Monumental Projections
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6th Multitel Spring workshop on video analysis
June 28th 2011
Goals

Projections on huge buildings

i. Reconstruct the projection surface

ii. Calibrate the projectors

iii. Project!!!
Plan

i. What exists?

ii. Real-time rendering

iii. 3D reconstruction

iv. Calibration

v. Rendering Engine
What exists?

Homography

\[ x_d = H \cdot x_s \]
What exists?

Structured light

\[
[x_{\text{proj}} \mid x_{\text{cam}}] \& [x_{\text{cam}} \mid x_{\text{dest}}]
\]

- Light pattern = code
- Camera point of view
Interaction

• Homography \textit{limited}
• Structured light \textit{limited}

$\Rightarrow$ Real-time rendering of the scene
Plan

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v. Rendering Engine
Real-time rendering

• Model of the scene
  => 3D reconstruction
• Model of the projector
  => Calibration
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3D reconstruction

From
Images

To
3D Model
3D reconstruction

1. Extract particular pixels for images

2. Track them in the sequence

3. Retrieve the different pose of the camera

Simplification: calibration of the camera
Features detection

Good Features to track
Features Tracking

- Window around the feature eg. 7x7 pixels

Find the feature that a similar neighbour
Using SSD
Results
False couple

Eliminate the false couple using the fundamental matrix $F$

$x'^T F x = 0$
Results
Pose estimation

Matrix Essential $x'^T F x = 0 \Rightarrow X'^T E X = 0$

Pose from E
Results
Results
Results
Plan

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Projector calibration

Projector = Camera

⇒ Use the same method of calibration
Calibration Method

1. Calibrate a camera
   - Camera intrinsic properties (focal length, optical center, ...)
   - Camera extrinsic properties (rotation & translation from world to camera)
Calibration Method

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Calibration method

• projector calibration
  - Project a known pattern (chess board)
  - Detect the points in the camera images
  - Calculate the world position of the points

 ➔ World points and pixel positions in the projector
 ➔ Projector calibration
Projection Principles

• Recreate the scene in 3D with OpenGL
• Create virtual camera with the same intrincis and extrinsics properties as the projector
• ... Render
Projection Principles

✓ Simple method
✓ Fast to implement
✓ Good results
✗ Not flexible
✗ measures of the surface
Plan

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Rendering Engine

- OpenGL/OpenFrameworks (c++)
- Master - Slave architecture (one pc - one projector)
- Read video playlist and sound
- Linear fading between projectors not automated (but asap ...)
Architecture
3ds Importation
3ds Importation
Thank you for your attention!
Any Questions?