The Power of Reality in Rich Volumetric VR Experiences

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About the speaker

Eric Hanson

is CEO of Blueplanet VR, as well as a faculty member at the USC School of Cinematic Arts. With a background in design, architecture, photography, and feature film visual effects, Eric currently creates volumetric VR content spanning natural history, cultural heritage, and science visualization. His VFX work can be seen in “The Day After Tomorrow”, “Cast Away”, and “The Fifth Element”, among others. Recent work has led to collaborations with The Dunhaung Foundation, Frontline/PBS, The Navajo Nation & Ai Weiwei, and the Onward Project. Eric finds enormous potential in volumetric VR for creating important and meaningful experiences.
Class Overview

This class will cover an overview of the workflow of capturing and utilizing real-world locations in order to make powerful realtime volumetric 6DOF virtual reality experiences. Starting with site capture methodologies, techniques of utilizing 360 panoramas, DSLR photogrammetry, and laser scanning are discussed, along with specific hardware concerns. Post-production workflow is then described, utilizing raw conversion, tone-mapping, photogrammetry solves, cleanup and prep in Autodesk Maya, then final import into Unity. Final examples are shown through a VR headset session that illustrates detailed captures.
Class Goals

SITE CAPTURE & POST-PRODUCTION

Ability to capture locations with correct methodology and hardware, convey efficient post-production workflow

APPLICATIONS

Discover the untapped potential of utilizing real-world volumetric capture in a variety of fields

UNDERSTANDING SCOPE AND BUDGET

Ability to budget or schedule the correct scope of work
Intro to 6DOF VR Immersion
Site Capture Technique
Site Capture Technique

**SPHERICAL PANORAMAS - MONO/STEREO**
- Camera/ lens choice dictates resolution
- Use pano chart to calculate image overlap
- Use indexed pano head rotator
- 8mm fastest, yields 14k on Sony a7Riii

**HDR LIGHTING PROBES**
- Use 8mm 180deg (fullframe sensor) at 4 rotations
- Use special rotator w/ 90 deg detents
- Shoot at 1 stop increments, 11 stops total
- Always shoot color calibration chart

**SHOOTING PHOTOGRAMMETRY**
- All manual settings, but AF acceptable
- Sharp focus throughout
- Heavy overlap with a continuous flow of images
- 25mm a sweet spot for resolution/speed

**LASER SCANNING**
- Used to fill photogrammetry's shortcomings
- Always use w/ urban or built subjects, less w/ nature
- Low to med settings acceptable for this purpose
- Expensive but rentable w/ insurance
Spherical Image Capture

- Camera/ lens choice dictates resolution
- Use pano chart to calculate image overlap
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**Fullframe Sensor:**

<table>
<thead>
<tr>
<th>15mm &gt; 11.4K H resolution</th>
<th>20mm &gt; 16.9K H resolution</th>
<th>35mm &gt; 27.6 K H resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 every 60 deg H, +/-30 deg tilt 1 every 90 deg tilt (13 img)</td>
<td>9 every 40 deg H, +/-35 deg tilt 1 every 90 deg tilt (19 img)</td>
<td>18 every 20 deg H, 0 deg tilt 9 every 40 deg H, +/-45 deg tilt 1 every 90 deg tilt (37 img)</td>
</tr>
</tbody>
</table>

**Cropped Sensor:**

<table>
<thead>
<tr>
<th>15mm &gt; 15.8K H resolution</th>
<th>20mm &gt; 20.4K H resolution</th>
<th>35mm &gt; 30.4K H resolution</th>
</tr>
</thead>
<tbody>
<tr>
<td>12 every 30 deg H, 0 deg tilt 6 every 60 deg H, +/-45 deg tilt 1 every 80 deg tilt (25 img)</td>
<td>12 every 30 deg H, +/-20 deg tilt 6 every 60 deg H, +/-60 deg tilt 1 every 90 deg tilt (37 img)</td>
<td>24 every 15 deg H, 0 deg tilt 15 every 24 deg H, +/-30 deg tilt 12 every 30 deg H, +/-60 deg tilt 1 every 90 deg tilt (79 img)</td>
</tr>
</tbody>
</table>
High Dynamic Range Capture

- Use 8mm 180deg (w/ fullframe sensor) at 4 rotations
- Use special rotator w/ 90 deg detents
- Shoot at 1 stop increments, 11 stops total
- Always shoot color calibration chart
Pano/HDR Integration

- Spherical panoramas with matched HDR useful for easy compositing of CGI elements
- Can be used in 3DOF VR or VFX flat renders
Photogrammetry Capture

- All manual settings, but AF acceptable
- Sharp focus throughout
- Heavy overlap with a continuous flow of images
- ALWAYS move camera in world space
- Always shoot in RAW + small JPG
- 25mm lens a sweet spot for resolution/speed
- Three scenarios: Interior or Exterior or Object
Interior Capture

- Never shoot from center or pan from one spot
- Back against the wall, “step then shoot” along perimeter
- Repeat perimeter moves w/ panned cam positions
- HDR and tripod may be necessary but slows speed
- Can use custom rigs to provide tilts, add speed
Interior Capture

- Never shoot from center or pan
- Back against the wall, step then shoot perimeter
- Can use custom rigs to provide tilts, add speed
Exterior Capture

- Cover full expanse with all occlusions
- Mostly handheld, but poles invaluable for hard to reach areas and ground capture
- Consider what final VR experience will be and shoot accordingly, full extent of capture will be prohibitive
Exterior Capture

- Cover full expanse with all occlusions
- Mostly handheld, but poles invaluable for hard to reach areas and ground capture
- Consider what final VR experience will be and shoot accordingly, full extent of capture will be prohibitive
Exterior Capture

- UAV/Drone use useful for larger site context
- Fixed-wing or helicopter charter for next level of scale
- GIS data useful for largest level of scale
Laser Scanning Capture

- Used to fill photogrammetry’s shortcomings
- Always used w/ urban or built subjects, less w/ natural
- Low to med resolution settings acceptable for this purpose, greater need for speed with many station points
- Expensive but rentable w/ insurance
Post-Production Technique
Post-Production Technique

RAW COLOR GRADING
- Use of Adobe Bridge, speed counts
- Define white point w/ color chart
- Adjust varying exposure levels w/ curves, etc
- Boost fill shadows, make 2nd set for texturing w/ intended final grade
- Export max quality JPG

PROCESSING PHOTOGRAMMETRY
- Verify all images for sharpness, exposure
- Use of Reality Capture for highest quality rendition, large loading, GPU speed
- Use of open-source Meshroom for learning, minor work
- Export 2M polys with single 8k texture map

PANORAMA/ HDR STITCHING
- Use of PTGui, best for spherical stitching
- Also can export 32 bit HDR and/or tonemap
- Typically export at 8k x 4k equirectangular map
- Useful for variety of VR tasks, video re-projection
- Use of SNS-Pro for photogrammetry tonemaps

CLEANUP/ INTO UNITY AND VR
- Use of Maya, Meshmixer, Mudbox
- Import initial mesh, then trim excess w/ Maya or Meshmixer (handles large meshes faster)
- Cut into pieces for further re-texturing, then paint fix in Mudbox
- Final poly reduce in Maya, then import into Unity
RAW Processing and Grading

- Use of Adobe Bridge, speed counts
- Define white point w/ color chart
- Adjust varying exposure levels w/ curves, etc
- Boost fill shadows, make 2nd set for texturing w/ intended final grade
- Export max quality JPG
Panorama/ HDR Stitching

- Use of PTGui, best for spherical stitching
- Also can export 32 bit HDR and/or tonemap
- Typically export at 8k x 4k equirectangular for VR
- Useful for variety of VR tasks, video re-projection
- Use of SNS-Pro for photogrammetry tonemaps
Processing Photogrammetry

- Processing speed has dramatically reduced due to GPU
- Verify all images for sharpness, exposure beforehand
- Use of Reality Capture for high quality texture rendition, control, large image loads, GPU speed
- Use of ReCap Photo or open-source Meshroom for learning, occasional work
- Will create billions of polygons, but export 2-5M with single 8k texture map to start
- Decisions depend on pre-rendering or realtime use
Cleanup/ into Unity and VR

- Use of Autodesk Maya, Meshmixer, Mudbox
- Import initial mesh, then trim excess w/ Maya or Meshmixer (handles large meshes faster)
- Cut into pieces for further re-texturing, poly reduce in Maya, then paint fix final geo in Mudbox or other
- then import into Unity or UE
- VRTK useful in Unity
- Delivery platforms are desktop (Most HMDs) or Android (Quest, Pico)
- Establish correct perceptual scale of model
- Establish region and means of movement (teleporting)
- Deep well of UI possibilities
- Social potential w/ Normcore.io
Present to Future of Immersion
Present to Future of Immersion

**USEFUL FOR ALL HUMAN ENDEAVORS**
- Virtual Travel
- Interactive Storytelling (Wolves in the Walls)
- Real Estate
- Medicine
- Architecture and Construction, etc etc

**NEEDS WIDE PROLIFERATION OF HMDS**
- Needs a major to bring millions of users
- Apple expected
- AR will be a gateway drug for VR

**INCREASINGLY SOCIAL**
- Pandemic has shown need and increased growth
- Affords remarkable presence (Museum of Other Realities)
- Obvious use in education (historic recreation)
- Etc etc

**NEEDS EVOLUTION OF CONTENT OFFERINGS**
- Majority of titles are gaming-centric, needs expansion
- Most creative work in film festivals (non-commercial)
- Potential remains untapped (world of “what if?”)
Thank you!

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