Introducción a la Fotografía 3D
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Clase 3 : Jueves Abril 4

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Triangulation by Laser Striping

- Manually or mechanically translated laser stripe
- Per-pixel depth by ray-plane triangulation
- Requires accurate camera and laser plane calibration
- Popular solution for commercial and DIY 3D scanners

3D Photography on Your Desk: Bouguet and Perona [ICCV 1998]

- DIY scanner using only a camera, a halogen lamp, and a stick
- Per-pixel depth by ray-plane triangulation
- Requires accurate camera and shadow plane calibration

J.-Y. Bouguet and P. Perona. 3D photography on your desk.
Assembling Your Own Scanner

- Parts: camera (QuickCam 9000), lamp, stick, two planar objects [~$100]
- Step 1: Build the calibration boards (include fiducials and chessboard)
- Step 2: Build the point light source (remove reflector and place in scene)
- Step 3: Arrange the camera, light source, and calibration boards
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Swept-Plane Reconstruction Geometry

\[ P = \Lambda_C(x,y) \cap \Pi_l(t) \]
Demo: Data Capture

Figure 1: Video Capture for Scanning with Shadows
Video Processing: Assigning Per-Pixel Shadow Thresholds

\[ l_{\text{min}}(x;y) = \min_t l(x;y;t) \]

- Convert from RGB to grayscale (for luminance-domain processing)
- Determine per-pixel minimum and maximum value over sequence
Video Processing:
Assigning Per-Pixel Shadow Thresholds

\[ I_{\text{min}}(x;y) = \min_t I(x;y;t) \quad I_{\text{max}}(x;y) = \max_t I(x;y;t) \]

- Convert from RGB to grayscale (for luminance-domain processing)
- Determine per-pixel minimum and maximum value over sequence
Video Processing:
Assigning Per-Pixel Shadow Thresholds

\[ I_{\text{min}}(x; y) = \min_t I(x; y; t) \quad I_{\text{shadow}}(x; y) = \frac{I_{\text{max}}(x; y) + I_{\text{min}}(x; y)}{2} \]

- Convert from RGB to grayscale (for luminance-domain processing)
- Determine per-pixel minimum and maximum value over sequence
- Evaluate per-pixel “shadow threshold” as average of min. and max.
Video Processing: Spatial Shadow Edge Localization

- Select region of interest on each calibration plane (occlusion-free)
- Estimate zero-crossings to find leading and trailing shadow boundaries
- Fit a line to the set of points along each shadow boundary

Result: Best-fit 2D lines for each shadow edge (in image coordinates)
- Tabulate per-pixel temporal sequence (minus shadow threshold)
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- Estimate zero-crossings to find shadow-crossing times
Video Processing:
Temporal Shadow Edge Localization

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⇒ Result: Use shadow-crossing time to lookup corresponding 3D plane
Course Schedule

- Introduction
- The Mathematics of 3D Triangulation
- 3D Scanning with Swept-Planes
  - Camera and Swept-Plane Light Source Calibration
- Reconstruction and Visualization using Point Clouds