Episode 23: A Renaissance at the Intersection of Media and Technology
Host: Nicole Huesman, Intel
Guests: Rob Bredow, Industrial Light & Magic; Jim Jeffers, Intel

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Nicole Huesman: Welcome to *Code Together*, an interview series exploring the possibilities of cross-architecture development with those who live it. I'm your host, Nicole Huesman.

To deliver increasingly captivating stories on the proverbial 'big screen' takes more and more advanced and open technologies. Today's guests truly *live* on this cutting-edge.

Rob Bredow is an Academy Award nominated VFX Supervisor who serves as SVP, Chief Creative Officer at Industrial Light & Magic. Rob has a particular focus on the creative strategy for the storied visual effects company where he is responsible for the company's overall creative strategy. Some of his previous projects include Solo: A Star Wars Story, ILMxLAB's story-based virtual reality experiment *Trials on Tatooine*, and films dating all the way back to *Independence Day*. Rob serves in several capacities within the Academy of Motion Pictures Arts & Sciences, including the Science and Technology Council, through which he was instrumental in founding the Academy Software Foundation where he is chairman of the board and collaborates with our other guest today, Jim Jeffers, Intel's ASWF board member. Rob, thanks so much for being here with us today!

Rob Bredow: Thank you so much for having me. It's great to be here.

Nicole: In addition to his role within the Academy Software Foundation, Jim Jeffers works as Senior Principal Engineer and Senior Director of Intel's Advanced Rendering and Visualization team where he leads the design and development of the open source rendering library family known as the Intel oneAPI Rendering Toolkit. This toolkit includes the Embree Ray Tracing library, which recently received a Technical Achievement Award by The Academy of Motion Picture Arts and Sciences. Jim, welcome back to the program!

Jim Jeffers: Thanks, Nicole, it's always fun to be here.

We're excited to hear how you're collaborating to bring amazing experiences to life at the intersection of media and technology. I'll hand the discussion to the two of you.

Jim: Okay. Thanks Nicole. So, I can't let Rob off the hook without a couple of key burning questions that I have, and I'm sure the audience does. So, my first question, Rob, is baby Yoda in the Mandalorian actually Yoda reincarnated, or is it Yoda's long lost child or something else? Or can you not even tell me what that is?

Rob: Yeah, I mean, if I did tell you I would have to kill you afterwards, isn't that what I'm supposed to say? Yes. I think Grogu's history is yet to be discovered and I'm actually looking forward to it along with all the fans. I actually, even though, you know, I'm actively working on the show and we have hundreds of artists who are working on these shows. So many of us are such big Star Wars fans. We actually try not to get spoiled on some of this stuff, which is really hard when you're working on shots or you're seeing sets or you're seeing things that are coming together in StageCraft. But no, we're big fans of the show.

Jim: Okay. One more twister that you probably can't answer either. And then we'll go on to actually have a real conversation. So, were you involved with *WandaVision*?

Rob: Yeah, ILM was very fortunate to get to work on *WandaVision* with Marvel.

Jim: That's what I thought. So, what was the choice between the two possible actors as Wanda's brother? Was that an artistic choice or was it due to contractual issues?

Rob: I read all the fan theories too. And to be honest, I'm not any more clued in than any of the fans are on that, but I had the same question too. I can only assume it was an artistic choice just because of the way the clever choices were made throughout that series. I don't know about you, but my mind was blown by episode three in that series.

Jim: Yes. You know, I saw it relatively early, so it was kind of like, Oh, it's just going to be like, you know, an extension of the original and it's so creative and so incredibly written, I was blown away.

Rob: You know, I think that we're in a renaissance of the kind of creative stories that can be told. I mean, it's not to say that film isn't amazing. Film is amazing. And I love the kind of stories you can tell on film, but in an hour and a half, couple hours, there's a certain kind of storytelling that we've all gotten used to. And, you know, for a long time, it was pretty much just HBO where you could go for really high quality, limited series like this, where people were really putting all production value in. And now we have so many options. It's certainly—on Disney+, the shows that we're working on there and for our other clients as well, 'cause we're working for all the studios—and it's just such an amazingly refreshing creative time in the studio where people are getting to tell stories that are best formatted in these longer formats, which is really exciting.

Jim: Yeah. Okay. Let's get down further, a little bit of brass tacks of what our audience want to hear. We talked a little bit at the ASWF board, which we both said we're members of, but either a recap or your perspective on the virtualizing or remoting of human assets, developers, artists. What has happened? How can you keep doing, you know, shows like *Falcon and Winter Soldier* and things like that and *WandaVision*. You know, when my limited experience with folks like you was, 'Hey, everything's done in-house, we occasionally burst to cloud.' And then suddenly the world changes. What is your perspective of that?

Rob: Yeah, you know, there's nothing like a forcing function to push forward the innovation curve. And that's, I think what we've seen in this year, I mean, there's been a lot of very serious negative outcomes from COVID. So, we don't want to gloss over those, but from our perspective of what it's like to work on these films in the digital visual effects realm, it's been tremendously innovative.

We saw the news at 1:00 PM on a Monday afternoon that we needed to shut down our San Francisco office by the next day by midnight. And we scrambled to get people equipment as they were walking out the door that night. And we were up and running on Tuesday, to some degree. And within a week, we were fully up and running. Where we had had a handful of people with emergency remote access for maintaining uptime before just people in our systems and IT groups, now, all of a sudden, for the first time in the history of ILM, we had a couple thousand offices, everybody's home office that we were securing and working with in a remote manner that limited any of our security exposure and gave the artists a really positive experience.

So, as I look to the future, I think these lessons that we've learned during this time where people are remotely working from home in an amazingly efficient [way]. People have been so resilient. People have been so responsive to work in this configuration. And a lot of people are pointing out, you know, I don't want to go back to a two and a half hour commute every day when I can be efficient in this configuration. So, what are we going to do in the future? And ILM, we're looking at a hybrid configuration where people will spend some time in the office 'cause we love seeing each other in the office. It's an important part of our culture. It's an important part of innovating and being able to think in the same room at times, but we were already in five offices around the world and this has brought our international studios even closer together. So, we're going to be, you know, maybe roughly half in the office, half at home for the long-term, which is a huge transformation for our business. And I think it's going to be a great improvement for people's work-life balance and still have some of those advantages that we all miss from not being in the office today, but capitalize on some of the big advantages of being, you know, I'm home with a puppy right now. I wouldn't be able to be home with a puppy if I was in the office today. So, there's some nice work-life balances that can be achieved.

Jim: Exactly. Almost exactly what Intel's CEO said to us. Intel has just finished a whole survey of the population about the hybrid notion. And so, in the exact same mode as ILM and the vision is this hybrid mode goes on to the combined benefit of the company and work-life balance because people have these options and the infrastructure put in place to work. And I know my team actually loves to work and they do love to get together, but we're a full international team as well. And I was going to ask you, you sort of answered it a little bit. I mean, I know there are a lot of freelance folks and, you know, specialists, I guess in certain areas. Does that open up some access to maybe individual or small company contractors that, maybe, would be harder to work with?

Rob: I think it does. And it also really opens up the possibility of us recruiting from areas that might have had longer commutes. We have studios in world-class locations. So, we're in San Francisco and Vancouver and Sydney and London and Singapore, which are all wonderful places to live and work. They're also really expensive places to live and work and you have to have pretty long commutes in some cases. So, we're really interested in what this means from an inclusion perspective. If we can recruit somebody who can commute one or two times a week from an area that we may not have been able to recruit before, we could reach a whole demographic of talent that we haven't been able to reach before. There's a lot of systems in place that make it challenging to be really inclusive. And one of those systems is simply having offices in really expensive areas. It means you're recruiting from people who can afford to live in those areas. And that means we're missing some amazing talent out there who might not be in those areas. So, it's a big opportunity for us to look at changing the game, being able to open the door to people that we may not have been able to reach before. And it's going to be great for our business to find amazing talent that we haven't been able to find before. So, it's not only the right thing to do from a diversity and inclusion perspective, but it's also just good smart business.

I'm excited to see the shift that's taken place in a lot of corporations over this year. I mean, if we've done a little more soul searching in this configuration, and I think with the things in the news where racial inequity has just been brought to the forefront, I think having big companies like Intel, like Industrial Light & Magic, and our parent company, Lucasfilm, and our parent company above that, Disney, really invested in making this a higher priority and putting it front and center in our future plans.

I think it's going to be a really good thing. I think we can take some steps in the right direction, but we have a long ways to go.

Jim: Exactly, make the world a better place, but you know, we want to make it the best. So, switch gears a little bit. This is actually a question I have for you kind of personally, but I think it'll help everybody. This actually comes from me as someone who delivers technology through open source—fantastic—into the marketplace. But right now, given everything, you know, you can include what's happened with COVID and everything. What are, like, the top one or two, let's say technological pain points that for instance, a company like Intel or our collective friends in the Academy Software Foundation, what would be pain points that could really help in this new world of rapid development, streaming movies, all the things you were talking about?

Rob: Yeah, that's a great question. Some of the areas that I'm most excited about where we're seeing the most innovation, and certainly, Intel has big plays in this space are really two things: real-time, and machine learning and artificial intelligence together. In the real-time area, we are making big bets and we're seeing our visual effects workflows transformed from a workflow that was always 'wait for overnight to see the next iteration' to, now, how much can we do in a 24th of a second? And when you're talking about taking something that used to take 10 hours and doing a 24th of a second, that's a combination of things. It's different algorithms, it's different compute metrics. It's all sorts of different things that make that possible, but it completely transforms the way we create films. When we can put a filmmaker in a virtual environment, in a VR headset or on one of our LED stages, which we call stagecraft, where they can see the world around them as they are photographing it, so it's real-time visual effects, that completely changes the kind of experiences we can make.

Just to give you a really, maybe it seems like an obvious example, but one of the first times we did full in-camera, final photography on a Star Wars movie was on Solo, and I was supervising that show, and we did a 180-degree wraparound screen. It was about a 30-foot diameter screen, very cool projection technique. We used rear projection, so it was an 8K wide media. And we had prepared all the media to play back. So, you could do hyperspace. You could do the entire Kessel Run on this screen. So, it was a pretty cool wraparound screen wrapped around the cockpit of the Millennium Falcon. So, the cast could see it. The camera team could see it. So, Bradford Young, our DP, was able to create shots. So, the very first time we went into hyperspace, for example, when the crew pushes the lever, in every other Star Wars movie we'd made for all those years, almost 40 years of Star Wars movies, when you push the levers up, you cut because there's nothing else happening, right? They push the levers up, nothing else happens in the cockpit. But what happened on Solo is you push the levers up and you see hyperspace streaking, and the DP can see it. The Director of Photography can see it live on set. The Director can see it live on set. The Editor can see it live. And what Bradford did is he panned the camera over onto Han Solo's face, and you could see, like, the reflection of hyperspace in Han Solo's eye. So instead of cutting, we had three or four extra seconds of storytelling, visual storytelling that happened right on screen. And that's what we're seeing over and over again. When we put real-time tools in the hands of creatives, they make different creative choices. They tell different stories. And that's really exciting. So, we're making big investments in real-time. I know others are as well. It's a very exciting time to see our workflows that used to take 10 hours happening in a 24th of a second. And it's a lot of hard work, a lot of hard engineering, a lot of hard work on the compute, a lot of hard work in the infrastructure to be able to pull that off.

Jim: I just want to make a side comment to Intel management if they're listening. I did not plant Rob with that because you sound like somebody inside Intel who would be me. That is fantastic. Rob, that really aligns with a lot of the changes and things I'm seeing. So I at least feel good that, you know, while we have our every day to day jobs and everything, but that is absolutely the direction that Intel wants to participate, you know, in what we typically just call the creator industry. So that's fantastic. Thanks.

Rob: Well, I mean, the other aspect is the machine learning side where the algorithms that have been hand-coded for all these years, many of them are suitable to be replaced with these neural networks that can be trained and we're getting spectacular results. They're not without their own limitations. They're not without their challenges. There's a lot of challenges in there, but boy, we're finding that there are substantial workflows. It's not like optimizing an algorithm as much as it is rethinking the way the workflows are actually going to happen on our shows. And that's been pretty transformative as well.

Jim: Yeah. And it is an interesting methodology to go high-speed from, you know, like I said, the formative algorithms that didn't include that notion of consuming big data, but turning it into a machine answer that is, you know, let's just say, 98% of the time, correct, which means you can plan around that. So yeah, totally agree with you.

So, here's another one, I'm going to jump again. Another trend I'm seeing, and I haven't talked to you about this before, is what I would call the rise of volume rendering in conjunction with geometric rendering. Am I correct? And what is your view from both, again, the Academy and ILM's of the increasing impact of volume rendering?

Rob: Yeah. When you think back at the history of volume rendering, it used to be so expensive, you would only use it in the very few places you absolutely needed to. And it's still expensive because you're basically cubing the amount of calculations that have to take place and how much memory you need and all those things. However, it's so the right tool for the job for many of the things we pull off.

So, atmospherics that properly cast shadows and do all these amazing things, or pyroclastic clouds, or of course, Jim, you think of this, but people might not think of skin as a volumetric rendering solution. But if you look at the movie, *Soul*, that was just out this year, all the work that was done in the place outside of New York, right, all that work was actually volumetric, which is amazing to think of. Just think about that a few years ago. That wouldn't have even been possible. And of course, it's a lot of amazing engineers and artistry at Pixar that actually pulled that work off and made it possible to generate that sort of complexity on-screen. And you can see—you get all these wonderful subtleties that wouldn't be possible without calculating the depth in addition to, you know, what's happening on the surface.

So yeah, I think that's really exciting, and there's a really great Academy Software Foundation project that is focused on this. In fact, it was the first project accepted into the Academy, which is called OpenVDB, which is a volume database, a volume storage format. And we've really seen that particular library get huge adoption. It's adopted by all the major players and is used very extensively throughout many, many film productions. Most film productions probably use OpenVDB today.

Jim: And again, Intel advertisement. My team has a project called Open Volume Kernel Library. It is not a competitor to OpenVDB, it is an amplifier to OpenVDB. So, our friends out there, if you want one of the

best volume kernel libraries, we call it the "Embree of Volumes." It is a really cool project we spent a lot of time on. It's open source, and we would love to hear from our developer friends who are in this space.

Rob: Yeah. I mean, what you're talking about there is really the reason that Academy Software Foundation exists because projects like this can get momentum by getting some adoption here and there, but it's really hard for especially big companies to know how to contribute work back, to build on this without something like the Academy Software Foundation standing behind the projects and saying, we're going to make sure these are healthy projects, it's okay to invest in them, you can get behind these. And boy, it's been really exciting to see with these six, now seven, projects that have been adopted. They've just skyrocketed in terms of engineers contributing to the work, adoption, big companies and small companies alike being able to rely on the software, the software remains free, accessible to everybody. And then you can build on that, and you can build on it in the Academy Software Foundation code base, or auxiliary projects alongside that may or may not get adopted into those code bases, but you can now rely on these libraries and these core tools in a way that, you know, maybe before was more challenging.

Jim: Yeah. You transitioned perfectly into the next topic. Maybe for the slightly less initiated, your quickest overview of the purpose of the Academy Software Foundation, maybe a quick view of the original goals, how far are we along in those. Again, Rob and I are on the board. We had a board meeting last night and two projects moved towards full support within the Academy Software Foundation.

Rob: Yeah, it's great time. Lots happening at the Academy Software Foundation, specifically OpenCue migrated from its early adopter status to a full project just yesterday when the board voted to make that official. And that basically means it has a certain amount of adoption. It's achieved a very healthy status. It's a bit of a badge of honor to be able to claim that for OpenCue. So, I'm really, really pleased with the team and the progress they've made there. The other exciting thing that's happened is MaterialX has now been formally accepted into the Academy Software Foundation. So, it'll start in incubation stage where all projects start until it gets graduated. MaterialX is not a library itself; it's a way of describing materials so that you can standardize them between applications, between projects, between studios, and it's already gotten quite a bit of adoption. That's a project that actually has come out of my company, ILM, and we were excited to contribute it into the Academy Software Foundation.

And to Jim's point about why does the Academy Software Foundation exist? You know, we have great actors in this industry. We have Intel, we have ILM, we have lots of other companies who are doing open source projects for the benefit of the industry. Of course, it benefits us too because, you know, if a lot of people are benefiting from Intel's libraries, they're probably gonna run them on their chips. If somebody adopts MaterialX, it makes it easier for me to do interchange with them, so it might make it easier for me to solve creative problems on our filmmakers projects. But there's nothing like having a neutral third party to manage these projects for people to be able to trust the future development of something like a MaterialX or OpenEXR, both projects that are now run under the banner of Academy Software Foundation.

So that means that when an engineer from Weta wants to add an extension or fix a bug in OpenEXR, they can just log in, make the change, submit the pull request, and the team can immediately put that in. It doesn't just have to be ILM engineers, or it can be you the podcast listener who has never worked in visual effects, but you would like to. Maybe have some engineering background. Maybe you'd like to write technical documentation. Maybe you're a user of some of these tools and you want to submit a bug. You can actually contribute in the environment that the actual developers are working on developing these libraries. And that's what we wanted to create with the Academy Software Foundation, which is this forum where we can basically give developers superpowers. You can go in, make a code change, run the QA tests and actually make a change to a library that is used everywhere in our industry. The example I like to talk about on OpenEXR is, on your Mac without installing any software, you can click on an EXR image and hit the space bar and it'll pop up in the preview app, which means it's built into the operating system. And that would never have happened without open source. And now, the Academy Software Foundation to really provide quality secure versions of all of these tools that we can all base our work on. So yeah, it's very, very exciting.

Jim: Yeah. I think what I would boil that down to is we take away the wild, wild West notion of open source, right? Open source has migrated from that in its early days or many of the projects and they can accidentally get there if it's like an individual contributor, but a bunch of people go, yeah, open source is great, I'm going to use it, and it can get a little wild. So, the Academy Software Foundation for things that are, maybe let's say on the edge or verge, but are critical, it is a place that you can turn it back into well-honed engineering project, but multiple contributors can do it. So, it's really fun to be on that.

Rob: And I should have mentioned in the introduction, the origin of this foundation is a team effort between the Academy, the same Academy that gives out the Oscars every year that has lots of members in it, and we really care about the longevity of filmmaking and the filmmaking process, and the Linux Foundation. So, these are two organizations who are experts at what they do, respectively. And we found a great partner in the Linux Foundation. They know how to operate giant, open source, healthy ecosystems. And they've been a fantastic partner in setting up the infrastructure to make a great environment for developers and people who want to work on open source packages.

Jim: Yeah. Now, I see we're running a little bit low on time, but I do have one more thing. Again, as I speak with people like you, Rob, and other people at other studios in conjunction with not really only COVID, but really this move to the streaming and what I would say high-speed development, there's kind of this notion of with Netflix and everything else and the kinds of projects you're talking about, of what I would call mid-budget projects like $30 to $50 million, as opposed to the big blockbusters, which are still obviously fantastic. We love them. We love the *Avengers*, everything else. Is there a new space that you see happening for this quick turnaround? And this is part of the drive to real-time, I guess. What's your comment on that? Is that going to be sustained?

Rob: Well, I think it is a very exciting time on the content creation side. And I think what you're pointing out is really now we have projects of a much wider variety. We used to have TV and film. And TV was relatively inexpensive per minute, compared to film. And film was where you had those blockbusters you're talking about. Now we're seeing a huge number of gradations in between.

So, it opens up the opportunity for stories that can be told for $50 million that may not have had a home before. You might've had a great story, but it was too expensive for TV. And it's funny to say too inexpensive for film, but it wasn't necessarily a kind of blockbuster that was going to draw everybody out to the theater on that weekend, or it couldn't compete for those limited slots on a Friday night that everyone's going to go see those movies. So now we have multiple places with multiple streamers who are looking for content of all kinds, and it doesn't have to necessarily get you out on a Friday night, or take up one of those 52 slots in the year. It can compete in another way, which is fantastic, I think, for creators and for people who are creating technology behind entertainment, and studios of different kinds, to really work on a wider variety of shows.

I mean, you know, a few years ago we got into the TV business because we wanted to be in the streaming business because we love the kind of creative storytelling that is happening in that world. And, you know, we do 4 or 5,000 visual effects shots on a Mandalorian and that's a blockbuster of the streaming world. So, we're also working on shows that have budgets that ILM wouldn't have been able to entertain a few years ago. And we love working on those shows. So, the smaller budget shows can be just as exciting, and it can be great storytelling opportunities at various budgets.

Nicole: Amazing, just incredible discussion. I wish we had more time today. We could likely go on for hours. As we wrap up today, Rob, where can listeners go to learn more?

Rob: For more about Academy Software Foundation, head to ASWF.io. And that's really the hub of everything for the Academy Software Foundation. If you have any interest in some of the things we've talked about, the technology behind the movies, we want to make it easy to onboard you there. And there's lots of ways to connect with us, whatever your social media preference is, or if you like Slack, or if you want to jump on an email list, there's lots of ways to connect with us on Academy Software Foundation, ASWF.io. We would love to welcome you there, especially if you're not in the industry, and you didn't realize that there's thousands of engineers doing really innovative work in the film and TV business, and you love movies and you love engineering, or you love work that's adjacent to engineering and you've been using these technical tools or maybe documentation or anything else in that area, we would love to welcome you in as a great way to get onboarded. I mean, it's been a really exciting industry for my life. So hopefully there's people listening to this who didn't realize, like I didn't realize when I was younger, that this could be a full-time job and it really can be, and we'd love to have your help.

Nicole: Absolutely. Thanks Rob. And Jim, is there anything more you'd like to share with folks, any other resources you'd like them to check out?

Jim: Yeah. Two simple things. You can just go on our friends from Google or your favorite search engine, type in oneAPI, that's oneAPI rendering toolkit. You should get some good hits there. Or if you want to just go directly to see what we're doing in this area of libraries that augment what's happening at the Academy Software Foundation, you can go to bit.ly/renderkit, and that will get you through all the Intel long URLs more simply. And if you want to follow me on Twitter at @jamesljeffers.

Nicole: Again, this has been an amazing discussion. You know, I think about my ten-year-old, right, and the consumers demand is really insatiable, you know, for these amazing immersive stories. It's only

going to increase as the both of you have pointed out. It's been incredible to hear how you're working together, and the industry is collaborating to meet all of these challenges. So, we look forward to having you both back on the program. Rob, thanks so much for being here to share your insights with us.

Rob: Thank you so much. This has been great.

Nicole: And Jim, always great to speak with you.

Jim: Yep. I'm here if you need me. Thanks.

Nicole: Excellent. And a big thank you to all of our listeners for joining us. Let's continue the conversation at oneapi.com.