

New Applications of the Image Grand Tour

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Overview

- Pixel Tours and IGT
- Example 1: Minefield
- Example 2: MISR
- Example 3: Petroglyphs
- Conclusion



Image Grand Tour (IGT)

- Wanted – A method to address:
 - ◆ Multispectral imagery
 - ◆ Satellite imagery various look angles
 - ◆ Multiple time series
 - ✦ Seismic Signals
 - ✦ Electrocardiograms
- Our approach: ***Image Grand Tour***
- Original Developers:
Wegman, Poston, Solka

Pixel Tours (1)

The Grand Tour is motivated by the idea of looking at an object from all possible points of view. From a high-dimensional data visualization point of view, we want to look at a point cloud from all perspectives.

Types of tours:

- **2-dimensional (Asimov, 1985), (Buja and Asimov, 1985)**
 - ***d*-dimensional (Wegman, 1991)**

Pixel Tours (2)

Two key components of a grand tour:

- **Space Filling**
- **Continuous**

Smoothly rotate a d -dimensional coordinate system indexed by time so that it "occupies all possible orientations." Project data into rotated coordinate system. Look for "interesting" configurations.

Pixel Tours (3)

- Possible Implementations:
 - ◆ Hypercube/Torus Tour
 - ◆ Random Interpolation Tour
 - ◆ Fractal Tour
 - ◆ Pseudo Grand Tour

Example 1: Minefield (1)



Example 1: Minefield (2)



Example 1: Minefield (3)



Example 1: Minefield (4) - Snapshot



Example 1: Minefield (5) - Movie



IGT Movie: Minefield

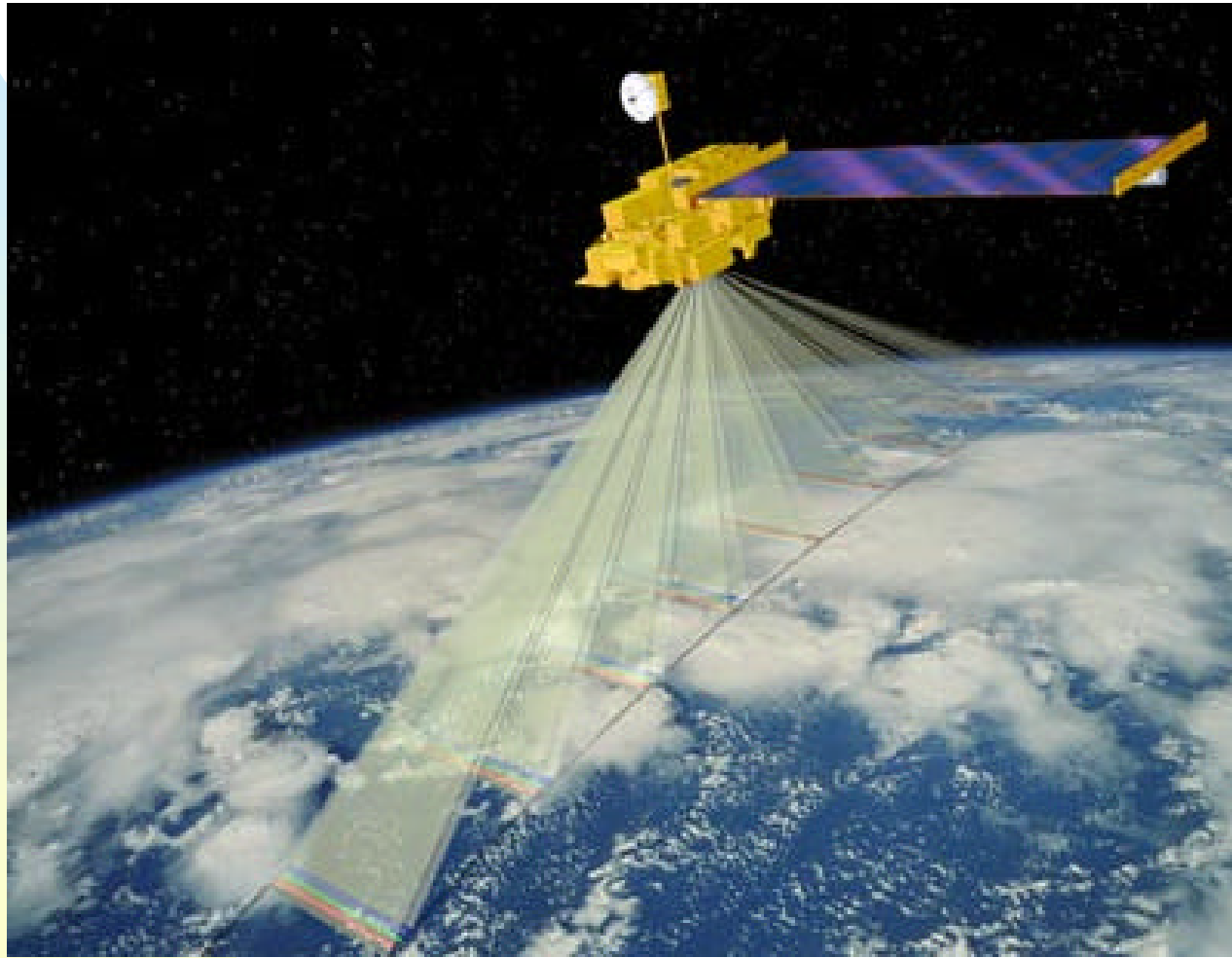




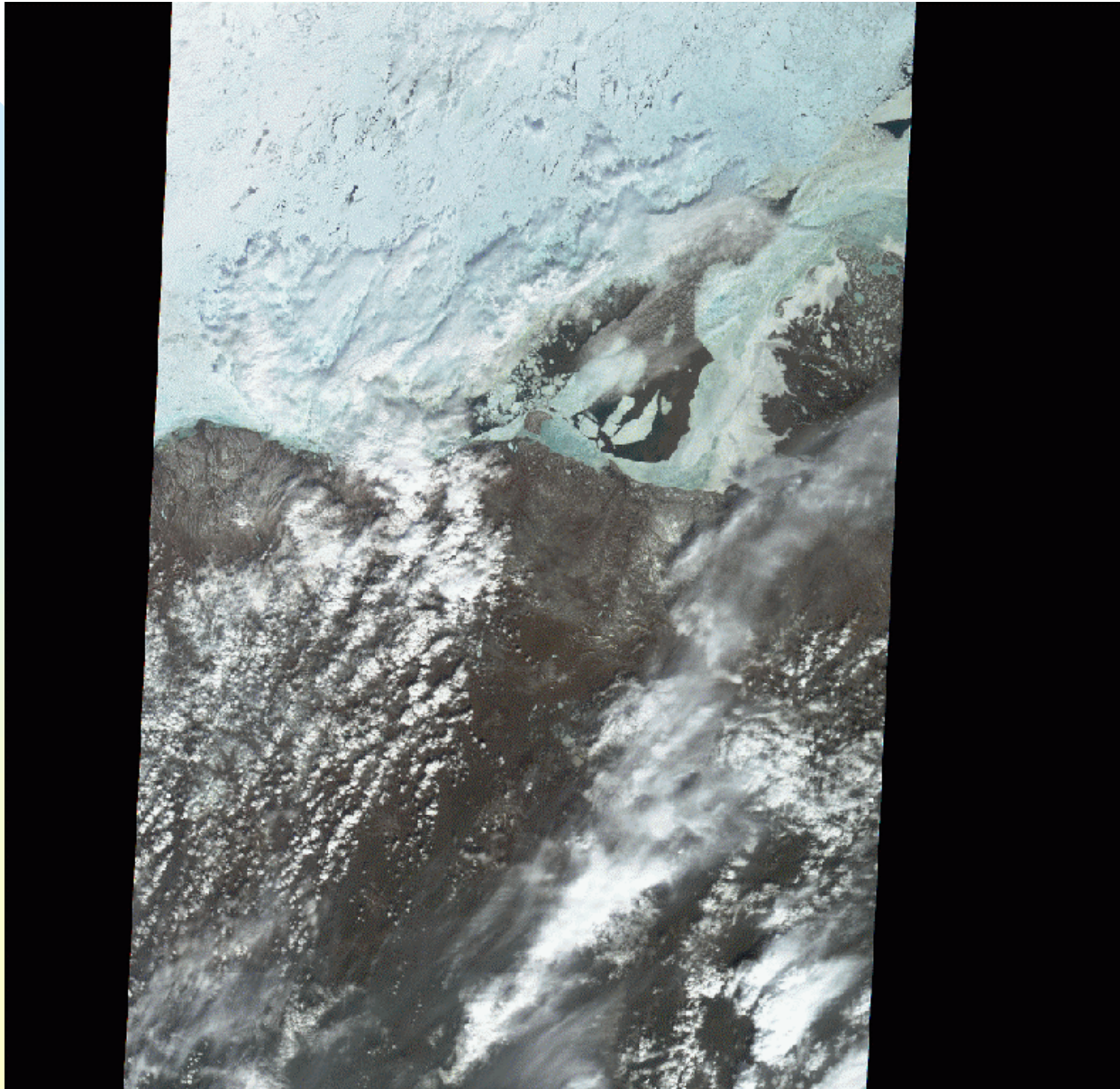
Example 2: MISR (1)

- MISR: Multi-angle Imaging SpectroRadiometer
 - ◆ On board of NASA's Earth Observing System satellite Terra
 - ◆ 9 cameras (at 9 different angles):
 - ✦ 70.5, 60, 45, and 26.1 degrees (forward and aft), 0 degrees
 - ✦ 4 bands each: R, G, B, NIR
 - ◆ Pixels: 1.1km x 1.1 km

Example 2: MISR (2)



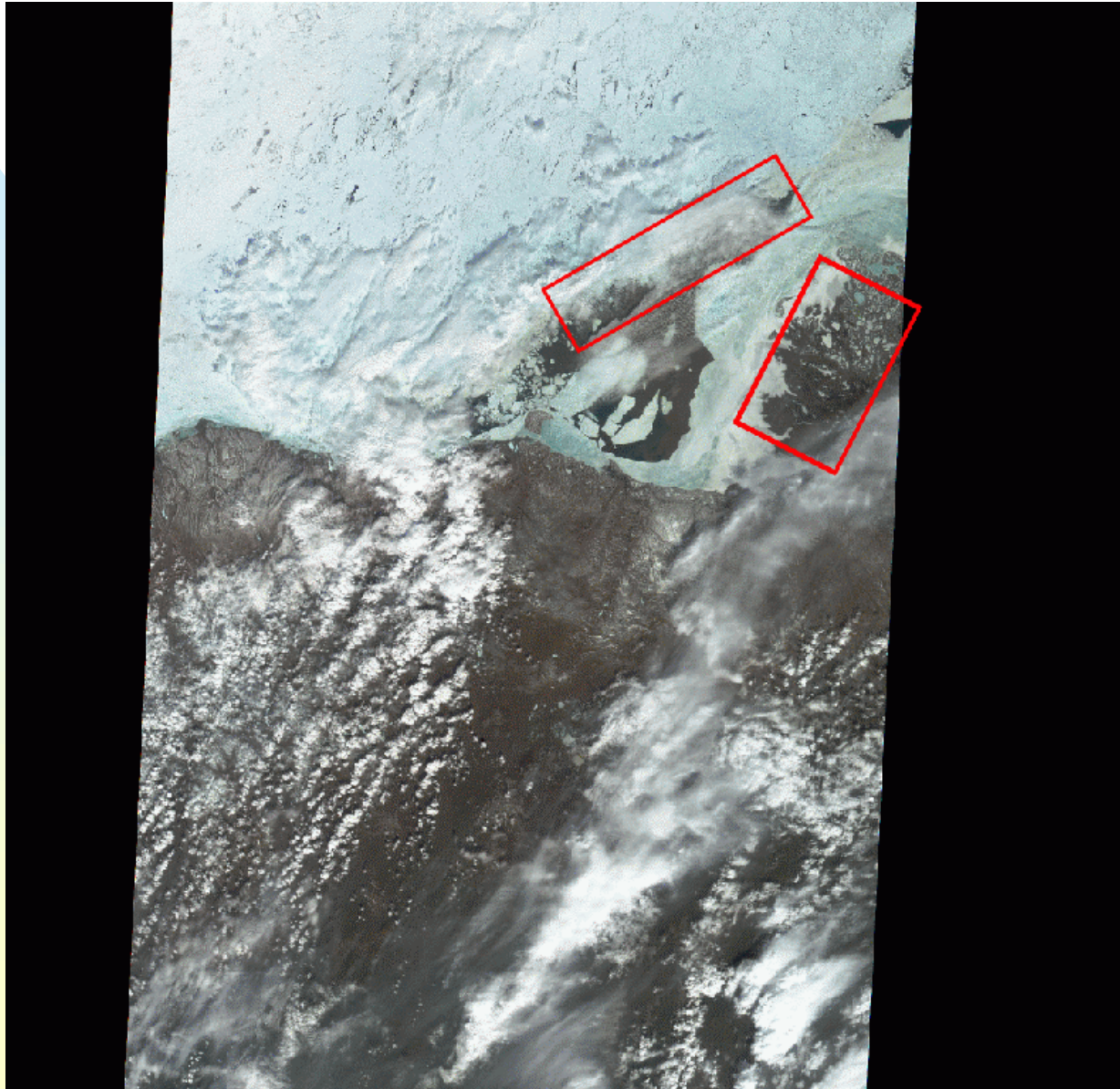
Example 2: MISR (3)



Example 2: MISR (4)

- North coast of Alaska (incl. Arctic National Wildlife Refuge)
- Ice: top - Land: bottom
- RGB composite of nadir (0 degree) camera
- Challenges:
 - ◆ Identifying clouds over ice and snow
 - ◆ Distinguishing among different types of ice (old/new, broken/solid)
- Multi-angle - multi-spectral data allows such identification via IGT

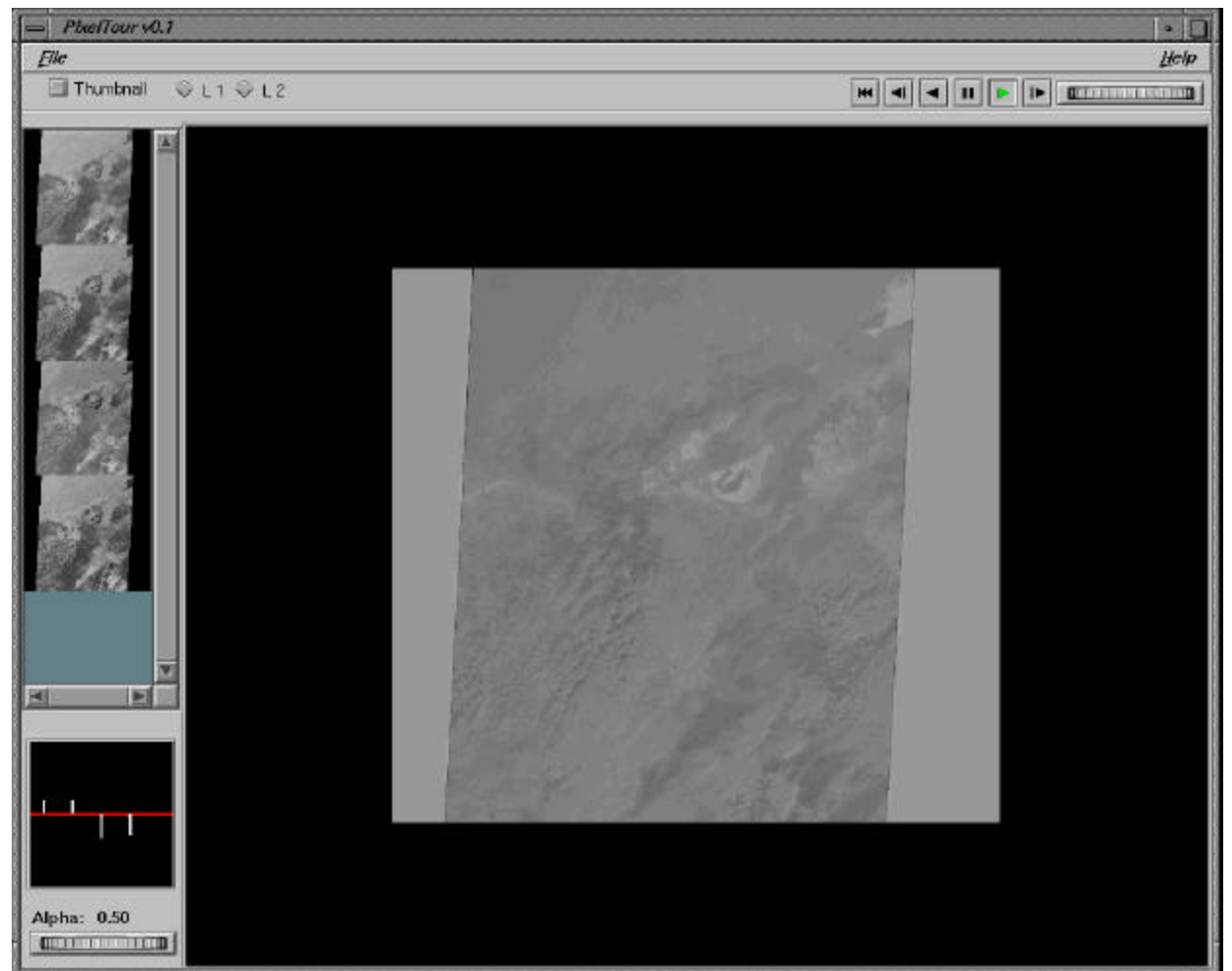
Example 2: MISR (5)



Example 2: MISR (6)



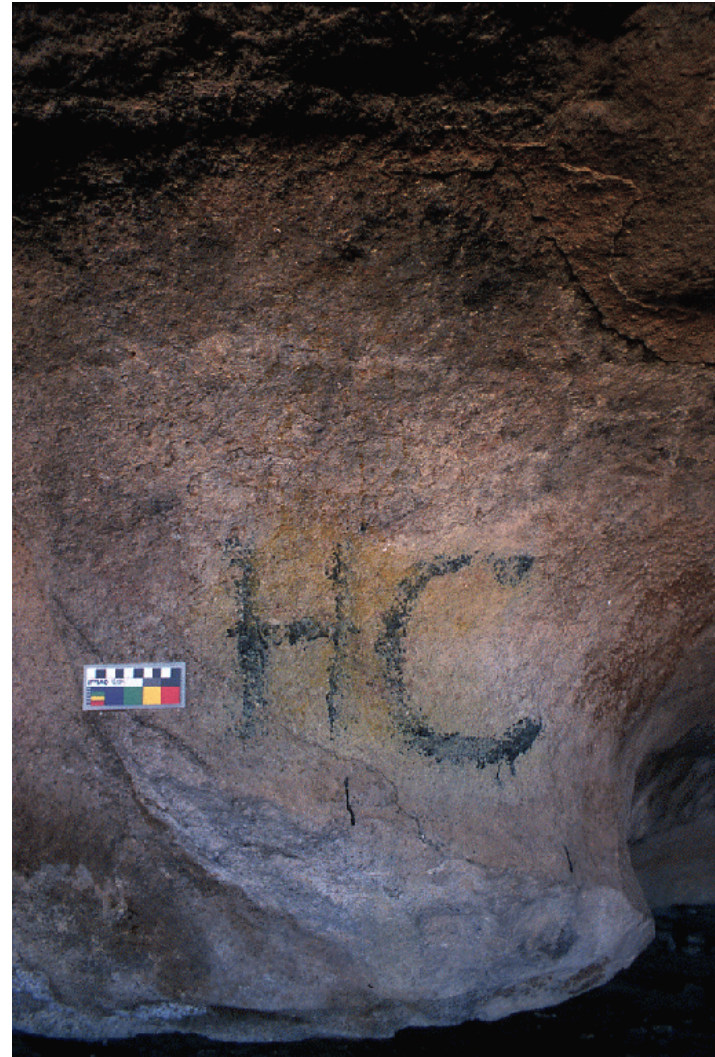
IGT Movie: MISR



Example 3: Petroglyphs (1)

- Pictographs from Hueco Tanks State Historical Park (east of El Paso, TX)
 - ◆ Faded over centuries
 - ◆ Destroyed through vandalism
- Current digital enhancement techniques time-consuming
- Use of IGT: faster detection of hidden features
- Photographs provided by Robert Mark

Example 3: Petroglyphs (2)

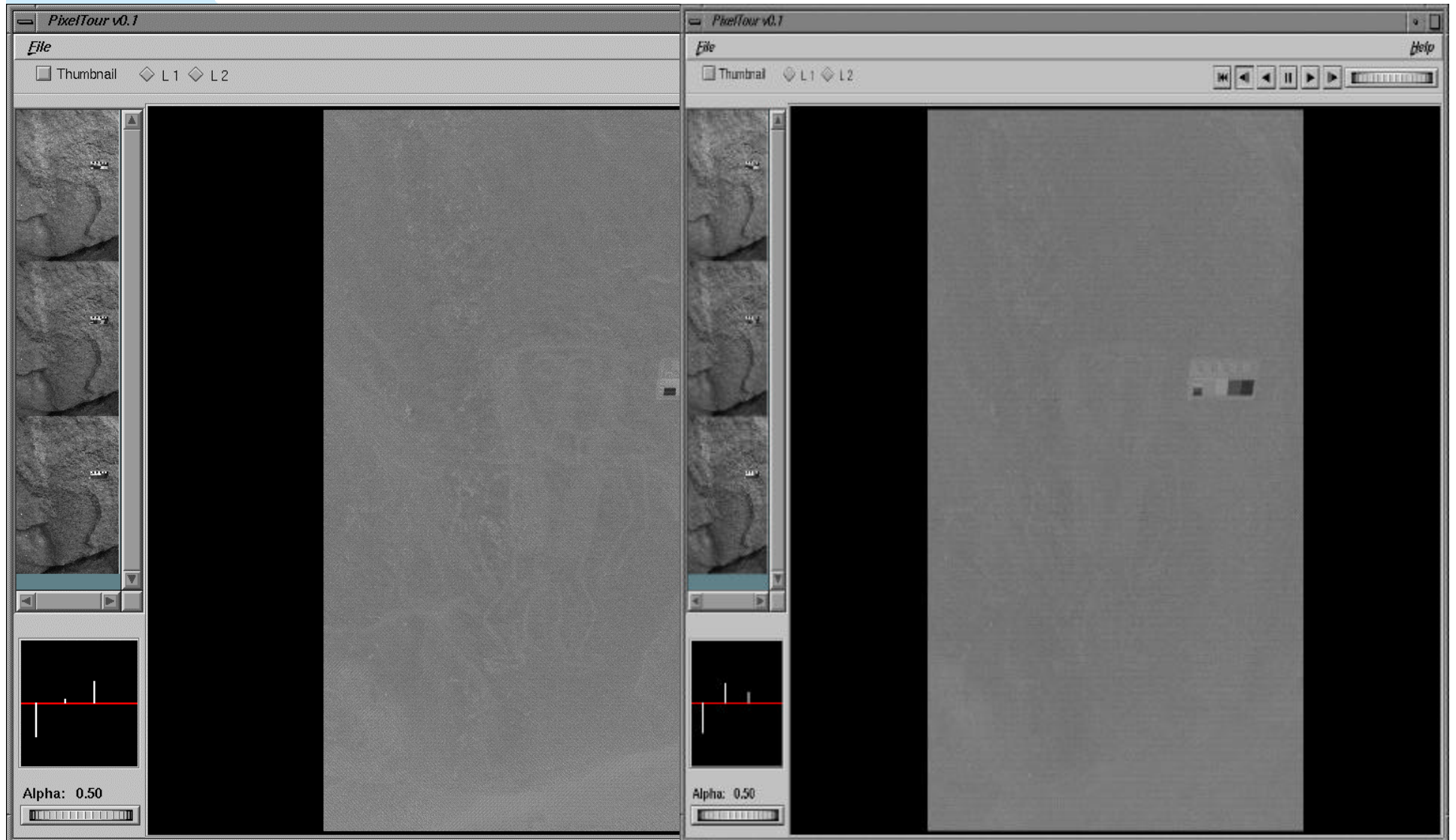


Example 3: Petroglyphs (3)



IGT Movie: Petroglyphs 1

Example 3: Petroglyphs (4)

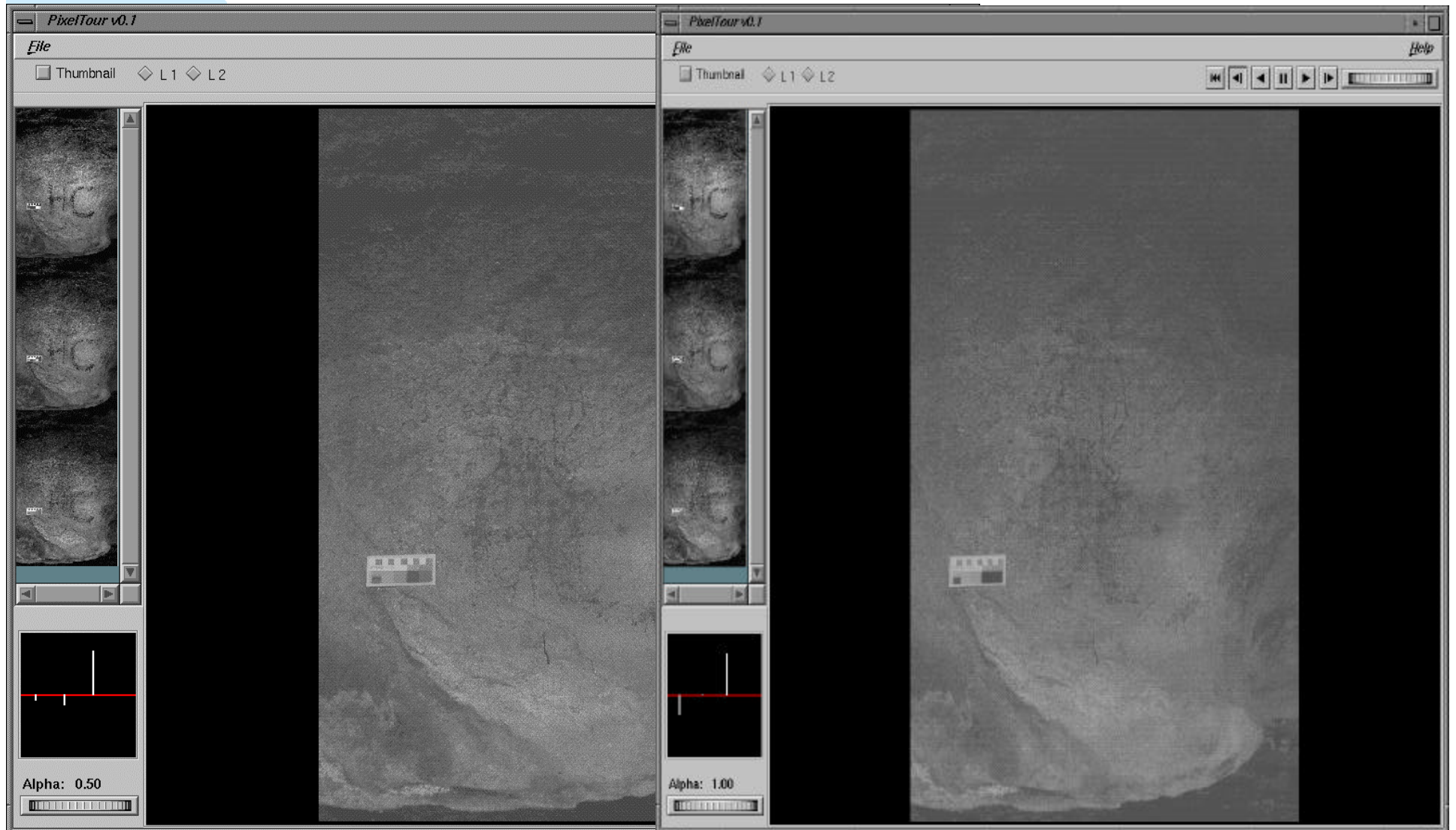


Example 3: Petroglyphs (5)



IGT Movie: Petroglyphs 2

Example 3: Petroglyphs (6)



Discussion

- IGT useful for multiple applications
- Fast to find “interesting” features in images
- Does not produce “nice” images
- Static view and movie view of interest
- Intended to add new functionality

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