Transcript for Leveraging Virtual Production to Enhance Student Learning
2023 ETUG Fall Workshop: The Evolving EdTech User (November 10, 2023)
Presenters: Andrew Wang and Matthew Yedlin

MODERATOR:
Andrew Wang and Dr. Matthew Yedlin from the University of British Columbia. Dr. Matthew Yedlin is a faculty member in the Electrical and Computer Engineering Department. Andrew Wang is a media specialist at UBC Studios. They're going to be sharing with us today their work on leveraging virtual production to enhance student learning. I look forward to learning more about this and I hand it over to Andrew and Matthew.

ANDREW WANG:
Hello everyone. Thanks for joining us. My name is Andrew and this is Dr. Yedlin, and we're here to talk about leveraging virtual production in order to enhance student learning at the University of British Columbia. Before we begin today, All right, and can we get a quick thumbs up if everyone can still...? Okay. Great. Yeah. My name is Andrew. I'm from UBC Studios. And UBC Studios, we are a digital media production unit on campus. But today we are focused on presenting on virtual production at UBC. So I'll let Matt take it away for that.

MATTHEW YEDLIN:
Thanks Andrew. I'm Matthew Yedlin. I'm a long-standing member of the Department of Electrical and Computer Engineering at UBC, and I've been teaching electromagnetics to the third year class for a number of years. And there's always a challenge in trying to present visuals for 3D visualizations of electromagnetic waves. We have an issue of how we do this, and it's extremely difficult to actually work with this material because of the visualization issues.

This is the kind of material that the students have to play with if given in a regular textbook. This is the example we're going to show for our virtual production. You can see a box, rectangular box, which is called waveguide, and the waves are trapped inside the box. What you see in the three white panels are the cross sections of the box with the field lines on each side of the box. I want you to focus on the upper left box. You'll see closed contours, which look like squares with rounded corners. Those are the magnetic field lines. If you look at the lower set of lines, they're going counter clockwise and the upper set of lines are going clockwise. This is a setup to show you when we come back to how we created the visualization using this particular software for the virtual studio.

Our first attempt to doing this was using VR. There's a problem with VR, virtual reality, because of scalability and cost. It doesn't work well when you have a class of 100 people looking in their headsets and trying to interact and talk about what's going on. We decided to go with the virtual studio creation, enabling us to do some of the 3-dimensional visualizations.

Here you can see our initial slide from our early creation. And I'm standing on the floor of the waveguide in the middle of those field lines that you saw earlier. And the ones on the left, you

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can see the counter clockwise field lines. And then to the right clockwise field lines all coloured in blue. Later when we see the video, we're going to have a wall going through the middle of the guide. You'll only see half of the field lines. That's the set up now, and I'll pass it to Andrew.

ANDREW: Sounds good. And I'll just quickly go through some of the basic tools and equipment that you need for virtual production. Since the COVID 19 pandemic, a lot of these equipments have come down in price, as well as become more accessible to everyday users and not just to high-end studios that you would find in the film industry. All you would need is a computer, a capture card, a camera, it could be a DSLR or it could be like a nice video camera. You would need some type of green screen studio. And lastly, you would need software such as vMix, or we use Axymmetry, which is a software that uses Unreal Engine as its renderer to create these virtual environments for our production. We will show a quick clip of part of the video that we made for... It's our prototype and our proof of concept. We took the waveguides that Dr. Yedlin talked about, constructed it together using Blender. And then, yeah, you'll see the results that came out of that.

[VIDEO STARTS]
Welcome to waveguides in space. We are here to show you and explain the TE10 mode. The electric field is in the EY direction for TE10. There is no EX component, and the floor is illustrating the magnetic field lines in blue, and that is the HX and H Z component. Y is the axis that's perpendicular to the floor. The X axis is the short front edge of the waveguide. The dimensions are as shown. Now let's look at the magnetic field lines first that are illustrated in blue. Here is one of the field lines here. You can see it circulates around and goes through the wall. Now we know that magnetic field lines are continuous. So these field lines are going to appear on the other side of the wall, and there we'll have a sense as to the direction they are curling around. Are they clockwise or are they counter clockwise? Let's find out. Well, I made it through the wall okay. You can see where the arrows are going. They're going counter clockwise. That's the direction of the fields. Boy, I'm glad I solved that problem. Well, we've just looked at the magnetic field.
[VIDEO ENDS]

ANDREW:
All right, we won't show the entire video, but that's a gist of the very basic rudimentary capabilities of something like virtual production. And we'll talk about later some ways that we are hoping to elevate. But before that, I'll pass it back to Matt to talk about some of the things that we learned from this prototype.

MATTHEW:
Thanks Andrew. So the students really have trouble with waveguides, and you can see why. They found it extremely helpful. Normally, I do this presented at the end of the waveguide section, but this year I'm going to actually use our video to introduce waveguides and say, okay, this is where we're going to end up. How do we get there? And how do we understand the

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mechanisms of transmission inside a waveguide, which has fields that are 3-dimensional versions of the types of sound fields that you see inside an organ pipe in church.

You saw on the presentation and in the videos. Kind of funny, I walk through the walls. Humour is very important. It's a great ice breaker. It reduces the cognitive load and lets people relax a bit and absorb the material, so I use that regularly in my video instruction, even for physics, things like electromagnetic waves.

ANDREW:
Yes, I'll touch upon some of the technology lessons that we learned through and things that we took away from the prototype. On the left here, you'll see that this is a behind the scenes of Matt and I testing out the capabilities of the software. And one of the things that we wanted to use it for was to point at specific objects, 3D digital objects within the space, so you can point as well as highlight specific things that you want the students to focus on. But one of the drawbacks of the current setup was that because the movement of the camera is actually software based, it's fake, it's a bit different every time when you're trying to point as something. We tried to mark it down in the green screen. Be like, all right, we're going to be pointing at this direction every time, but you can see on the video that sometimes it changed quite a bit. It made it hard to pinpoint exactly when we're trying to point at a waveguide on the floor to get that correct every time.

One of the other lessons that we learned was that there has to be a lot more time spent on pre-production as well as creating the asset development. We want to make sure that the 3D assets as well as the video that we develop fits into the course pedagogically and makes sense for the students and doesn't confuse them even more. More time spent on the planning as well as scripting out the storyboarding to make it so that the finished product is something that will actually improve the students' learning in the course.

Looking forward, what is next? Matthew: Looking forward, we want to see how to create more learning applications for the kinds of situations that could benefit from the use of these 3D productions, not only in electromagnetics, for example. And you can see here in the picture, I'm playing with a slinky to demonstrate waves. But also in areas like biology, computational molecules. You could walk around the molecule and point to the different components and how they interact and what's important. Another example is in machine learning, where we want to look at geometry of surfaces. This is only a beginning, and we look forward to continuing this work.

ANDREW:
Then the other point that we wanted to point out was the improvement in technology, hopefully better than this. But one of the things that I mentioned before was the tracking was difficult, it actually can be overcome by attaching a tracking module to a camera so that now the software knows where the camera is at all times within 3D space. You can also map out the area, so now when we point at something, it will attract accordingly. And even if we move the

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camera, the software will know that we are moving our physical camera, so it'll actually shift the image to match that. A little bit like the video production technology they use in a lot of big Hollywood movies. But a rendition of that, that will help streamline the process for creating these virtual environments.

MATTHEW:
Also we, and I've started doing that as you heard earlier, integrating the resultant videos with the 3D visualization in a particular pedagogy. You can see from the slides we use the lightboard for a lot of work. This is a slide of Machine Learning using the lightboard. So we can now integrate lightboard production with these 3-dimensional, if you like, movies where we're importing the digital assets, so there's lots of applications. We're looking at some geometry, surfaces, volumes, lots of things like that. Really there's a multitude of applications in math, physics, and biology and architecture that we can look at in the future.

ANDREW:
All right, Thank you so much for joining us. That's the end of our presentation here. There are some contacts. If you would like to contact Dr. Yedlin as well as myself. Yeah. We're happy to answer any questions that you may have. I see there's a few in the chat here. Take a look here. All right. It looks like you have some fans. Yeah, we'll definitely share the link to the video afterwards. And Keith asked, "Was there a monitor for Dr. Yedlin to look at while he pointed at the virtual objects?" Yes, we had a big TV in front. We had to find a way to mirror, and he can basically look at the TV to match a little bit at work. He was pointing to make the movements more natural. We actually just also taped down and marked down on the on the green background as well of where he was supposed to point. And we did a couple tries. Right.

MATTHEW:
Right. So that was one of the time-consuming pieces that the software will help because we had to basically map out, tape out the floor so it's like you're doing pointing and screens and stuff like we do for the lightboard, you need 3D cues. But when we get the new software that Andrew talked about that will obviate the problem. We'll be able to make the videos a lot more quickly. And really, what needs to be done, as Andrew mentioned, is to create more assets. We're starting with simple assets. We've got in play an asset we're going to develop for doing a 3D vector geometry problem that the students have a lot of trouble in, but it is very central to the development of some of the concepts in electromagnetic wave propagation in three dimensions.

ANDREW:
Awesome. There is another from "What is the name of the software?" The software we used was called Aximmetry, So it's A-X-I-M-M-E-T-R-Y, I believe. The nice thing about that software is they do have a community version which is completely free, so you can do any testing, things like that if you have most of the gear and you just wanted to try it out to see if it works, you can always download the community version. There is a lot of other software out there. You can

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use a real engine itself or there's another one called vMix that you can use for virtual production. But we just went with Axymmetry as that was the most accessible one at the time.

MATTHEW:
I see Andy said, "Do you see an increased understanding of waveguides among the EM students?" It's too early to tell, but certainly it demystifies the process. Other points, "Are we affiliated with UBC?" Not in the direction of the creation, but we have a strong connection with the people doing similar work at that UBCO studio. We're a sister unit to the UBC Studios Okanagan. We always share knowledge and things like that, and we do work closely together as well. Abir asked a question, "How intensive was the development effort? What skill sets did you need on the production team?" I'm going to address that very directly to Andrew. Andrew, you and I've been working together since 2017, so we have a fantastic chemistry of working and production. Andrew has helped me create close to 130 lightboard videos in that time. And that's the basis of two courses, Machine Learning, Electromagnetic. So we've had an incredible run and so that addresses the issue of production. You have to have a team with complementary skill sets, which we have in just the two of us here.

ANDREW:
Yeah, and skill set wise. So more technically you do need someone with pretty strong 3D sculpting or 3D graphical work capabilities. I don't have it. That's why the first video is just a box with three apps put together. That's one of the things that you would want someone to have skill set wise. The other one is just a basic production/audio visual skill set, knowing how to connect the cameras together, how they talk to each other, and how they work together. Thankfully, we did have some camera operators here as well that can share their knowledge with us. From Bonnie. "What challenges would you foresee the units without an extensive studio setup to do virtual production?" One of the nice things about virtual production is you actually don't need a full green screen studio like what you saw in the picture of both the floor as well as the background. If you have a pop-up one, you can actually do virtual production. Just limits the amount that you can walk. You have to create your video and storyboard based off of those restrictions. But you can definitely still do virtual production because you can always build out the environment as well digitally. It means even if you don't have that space, you do have a lot of that digital environment that you can work with. It's just the actual space that you're walking around in is a bit more limiting. But we'll hopefully see there will be more updates to the program, so they'll be more cost effective in the future.

MATTHEW:
Just a bit in summary, following up on that, my modus operandum is that if you think of virtual studio and elections and stuff and all the stuff they bring in, the objects are the furniture of your studio. The digital assets are like the furniture. Then even in a situation as Andrew described where you don't have a big studio, you could still tape things out and do the movements and stuff. It's just you'll be constrained by essentially the floor area that you're able to do it. Now in our case, we had these field lines and I had to walk around as a very special application. But in general, you may not have that. You may have a different application, like

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you might have a molecule that you're holding or something like that. Totally good. That's the whole idea, digital asset import into a volumetric recording.

ANDREW: All right, I guess that is it.

MODERATOR:
Thank you so much, Andrew and Matthew. That was terrific. Thank you also for sharing your work actually, for showing us actually what it looks like because that was really terrific. Thank you, everybody, and we're going to take a 10-minute break and be back at 3:10 for our final session.

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