Panoramic Views into The Future

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VISGRAF Lab - IMPA

Outline

• One Bit of Futurology
• Some Concepts and Theory
• State of the Arts & Craft

Past, Present and Future

Past

Film / Video

Present

Film / Video

VR

AR

Games

Future

Film / Video

VR

Games

AR

corvergence / integration
BTW, **SIGGRAPH 2016**

Electronic Theatre

VR Village  Emerging Tech

Real-Time Live!

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### Content, Modes and Users

<table>
<thead>
<tr>
<th></th>
<th>Film / Video</th>
<th>VR / AR</th>
<th>Games</th>
</tr>
</thead>
<tbody>
<tr>
<td>Story</td>
<td>Passive</td>
<td>Many</td>
<td></td>
</tr>
<tr>
<td>Exploration</td>
<td>Interactive</td>
<td>Individual</td>
<td></td>
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<tr>
<td>Role Playing</td>
<td>Engaging</td>
<td>Groups</td>
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### CG & Animation

<table>
<thead>
<tr>
<th>Film / Video</th>
<th>VR / AR</th>
<th>Games</th>
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<tbody>
<tr>
<td>2D Images</td>
<td>Single Camera</td>
<td></td>
</tr>
<tr>
<td>3D Geometry</td>
<td>Multi-View</td>
<td></td>
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<tr>
<td>Behaviour (4D)</td>
<td>Autonomous PV</td>
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### Production Pipeline

<table>
<thead>
<tr>
<th>Film / Video</th>
<th>VR / AR</th>
<th>Games</th>
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</thead>
<tbody>
<tr>
<td>2D / Compositing</td>
<td>Off-Line</td>
<td></td>
</tr>
<tr>
<td>3D / Rendering</td>
<td>Real-Time</td>
<td></td>
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<tr>
<td>Simulation / AI</td>
<td>Concurrent</td>
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### Systems & Technologies

<table>
<thead>
<tr>
<th>Film / Video</th>
<th>VR / AR</th>
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</thead>
<tbody>
<tr>
<td>VFX / Post</td>
<td>Displays</td>
<td></td>
</tr>
<tr>
<td>Assets / Worlds</td>
<td>Input / Output</td>
<td></td>
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<tr>
<td>Rules / Engines</td>
<td>Location Aware, Networked</td>
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### Technology Trends

- Input
  - Cameras
  - Sensors
- Output
  - Displays
  - Sound

*dependencies*
Cameras

- RGBD
  - Zed / Kinect / Tango
- Omnidirectional
  - PointGrey Ladybug / KodakSP 360
- Plenoptic
  - Lytro Immerge

Displays

- Full Dome
  - IMAX
- HMD (Head Mounted)
  - Oculus / Google Cardboard
- Light Field
  - MS HoloLens / NVIDIA Projects
- Tablets, Etc..

The Dream Camera

- 360 Degrees
- Depth
- HDR
- A-Res
- Noiseless
- Robotic

We are Getting There…

announced Oct. 2015

announced Oct. 2015

Ideal Display

- Stereo 3D / Holographic
- Viewpoint Aware
- Tone Mapped HDR
- Retina High-Res
- Space Embedded
- Zero Latency
Dilema!

- Are Theatres Doomed?
- Multiple Scenarios / Platforms …

What are people doing?

- Oculus Storyboard Studio
- ILMxLab
- Blender Animation Studios

Immersive Entertainment
- Lucasfilm Content (Star Wars / Jurassic Park)

Various Platforms
- Stereo VR
- HMD
- Tablet
Blender Animation Studios

- New Production Tools

Caminandes: Episode 3 - Xmas VR

Ongoing Project…

Challenges

- New Media
  - Language
  - Authoring
- Production
  - Representations
  - Tools

Research @ VISGRAF

- VR - 360° Video
  - Camera Language
  - Extended Panoramas
- AR - Stereoscopic Immersion
  - Mesa 3D
- Media Integration
  - Blender Multi-View Tools

360° Video
**Field of View**

- Reference to Observer
  - 30 to 90 degrees

**Film Language**

- Conventional Cinema
  - HD Television
  - Theater / Panavision
- 360 Degrees Cinema
  - Omnimax / Full Dome
  - HMD
  - Tablet

**Conventional Cinema**

- Camera Moves Language
  - Track
  - Pan / Tilt
  - Zoom

**360° Camera**

- Camera Moves Language
  - Track
  - Pan / Tilt
  - Zoom

  - yes
  - maybe
  - ?

**360° Image Transforms**

*Moebius Transformations for Manipulation and Visualization of Spherical Panoramas*

- Current Research at VISGRAF Lab
- Collaboration with
  - Leonardo Koller Sacht (PhD Student)
  - Luis Penaranda (Post-Doc)

**Möbius Transformations**

- Complex Map
  - $M : \mathbb{C} \mapsto \mathbb{C}$

  - elliptic
  - hyperbolic
  - parabolic
Math of Camera Moves

- Omnidirectional Images and Moebius Transformations
  - Pan / Tilt ↔ Elliptic Transform
  - Zoom ↔ Hyperbolic Transform
  - Perspective ↔ Parabolic Transform

Transformation Pipeline

- Möbius Mapping

Example

- Extreme Zoom

Comparison

- Alternative Projections

Augmented 360° Panoramas

Photorealistic Rendering of Omnidirectional Images, combining Real and Synthetic Scenes

- Current Research at VISGRAF Lab
- Collaboration with
  - Aldo Zang (PhD Student)
  - Dalai Felinto (Research Assistant)
HDR RGB-D Panorama

- Radiance
- Depth

Environment Model

- Derived Data:
  - Scene Geometry
  - Light Map

CG Integration

- Blender Plugin

Synthetic Objects

- Insertion into the Scene

Augmented Reality

- Full Simulation of Real-Virtual Interaction

Photorealistic Rendering

- Blender to LuxRender
Fish Eye Output

- Cycles

Stereoscopic Immersion

Mesa 3D

Interactive Horizontal Stereoscopic Display

- Current Research at VISGRAF Lab
- Collaboration with
  - Dalai Felinto (Research Assistant)
  - Bruno Madeira (PhD Student)
  - Djalma Lucio (Research Staff)

Planovision

- Horizontal Oblique Projection
- Viewpoint Tracking
- Embedded Augmented Reality
Media Integration

Current / Future Research

- Authoring Systems
  - Integrated Media
  - Natural Interfaces

- Production Techniques
  - Live Action + CG
  - Real Time Simulations

Authoring Issues

- Passive
  - Movies

- Interactive
  - Google Street View

- Immersive
  - AR Cinema

Emerging Medias

Blender VR

Integrated Multi-View and Stereo 3D

- Current Research at VISGRAF / Blender Institute
- Collaboration with
  - Dalai Felinto (Research Assistant)
  - Aldo Zang (PhD Student)
  - Djalma Lucio (Research Staff)

VISGRAF Studio Setup

Panoramic Projection

HMD - Oculus

Mesa 3D

Optitrack
to be continued…