set capabilities of our proprietary 3D software package, Zeno. *Rogue One* was the first movie to extensively use the brand-new iPad/Gamevice Virtual Camera (also known as the ILMvCAM), but ILM has been doing virtual production with a variety of different types of virtual cameras for 10+ years.

01 X-wings close in on the Imperial shield barrier above Scarif.

02 A Star Destroyer emerges from the shadows.

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*Rango* was a film that extensively used virtual camera in Zeno, since the entire movie is all computer-generated (CG). Incidentally, *Rango* was ILM's first animated film, and we built the whole thing as a virtual environment in Zeno. The Zeno VSet, combined with a previous iteration of the virtual camera hardware, allowed director Gore Verbinski to "walk around" the set and get a feel for it at the storyboarding stage.

It became a storyboarding tool that gave Verbinski far more freedom than a 2D storyboard, because he could actually move things around and problem solve. And because of the success using the tool, we decided we wanted to dedicate attention to it and make the device lighter, to make interacting with a digital environment feel more effortless. Some directors prefer the heavier cameras, and some prefer the lighter ones. A big piece is that it is now Wireless as well.

**So the device is similar to a handheld movie camera?**

The interface is an iPad Mini with a Gamevice game controller stuck on either side of it, and a motion-tracking system attached, that represents a camera in the virtual world. The user can move it around and look at anything they want, and the device captures the exact camera move. It's essentially a motion-capturing tool for the director's camera moves.

**"THIS IS A WAY TO PHYSICALIZE THE VIRTUAL WORLD, AND HAVE INSTANT ACCESS TO IT, FOR ULTIMATE CREATIVITY."**

**What benefits does the director get from this?**

A big goal for us is to have that feeling of iteration, so you can do take after take after take in real-time, without stopping. It allows you to explore and find happy accidents in a way that might happen on set, but which hasn't previously happened in imaginary worlds—because they don't really exist. This is a way to physicalize the virtual world, and have instant access to it, for ultimate creativity.

**How did that come into play on *Rogue One*?**

It came in very handy for the shield-gate sequence. We tried a few different angles, following different ships as they

passed through the shield gate, making twists on the way through. Gareth Edwards was totally in control of that, and was able to get a very realistic idea of what it would look like in the movie. Of course, there are lighting effects and explosions and stuff that get added later, but the bones are there, rendered in real time. And because we're using Zeno at every stage, these feed right into our artist pipeline, so ILM artists iterate on the exact same shots that Gareth made to perfect the motion for the final shots in the movie.

**So a director can "walk around" an environment even when it's in space?**

You really can go anywhere. The virtual set/digital environment has already



**ZENO**

The Zeno virtual production system is ILM's proprietary 3D software package, used (among other things) for modelling environments, objects, and simulation effects. The system's Virtual Set component had already been in use for some years, but *Rogue One* gave Mike Jutan and his team the opportunity to push the system forward.

"We've built up a lot of tools over 20 years of ILM's development," explains Jutan, "but the virtual production component of Zeno is something that has existed for 10-plus years, in some form or another."

"About a year-and-a-half ago, Cary Phillips, the head of Research & Development, decided that virtual production was something that R&D as a unit wanted to push much harder," Jutan continues. "We had a group of about ten of us focus completely on this. That's about a third of the department. We're usually pretty light and lean, so to have a lot of people on one thing is a very big deal."

been built and there are no fixed camera views. If a director wants to move into an unexpected section where we don't have textures, we can up the resolution of that in seconds. We have all the models ready, automatically optimized for real-time use. We don't have to dig them out: we're dealing with the real data.

**What specific challenges did *Rogue One* pose?**

In the past, we'd always scaled the virtual world on a 1:1 scale with the real world. But when the decision came to include the Death Star in the first trailer, in early March 2016, no shots of it existed at that point, just some basic pre-visualizations.

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► So Gareth said, “Make the Death Star like a basketball and let me walk around it.” That was a new feature for *Rogue One*, playing with scale like that. It allowed us to help Gareth find the shot much more quickly, within 10 minutes or so of looking at the Death Star through the ILMvCAM, as if it was a model on a table. He could move over the top, around the sides, and look at any possible angle.

We shot about 40 takes in a row like that, and somewhere around take 20, he found this great angle which we started fiddling with. He said, “Oh, this looks pretty good. You can see the shadow creeping.” And because it’s a live package where everything’s adaptable, we just took the sun and moved it around. This real-time lighting functionality helped us place a shadow moving across the surface of the Death Star. Gareth directed us as we moved the light source until we had something he liked. The shadow was being cast by the Death Star dish docking into the Death Star, and gave a really ominous effect as it crept across the shot, revealing both the Death Star itself and the group of Star Destroyers.

**“GARETH SAID, ‘MAKE THE DEATH STAR LIKE A BASKETBALL AND LET ME WALK AROUND IT.’”**



## RESEARCH & DEVELOPMENT

Key to the development of Industrial Light & Magic’s ground-breaking effects technology, ILM’s R&D team currently consists of around 30 people, of which Mike Jutan has been a member for almost a decade.

“It’s a pretty amazing and diverse group, consisting of people from around the world of all ages, genders, backgrounds. It’s a real pleasure to be a part of,” says Jutan. “I’ve been part of the animation and creature development pipeline group, which sounds like a catchall. It’s like an ‘all of the above.’ My work here has generally been focused on rigging, which is the art of creating a bone structure inside a character, essentially making a CG character animatable, and turning it from digital clay into something that animators can work with.”

It was the first time Gareth had really used the technology, and as he found that shot, myself and the other motion-capture operator were (quietly) sharing the joy of watching *Star Wars* being made in front of our very eyes. As soon as Gareth finished the shoot, his camera moves were sent to the ILM artist teams to further refine the shot. Six days later, the teaser trailer was released with the Death Star reveal.

### So Gareth embraced that flexibility?

It’s much more like how he would work on set. He doesn’t just follow the

guidelines for the shoot day: he gets a lot of really great, creative stuff by going outside the rails a little bit and trying things that aren’t originally part of the plan. He’ll follow the sequence plan, but then he’ll say, “You know what, I want to see what it looks like over here.” He would do that a few times, and find something much better than they had planned in advance.

Our ultimate goal is to give directors that level of freedom, and then capture what they do with absolute fidelity. Gareth’s moves are the raw source of the camera work you see in the finished movie. They’re not an interpretation: they are Gareth’s shots captured as animation curves in the software.

It’s as if ILMvCAM is a paintbrush, and instead of telling us what he wanted a painting of, he was able to paint it himself. He told us after the first session that being able to do that saved two or three weeks of back-and-forth discussion. Obviously, we then take his “painting” and we work over the top of it to create the final

effects, but it’s still the original camera work underneath. Ensuring we match his artistic vision is the goal for us. 😊

03 The ILMvCAM helped plot the twists and turns of the Scarif battle.

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