

RIT Previsualization and Virtual Production Curriculum Development with Unreal

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RIT respectfully requests a grant of \$350,000 from the Epic Megagrant program to use the Unreal Engine as the core platform to create a fully developed previsualization and virtual production curriculum that will include innovative collaboration with industry partners. The curriculum formula will be shared with other educational institutions allowing for faculty and students to keep pace with the demands of industry.

Executive Summary

Epic Games Unreal Engine is at the center of multiple disruptive technologies, accelerating media tool development. This is generating a need to accelerate the learning process for those using these tools. At RIT, a multi-disciplinary team is specifically interested in addressing the shift from traditional production to **virtual production** by working with key industry partners at multiple levels and developing an adaptive curriculum that will adjust to future changes and industry needs.

Virtual motion picture production and 3D-animated previsualization are now fully mainstream and rapidly changing how feature films and TV series are conceived and created. The integration of the Unreal Engine brings the ability to integrate interactive elements, iterative 3D tools, photogrammetry, VR scouting, real-time compositing, rendering, and on-set tracking metadata which are redefining modern filmmaking pipelines.

Virtual production not only facilitates a fantastic evolution of the rules around motion picture storytelling, visual design, and audience immersion, it also accelerates all aspects of the filmmaking process.

And yet the fast-increasing use of virtual production and 3D previsualization requires an expanding pool of artistic talent comfortable and familiar with these rapidly evolving technologies. Traditional universities, and their associated film schools, generally move too slowly to adapt instruction to the ever-changing needs of industry.

Rochester Institute of Technology is an exception. With a formidable media arts school wrapped inside a premier technology school and accomplished instructors working across the arts and science, we are presently very well situated to develop new and effective curriculum for a select group of motivated film, animation, motion picture science, game design, and digital graphics students interested in acquiring expertise in virtual production and previsualization.



We at RIT are also under dynamic new leadership at the president and provost level as well as having just hired a new dean for our College of Art and Design – all dedicated to tearing down the walls of traditional academia and building cooperation and consensus across diverse academic disciplines.

Our infrastructure is also ready for creating and implementing this new curriculum. The brand new MAGIC Center and MAGIC Spell Studios, finished in late 2018, have the facilities and stated mission to change disciplinary boundaries at RIT.

Virtual Reality, Augmented Reality, Photogrammetry workflows, Virtual Cinematography, and Previsualization classes have had successful first runs during the past year or are being conceptualized during the spring 2020 semester.

Additionally, RIT has cultivated valuable partners in industry, ranging from our own noted alumnus Chris Edwards, co-founder and CEO of the premier Hollywood previs company *The Third Floor*, to *Optic Sky*, an innovative and expanding local production company founded by and employing recent RIT grads.

With this grant proposal ***we seek funding to research, develop, and implement a cost-effective, flexible, multidisciplinary curriculum around virtual production and previsualization.*** This would serve as a working model that would also enable concurrent process and technology research aimed at continuous optimization.

Finally, in the spirit of Tim Sweeney sharing the technology of his Unreal Game Engine, we intend to publicly disperse what we learn so that other institutions may more easily provide new and dynamic instruction to their most talented and motivated students.

Research and Innovation at RIT

RIT's competitive advantage lies in its unique combination of educational talent across film, animation, motion picture science, design, and interactive gaming, along with their associated core technologies of motion capture, volumetric capture, 3D tracking, and real-time rendering. RIT also demonstrates high achievement in spectral imaging, photogrammetry, and light-matter interaction physics – core competencies that underlie graphics and virtual production tools.



RIT continues to contribute to the technology evolution in the cinema industry through its research in color science, vision science, imaging science, motion picture science, graphics, and design. Alumni from these programs presently engage in core research at firms like Disney, Technicolor, Dolby, Netflix, the Academy of Motion Picture Arts and Sciences, Epic, and many more.



In our new MAGIC Spell Studios, the intentional confluence of scholarship and teaching across all the major media disciplines makes RIT an especially attractive location to build and test a new virtual production curriculum. The greatest technological innovations arise when the needs of artists challenge engineers and developers to provide brand new tools and techniques. RIT presently provides a living laboratory of that synergy with interactive cooperation across its arts and science research programs.

Additionally:

- RIT's School of Film and Animation boasts a top 10 national ranking for its animation programs across the undergraduate and graduate categories
- RIT's School of Interactive Games and Media is top 5 nationally among game design programs

- RIT's world-renowned Center for Imaging Science and Program of Color Science have been contributing research in color science, vision science, imaging systems engineering, image processing, and optics that have made their way into cinema, graphics, and games for more than 30 years.
- RIT's Motion Picture Science program is the only undergraduate program of its kind in the nation, combining a curriculum across imaging science, systems engineering, and live action and animation filmmaking. Faculty and students from MPS have been recognized for over a decade for their research contributions by the International Telecommunications Union and the Society of Motion Picture and Television Engineers.
- 3D Digital Design Department Chair, Shaun Foster, was recognized by Epic in 2019 with grant support, stemming from his early adoption of Unreal into instruction at RIT. Shaun not only built a curriculum, he also developed a large portfolio of training materials to expand and accelerate Unreal learning at RIT *and* has made much of this instructional material available for free online. He was also recognized internally at RIT with grant support for curriculum development in VR cinematography, materials, and lighting. From this research Foster is teaching an Unreal course this semester on **Cinematography & Previs** using Unreal (focused on the Sequencer / Lighting / Post Production Volumes) and CineTracer for teaching students accelerated blocking and staging techniques based on video game and film cinematography. Foster has also been using Mixed and Virtual Reality using Vive Trackers and has started testing low cost Virtual Production workflows.
- RIT's Center for Media Arts, Games, Interaction, and Creativity (MAGIC) opened a brand new 52,000 square-foot research and studio facility in 2018 to encourage collaboration amongst media researchers across film, games, graphics, and immersive technologies. MAGIC sits intentionally outside of any individual college at RIT so that it may invite participation across all of its affiliated departments.
- The MAGIC Center is also home to **Frameless Labs**, a cross-discipline assembly of faculty at RIT who contribute to the evolution of VR/AR/MR/XR content and technology. Frameless Labs holds a symposium every November where researchers from all over the country present their work in this field. (Keynote speakers for 2018 and 2019 were, respectively, Wyatt Saverese and Luis Cataldi of Epic Games.)
- **Optic Sky Productions**, founded by alumni of RIT, has come to rely on our program for new talent and has partnered with MAGIC Spell Studios in its production of commercial projects. The company recently used our 7,000 square-foot sound stage to recreate the surface of the moon for a Wegmans TV commercial.



- RIT is proud to claim as one of its alumni, Chris Edwards, CEO and co-founder of **The Third Floor**, the world's leading previsualization company. Chris graduated from RIT's School of Film and Animation and was on the first previsualization team commissioned by George Lucas at Skywalker Ranch. He is a champion of our proposed curriculum development in virtual production and previsualization.
- Chris Edwards is also a member of RIT's **Entertainment Advisory Board** and hosts its biannual meetings in Los Angeles. The EAB was founded as a nexus between the university and our professional alumni in film, animation, and interactive games tasked with contributing ideas and inspiration for instruction and research at RIT. Another notable member is Christina Heller, CEO and founder of **Metastage** – a volumetric content creator with close ties to RIT.

RIT has years of wide-ranging experience working with many of the core technologies associated with virtual production. The time is now to formalize strong pedagogy and curriculum around the full repertoire being deployed today throughout the entertainment community. Professional input from our close partners at **The Third Floor**, as well as other leading industry firms will allow us to craft especially relevant instructional design, immediately useful to the current media industry.

RIT's Curriculum Goals

Pedagogical approaches for delivering effective instruction in 3D previsualization and virtual production are yet to be established. A major intention of this project is a deliberate iteration of new teaching techniques that will ultimately yield the best trained graduates.

Critical goals to this plan are enumerated as follows:

1. RIT would like to stand up formal coursework in 3D previsualization and virtual production, initially across a two-courses sequence (with plans to expand to three courses) and constructed to serve as a declared concentration track for the highest achieving students in film, animation, games, design, and graphics. The courses will also be structured to invite participation through elective enrollment from engineering, computer science, imaging science, and other affiliated programs.
2. Course design research will intentionally explore the balance between design/engineering theory, process/tool tutorials, and experiential project-based education. Following on RIT's strong curricular experience in its film and design programs, we intend to emphasize hands-on activities early and often.
3. The first courses will be designed to deliver introduction to overall production pipelines and then focus in on specific technologies critical to various sub-domains of the virtual production ecosystem.

4. The advanced courses will be designed around actual pipeline deployment and intentionally focus on critical thinking, problem-solving and collaborative integration for a final delivered creative media project.
5. Faculty will be afforded the opportunity to research and refine pedagogical approaches in consultation with industry experts. Outcomes assessment will be heavily weighed to ensure the most effective delivery of instruction by teachers and mastery of concepts by participating students. (**Epic Games** will be invited to participate in outcome assessments.)
6. To invite additional collaboration amongst like-minded educational institutions, lessons learned in pedagogical development will be disseminated through the professional organizations **SIGGRAPH**, **SMPTE**, and **VES** as well as at the higher ed conferences **University Film and Video Association** and the international association of film schools **CILECT** (*Centre International de Liaison des Ecoles de Cinema et de Television*) of which RIT is a member.
7. Best practices will be communicated throughout the media industry to permit accelerated advancement of virtual production tools and techniques (e.g. development of a **SIGGRAPH** short course is already in the planning stage).
8. Findings will also be published in appropriate open access journals to reach the greatest number of interested readers and researchers. In this vein, we hope to partner with recent open publishing initiatives at RIT as a synergistic opportunity to disseminate our story to the greater higher ed community.
9. We would also present our findings at public events here at the MAGIC Center as well as at our own **Frameless Labs Symposium** - dedicated to research in VR/AR/XR, as well as other cutting-edge media technologies - held at MAGIC every November.
10. RIT will use the evolving curriculum and the practice of virtual production across in-house cinema projects to invite research proposals by computer science, engineering, and other technical students and faculty across campus interested in continuous improvements in tools and techniques. As with other media topics on campus today, the integration of artists and technologists across RIT will inspire scholarship activities that can serve to improve systems deployed in commercial production.

Curriculum Outline

We envision a two-course intensive sequence (eventually expanded to three courses with evolving content) that encompasses the following emerging media pipelines:

- **Previsualization:**

- Environments design: via CG elements, parametric construction, GIS data (Earth & ESRI City Engine) and photogrammetry
- VR / virtual scouting of environments
- Art design: generation of “Hero” art vs prop design elements
- Characters design: considering options from Real Illusion Character Creator integrated with traditional design work from Rochester-area costume designers
- Lighting design: blocking and staging passes
- Sequence design: animation, lighting and camera choreography for pre-visualization, including introduction to software pipelines and workflows (see also: stunts and wire-work below)
- Desktop, sound stage, and XR deployment of cinema pre-production and pre-visualization tools and techniques - built around both online/live and offline use cases
 - Use of VR and tablets for rapidly greyboxing, blocking, lighting, and framing shot sequences
- Multiple shot sequence assignment using Sequencer tools - this would use both multiple sequences as well as the Take Recorder and Vcam (with iPads) tools for live elements

- **Virtual Production:**

- Real-time compositing of CG assets in live cinematography
- Sequencer: CineCamera matching to real cameras for VFX
- XR techniques (Vive trackers and other) for match-move cinematography and VFX
- Real-time vs simulation vs practical VFX assignments
- Live actors in CG environments (referencing pioneering work of Rob Legato and “The Jungle Book” and Jon Favreau and the most recent work on “The Mandalorian,” as examples)
- Motion captured actors (using [Live Link](#)), lighting, and camera for fully CG-rendered production sequences (referencing techniques employed in productions such as “Hellblade”, “Avatar,” “The Lion King,” etc.)

- Practical environmental “projection” effects using large-scale emissive screens, camera tracking, and real-time graphics rendering
 - Desktop, sound stage, and XR deployment of cinema production tools and techniques
 - Virtual stunts, safety, wire-work and rag-doll simulations
 - Post Production: look LUTs and color grading - contrasted against traditional color grading methods and lin/log workflows
 - Post Production: audio pipelines for virtual production
- **Experimental / Emerging Techniques:**
 - Volumetric Production: 3D texture (RGB-D) capture of live action actors
 - Volumetric cinematography and post-production re-lighting
 - [nDisplay](#) for multiple display outputs
 - HRTF and binaural audio for virtual production vs Unreal Audio spatialization used for previsualization

The research project is built to test and assess the best pedagogical methods for delivery of these new skillsets – something we feel higher education has yet to do effectively in preparing students to enter the workforce in these emerging fields.

Additionally, much of this curriculum is equipment and space-intensive. We propose building functional production facilities to permit study and creativity in previsualization and virtual production workflows for media, ***with an intentional emphasis on cost-effective and efficient design.***

We are also very intrigued to include student practitioners in faculty scholarship work, advancing the art and science on multiple fronts. Once trained, student innovators become instrumental in helping RIT researchers address fundamental improvements in tools and techniques. RIT research will be committed to bettering the tools and to deploying emerging technology in compelling new ways.

A final intent of this project is to share learning and best practices with the film community and other educational institutions. The results of the curriculum development process will be published and packaged in a way that outside collaborators may be able to take advantage of the learning. We plan to lead and then share. Technology research will also be disseminated to advance the field in general and bolster RIT’s commitment to growing creative technologies.

Resources Desired

RIT is committed to this curriculum development and to investing in virtual production technologies that will prepare our students to lead the next generation of pipeline evolution. This effort is well underway through support from several academic programs and departments across campus as well as through MAGIC Spell Studios.

With this proposal, we are seeking Epic's participation as partner in the continuation of our process. We have already sought counsel from many old and new friends at Epic over the past few months, including Luis Cataldi, David Morin, Ryan Mayeda, Bryan Pohl, Juan Gomez, and Wyatt Sevaese, and are grateful for their input in confirming and shaping our message.

We are very excited for the opportunity to help build out much of the coursework and studio exercises with Unreal Engine as the backbone.

To advance the project, we are seeking grant support in the following categories:

Project Total: \$350,000

Academic Year Curriculum Development, \$110,000: To permit scholarship relief and time release for our core team members to both build the virtual production courses and to test and deploy studio technology, we require funding equivalent to a 1-year Visiting Assistant Professor faculty line at RIT. This Visiting faculty member will cover existing coursework, permitting course release and focused attention for the team.

Summer Term Curriculum Development, \$85,000: To cover compensation for core team members focused on project scholarship during the summer term.

Staff and Facility Support, \$35,000: Several RIT staff and facility personnel have been identified to help deploy studio technology necessary for standing up the new curriculum. This budget line permits relief from a portion of their current responsibilities.

Consulting and Faculty Training, \$70,000: In order to respect the value of our external partner's contributions of time and expertise to our project, we would like to be able to compensate the subject matter experts from *The Third Floor* and other industry colleagues. This funding would be intended to cover 1) industry subject-matter-expert consultancy, 2) training-related expenses for RIT faculty, and 3) proof-of-concept deployment with local production companies like *Optic Sky Productions*.

Studio Equipment Seed Fund, \$50,000: RIT is committed to investing significant resources into equipment and technology needed to stand up virtual production curricular activities in the MAGIC Spell Studios building; however, we are seeking seed support from Epic to permit greater flexibility and spending power for tools acquisition. We are also actively pursuing partnership from other development channels to augment this particular line item.

Proposed Timeline

The RIT team is pursuing an aggressive goal of commencing the first course in the curriculum sequence in January, 2021. Based on typical academic year budgeting guidelines at RIT, the focused effort outlay for the project is expected during the 2020/2021 academic term. In particular, funds reserved for the Visiting Assistant Professor position are expected for the Fall and Spring Semesters of this academic year.

Spring 2020: Select members of the team have been able to begin core research and liaise with industry consultants during the Spring Semester, 2020. Shaun Foster, in particular, has been able to take advantage of synergies around his current Epic Megagrant curriculum award as well.

Summer 2020: Pedagogy research, equipment acquisition, and curriculum development will begin in earnest amongst the full project team during summer 2020. Emphasis will be placed on the initial course offering which focuses on pipeline and tools competency. Summer salary funds proposed in the project budget will permit full-time attention to the work during this term. Elements of curriculum design will likely be produced, permitting strategic testing as smaller modules within existing 3D animation or 3D design courses during Fall Semester, 2020.

Fall 2020: Core team faculty will have release time to continue curriculum development, completing plans for the first courses and initiating design for the final courses. Equipment pipelines will be tested and confirmed for sound pedagogical delivery. Assessment plans will be drawn to permit thorough review of the first course offering in spring 2021.

Spring 2021: The first new course in the virtual production sequence will be taught. Core team members will continue to benefit from release time during this semester to refine and complete the second course while also participating in assessment of the first course.

Perhaps most importantly, the team will begin publishing findings from this research in spring, 2021, aiming for talks and short courses at **GDC**, **NAB**, and **SIGGRAPH** – as well as presentations at the summer **UFVA** conference and the fall **CILECT** conference.

We would also welcome input from the Epic education team on how best to maximize the lessons of this pedagogy research project. We intend to evolve the industry's talent pool across multiple institutions and want to see the full community benefit from advancing tools and techniques. We feel uniquely qualified at RIT to lead the way, supporting the growth of our friends and colleagues across the media landscape.

Project Key Players

- **Chris Edwards** – Founder and CEO, *The Third Floor*, Los Angeles, CA. (BFA – RIT School of Film and Animation)
- **Aaron Gordon** – Founder and CEO, *Optic Sky Productions*, Rochester, New York (BFA – RIT School of Film and Animation)
- **Shaun Foster** – Program Director, 3D Digital Design, RIT School of Design
- **David Long** – Director, MAGIC Spell Studios, Associate Professor, Motion Picture Science, RIT School of Film and Animation
- **Flip Phillips** – Professor, Motion Picture Science, RIT School of Film and Animation
- **Ihab Mardini** – Assistant Professor, 3D Digital Design, RIT School of Design
- **Atia Newman** – Associate Professor, 3D Animation, RIT School of Film and Animation
- **Mark Reisch** – Assistant Professor, 3D Animation, RIT School of Film and Animation
- **Frank Deese** – Assistant Professor, Screenwriting, RIT School of Film and Animation



Chris Edwards hosts RIT Film Students at The Third Floor in Los Angeles



Professors Ihab Mardini and Shaun Foster present research at RIT's Frameless Labs Symposium

Research and References

Virtual Production (Unreal)

- [Unreal Virtual Production / Visual Disruptors](#)
- [Unreal Mixed Reality](#)
- [Epic Virtual Production Field Guide](#)
- [Filming the Fantastic with Virtual Technology: Filmmaking on the Digital Backlot](#)
1st Edition by Mark Sawicki (Author), Juniko Moody (Author) April 2020

Technical References

- [Unreal Engine Sequencer](#)
- [Take Recorder](#)
- Multiple [Audio Inputs](#)
- [Quixel Mega Scans](#)
- [ESRI City Engine](#)
- [Agisoft: Metashape](#)

VP Companies

- [Animatrik](#)
- [Framestore](#)
- [ILM X LAB](#)
- [Foundry](#)
- [Fox VFX Lab](#)
- [The Future Group](#)
- [Halon Entertainment](#)
- [Lux Machina](#)
- [The Mill](#)
- [Method Studios](#)
- [Profile Studios](#)
- [Stargate Studios](#)
- [Stiller Studios](#)
- [The Third Floor Visualization](#)
- [Weta Digital Virtual Production](#)
- [Zero Density](#)