Immersive Virtual Reality Visualisation of the Arctic Clyde Inlet on Baffin Island (Canada) by Combining Bathymetric and Terrestrial Terrain Data

Mona Lütjens
Area of Investigation
Main Focus

• Creation of the digital elevation model
• Development of virtual reality application
• Advantages and limitations of displaying terrain data in 3D immersive applications
## Materials

<table>
<thead>
<tr>
<th>Dataset</th>
<th>Resolution</th>
<th>EPSG</th>
<th>Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>MSM 66</td>
<td>5 m</td>
<td>32661</td>
<td>Raster</td>
</tr>
<tr>
<td>IBCAO</td>
<td>500 m</td>
<td>3996</td>
<td>Raster</td>
</tr>
<tr>
<td>ArcticDEM</td>
<td>2 m</td>
<td>3413</td>
<td>Raster</td>
</tr>
<tr>
<td></td>
<td>5 m</td>
<td>3413</td>
<td>Raster</td>
</tr>
<tr>
<td>CDEM</td>
<td>~ 20 m</td>
<td>4269</td>
<td>Raster</td>
</tr>
<tr>
<td>RGI</td>
<td>varying</td>
<td>4326</td>
<td>Vector</td>
</tr>
</tbody>
</table>
Hydrographic Data Acquisition and Processing

- Kongsberg EM122
- 12 kHz
- 5 m resolution

Data: MSM66 (below surface) and ASTER GDEM (above surface) is a product of METI and NASA
Terrestrial Data Processing

- ArcticDEM 5m
- ArcticDEM 2m
- CDEM
Combining Bathymetric and Terrestrial Data

- Terrestrial DEM
- Extract Fjord (CDEM)
- MSM66
- IBCAO
- Critical locations
Creating the Splat Map

- MSM66
- IBCAO
- Transition
- RGI
- Terrestrial Terrain
Integrating the DEM into VR

Import

• Tiled landscape
• Scaling
• 128 tiles
• Each tile:
  • 2017 x 2017 pixel
  • 10 x 10 km
  • 8 million triangles

Software: Unreal Engine 4
Integrating the DEM into VR

Import

Level Streaming

• Distance : 10km

Software: Unreal Engine 4
Integrating the DEM into VR

Import

Level Streaming

Level of Detail

• Automatic LOD

• Manual LOD
  • 99.97% triangle reduction

Software: Unreal Engine 4
Environment and Texture in VR

Lightning

• Sky
• Underwater

Software: Unreal Engine 4
Environment and Texture in VR

Lightning

Landscape Texture

• Terrestrial Terrain
  • Natural
  • Grey
• MBES Bathymetry
  • Backscatter
  • Rainbow
  • Grey
• Transition + IBCAO
  • Dark grey
Environment and Texture in VR

Lightning
Landscape Texture
Foliage
• Alpine catchfly
• Heather
• Northern Androsace
• Three grass types

Data:
Photorealistic Landscape Pack 2 - Gokhan Karadayi
Open World Demo Collection – Epic Games
Environment and Texture in VR

Lightning
Landscape Texture
Foliage
Water Surface
Seagulls

Data:
Water Planes — Epic Games
Landscape Mountains — Epic Games
Locomotion in VR

Teleportation

Flying

Fast Travel

• 12 waypoints

Imagery Sources: Esri, DigitalGlobe, GeoEye, Earthstar Geographics, CNES/Airbus DS, USDA, USGS, AeroGRID, IGN, and the GIS User Community
Dynamic Interactions in VR

- Locomotion Display
- Elevation, Distance and Compass Measurements
- Height Difference and Slope Measurements
- Menu
Results: Terrain and Environment
Results: Motion Controller and Locomotion

- Elevation: 0 m
- Distance: 6,836 m
- Velocity: 1 km/h
- Arc Endpoint: 12 m
Results: Measurements

Elevation: 0 m
Distance: 1,901 m
Advantages

• Observation from different perspectives / distances
• Improved perception of the terrain
• Improved interpretation options (e.g. at slopes, visual axes)
Limitations

• Limited possibility to import/export geospatial datasets

• No proper spatial reference

• Time-consuming hardware and project setup
Conclusion

• Method for visualising vast, high resolution terrain in VR
• Combination of bathymetric and terrestrial datasets
• Increased perception of terrain compared to 2D presentations
• Some limitations: import/export, spatial reference system
→ VR has potential for future applications
THANK YOU
References


• Polar Geospatial Center & Regents of the University of Minnesota (2017). Introduction to ArcticDEM. Retrieved February 19, 2018, from https://www.pgc.umn.edu/guides/arcticdem/introduction-to-arcticdem/