

An aerial photograph of a mountain range with a river valley. The mountains are covered in green vegetation, and the river valley is a mix of green and brown. The sky is blue with some white clouds. The text is overlaid on the top half of the image.

Geo-Art Technique for Virtual Reality

Bird's Eye View

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Outline of Presentation

- Introduction
- Level Slicing of Elevation
- Assignment of Colors and Textures
- Procedures for “Geo-Art”
- Conclusions



Introduction

- HCC has developed “Geo-Art” technique by converting a designer’s sense to a scientific model
- Integration of hill shading, colors and textures corresponding to sliced elevation zones were used to create a “Geo-Art”

An aerial photograph of a mountainous region in Japan, showing a complex network of ridges and valleys. The terrain is color-coded to represent different elevation zones, with higher elevations in shades of purple and blue, and lower elevations in shades of green and yellow. The text is overlaid on the image.

Level Slicing of Elevation

- in case of Japanese mountains-

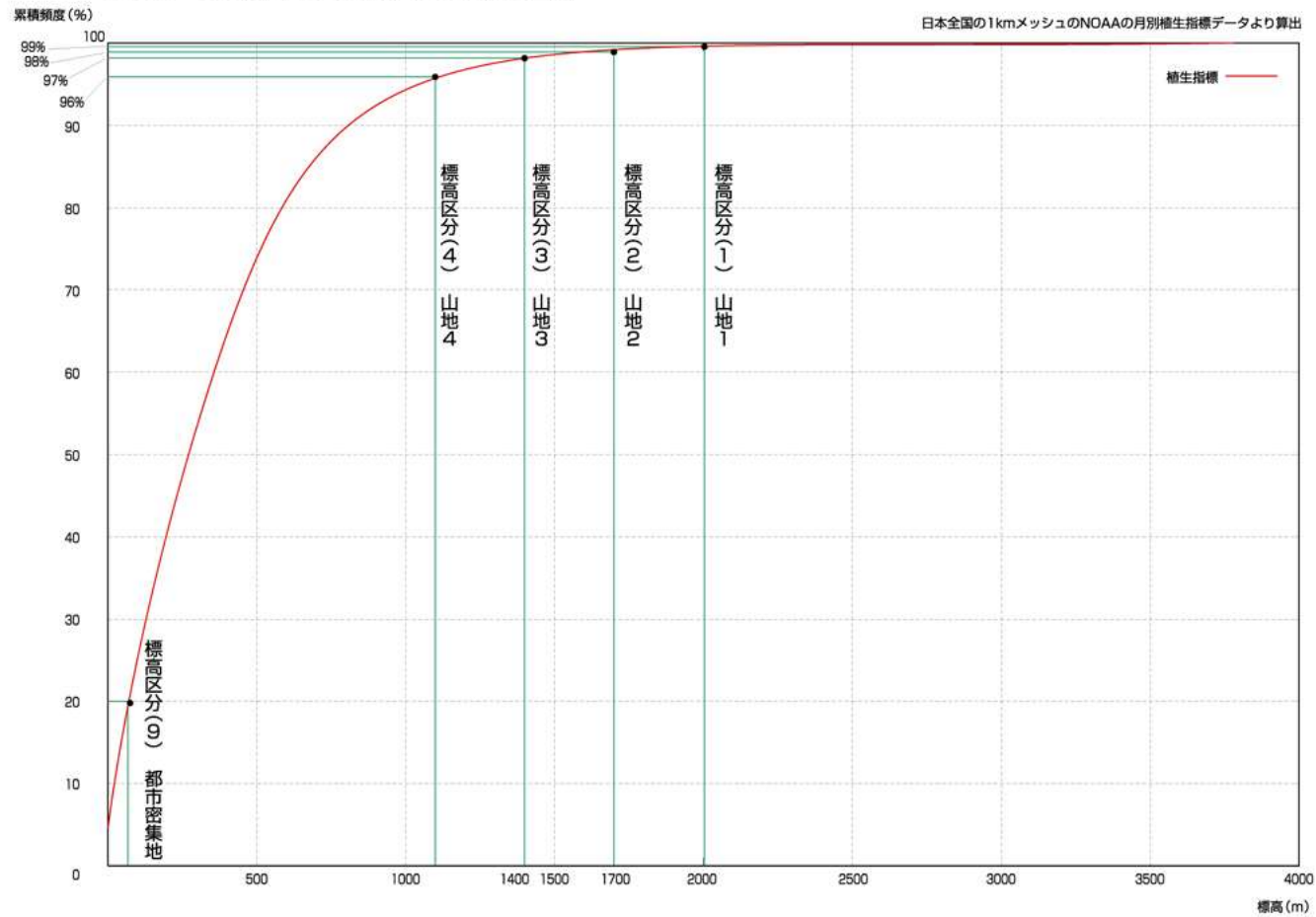
- A scientific approach for classifying nine elevation zones was taken with NOAA NDVI, land use data and DEM
- 1) 2000- 2) 1700-2000 3) 1100-1700
- 4) 1100-1400 5) 700-1100 6) 200-700
- 7) 100-200 8) 50-100 9) 0-50

Classification of Mountains and Urban with NDVI

- Accumulated histogram (%) of NDVI distribution with respect to Z (height) was used
- Zone 1: 2000m- ANDVI: 99-100%
- Zone 2: 1700-2000m ANDVI: 98-99%
- Zone 3: 1400-1700m ANDVI: 97-98%
- Zone 4: 1100-1400m ANDVI: 96-97%
- Zone 9: 0-50m (urban) ANDVI: 0-20%

Accumulated Histogram of NDVI

● 図1 0.2以上の植生指標の累積頻度曲線

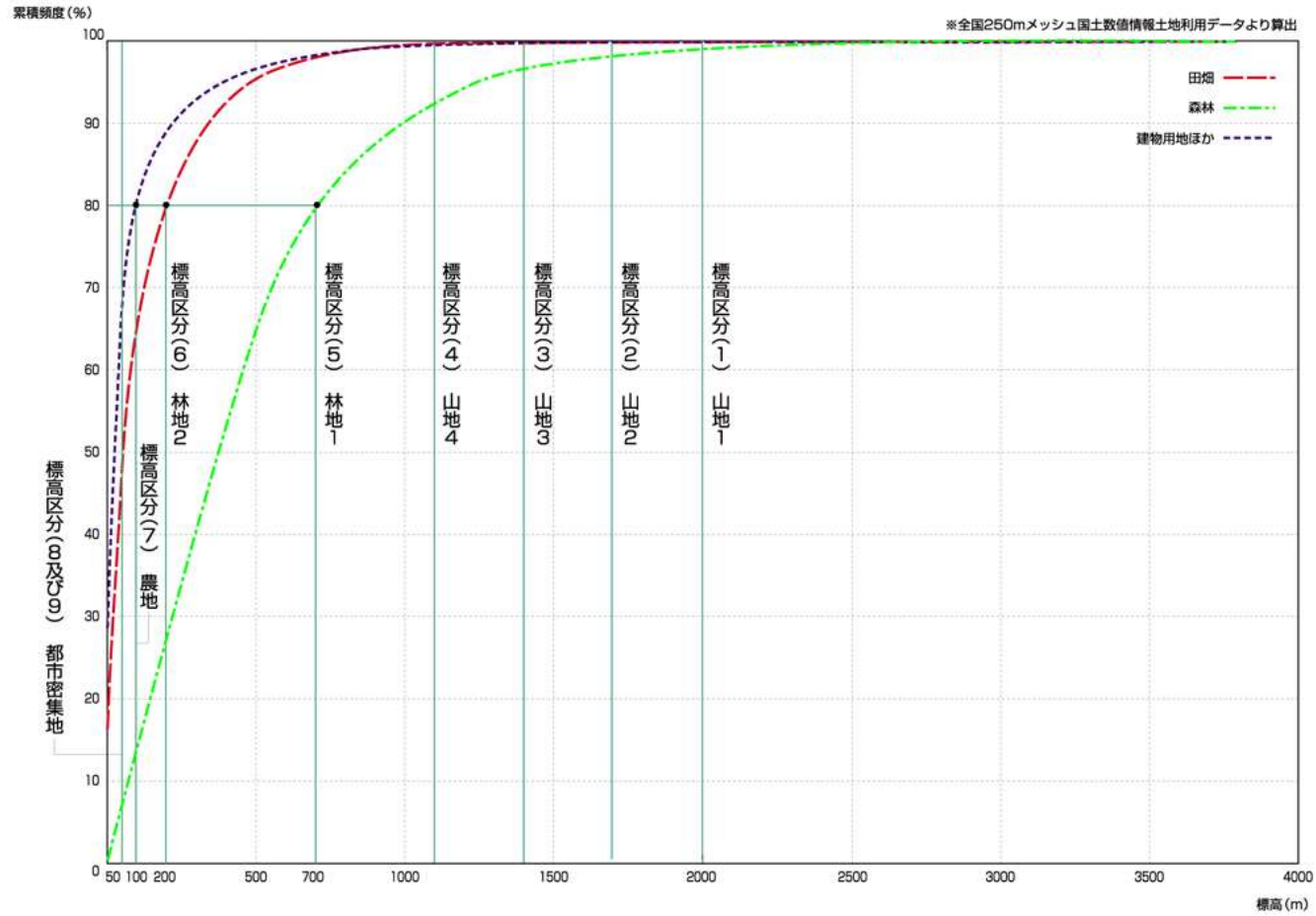


Classification of Forest Land and Crop Land with Land Use Data

- Accumulated histogram of crop land, forest and urban were used to classify Zone 5, Zone 6 and Zone 7
- Zone 5: 700-1100m Forests: AHF: 80-%
- Zone 6: 200-700m Forests: AHC: 80-%
- Zone 7: 100-200m Crop Land: AHU80-%
- Zone 8: 50-100m Crop Land: AHU –80%

Accumulated Histogram of Land Use

●図2 国土数値情報土地利用データの累積頻度曲線



Classification of Terrain Roughness

- Roughness is defined as height difference in a unit area
- Accumulated histogram of roughness with respect to 9 zones was used to classify 5 categories in each zone, which makes 45 classes in total
- 10m grid DEM were used to compute roughness in a unit area of 500m square










Assignment of Colors
















































- Colors: to be assigned to nine elevation zones
- Saturation (S) should be changed and reduced depending on the roughness
- Zone 1 is estimated rocky mountain with brown color

Color Chart for Zones and Roughness

●図4 標高帯別テクスチャ

等高帯		テクスチャ
1	$H \geq 2000m$	
2	$1700m \leq H < 2000m$	
3	$1400m \leq H < 1700m$	
4	$1100m \leq H < 1400m$	
5	$700m \leq H < 1100m$	
6	$200m \leq H < 700m$	
7	$100m \leq H < 200m$	
8	$50m \leq H < 100m$	
9	$H < 50m$	

●表1 (色)

等高帯		起伏量 (m)				
		1	2	3	4	5
1	$H \geq 2000m$					
2	$1700m \leq H < 2000m$					
3	$1400m \leq H < 1700m$					
4	$1100m \leq H < 1400m$					
5	$700m \leq H < 1100m$					
6	$200m \leq H < 700m$					
7	$100m \leq H < 200m$					
8	$50m \leq H < 100m$					
9	$H < 50m$					

Assignment of Textures

- Textures were extracted from actual aerial photographs by checking the elevation, roughness and land use
- Textures were combined with each color chart
- Textures increase the effect of virtual reality

Procedures of Geo-Art

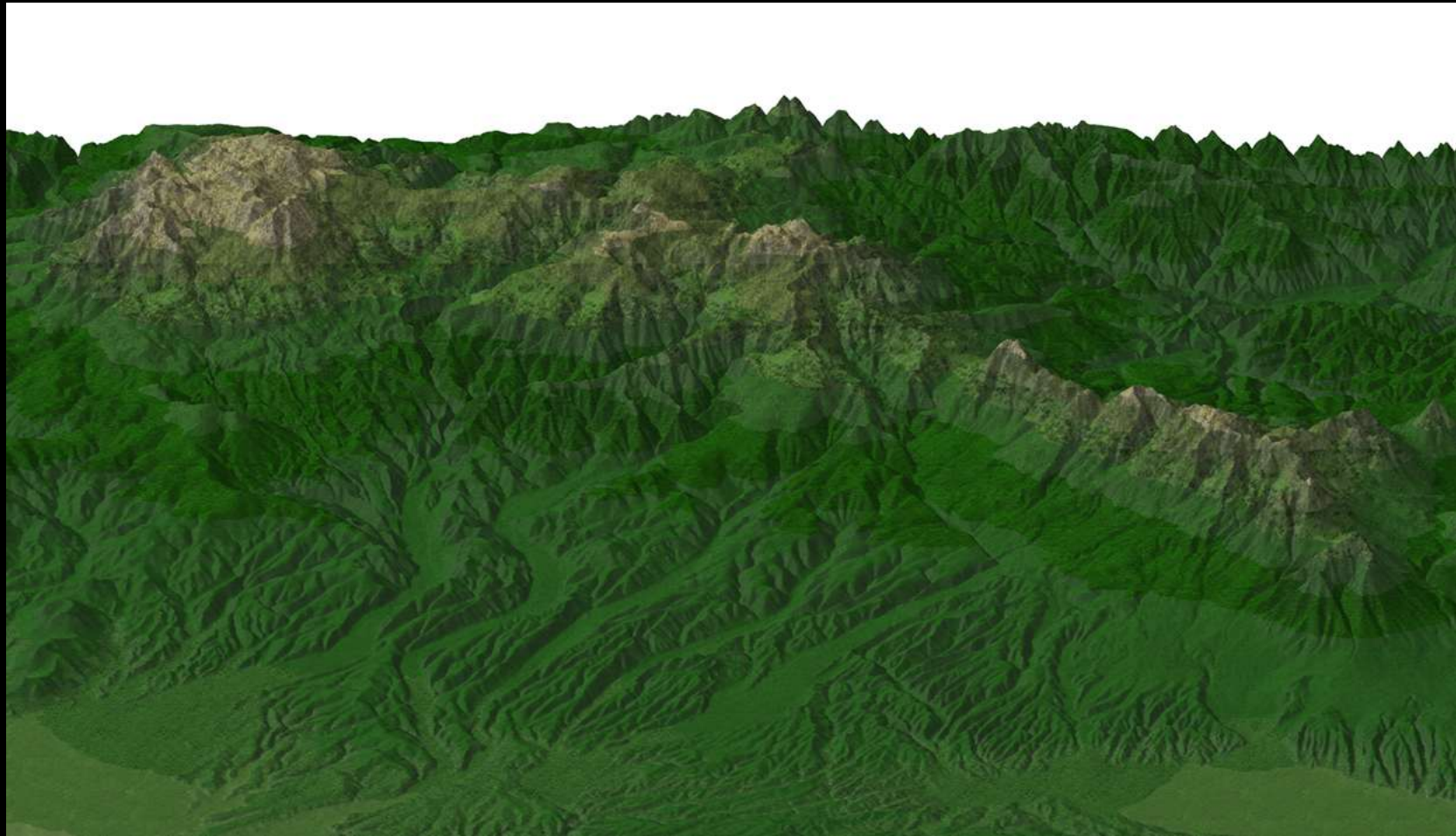
- Step 1: Compute hill shading from DEM
- Step 2: Classify DEM into 9 zones
- Step 3: Assign colors to each zone
- Step 4: Assign textures to each category and zone
- Step 5: Composite all products
- Step 6: Generate clouds and snows

Demonstrations of Geo-Art

- Texture Mapping Sample
- Mt. Daisetsu-zan, Hokkaido, Japan
- Japan Alps



Geo-Art of Texture Mapping Sample



Geo-Art of Mt. Daisetsu-zan



Geo-Art of the Japan Alps



The background of the slide is a topographic map of a mountain range. The terrain is rendered with hill shading, where higher elevations are shown in lighter colors (yellow and white) and lower elevations in darker colors (green and blue). The map also features a network of roads and rivers, with the rivers shown in blue. The overall appearance is that of a detailed, three-dimensional topographic map.

Conclusions

- Bird's eye view with hill shading, colors and textures gave more realistic images
- Level slicing of elevation zones with NOAA NDVI reflected more scientific approach
- Geo-Art revealed more value added