Computational Light Painting Using a Virtual Exposure

Nestor Salamon\textsuperscript{1}, Marcel Lancelle\textsuperscript{2}, Elmar Eisemann\textsuperscript{1}

\textsuperscript{1}Delft University of Technology, The Netherlands
\textsuperscript{2}ETH Zurich, Switzerland

https://graphics.tudelft.nl/Publications-new/2017/SLE17/
Light Painting
Light Painting
Light Painting
Light Painting

Mark Walker: light_painting-031 (CC BY-SA 2.0)

Pelle Sten: Light Painting the Abandoned Shelter (CC BY 2.0)
Making light painting simpler?

- Specialized Equipment [Car11]
  - Expensive
  - Restrictive
  - Manual processing

- Accumulate short exposures [MA13, MB15, TSY*07, BPB13]
  - Long acquisition (>20 min)
  - Artifacts remain (e.g., person)
  - No intuitive control over output
Our approach

• Acquisition

• Artifact Removal

• Drawing Interface
Acquisition and Tracking of the Source
Using the acquired data
Using the acquired data
Using the acquired data
Problems

• Background brightened
• Light positions missing
• Light source present
• Person visible
Background Illumination

- Background image before additional light sources
Difference Image: Input – Background

• Accumulated difference images
Corrected Result

- Accumulated difference images plus background

Background not overly bright
The Artifacts

- Background brightened
- Light positions missing
- Light source present
- Person visible
Missing Light Positions
Interpolate Between Two Light Positions

- Linearly interpolate Contributions

User input
Interpolate Between Many Light Positions

Acquired Light Positions
Interpolate Between Many Light Positions

(Delaunay) Triangulated Light Positions
Delaunay-based Interpolation

- Interpolate Contributions based on barycentric coordinates
Delaunay-based Interpolation

Delaunay Triangulation and Input points

Resulting interpolation
The Artifacts

- Background brightened
- Light positions missing
- Light source present
- Person visible
Light Source Removal
Light Source Removal

Trivial overdraw... not quite successful!
Light Source Removal

Poisson inpainting – misses details
Light Source Removal

Our idea: Take details from a different image!
Light Source Removal

Domain paste of a patch from the Trimmed mean (10%)
Light Source Removal

Integration [TKO12] of Trimmed mean patch
Light Source Removal

Integrated Trimmed mean patch with our gradient adjustments
The Artifacts

• Background brightened
• Light positions missing
• Light source present
• Person visible
Person-aware weights

darkday: Creative Side  (CC BY 2.0)
https://www.flickr.com/photos/drainrat/16845254552
Person-aware weights

* Light source visible for clarity of exposition
Person-aware weights

Contaminated....

clean....

* Light source visible for clarity of exposition
Acquisition from Both Sides
Fusion of the two Images

* Light source visible for clarity of exposition
Fusion of the two Images

* Light source visible for clarity of exposition
Fusion of two images
Person-aware Fusion
The Artifacts

• Background brightened
• Light positions missing
• Light source present
• Person visible
Final Light Painting
Bells and whistles

- Specularity treatment
- Starburst Pattern
- Depth Capture/Editing
- Real-time GPU Light Painting
Bells and whistles

• Specularity treatment

• Starburst Pattern

• Depth Capture/Editing

• Real-time GPU Light Painting
Bells and whistles

• Specularity treatment
• Starburst Pattern
• Depth Capture/Editing
• Real-time GPU Light Painting
Bells and whistles

- Specularity treatment
- Starburst Pattern
- Depth Capture/Editing
- Real-time GPU Light Painting
Results
Virtual placement of a wall lamp at different positions. Illumination is steered with our solution.
Summary

- Low-cost and simple
- Robust light interpolation and correction method
- Artifacts due to artist are removed
- High-quality, easy-to-use solution to light painting
Computational Light Painting Using a Virtual Exposure

Nestor Salamon\textsuperscript{1}, Marcel Lancell\textsuperscript{2}, Elmar Eisemann\textsuperscript{1}

\textsuperscript{1}Delft University of Technology, The Netherlands
\textsuperscript{2}ETH Zurich, Switzerland

https://graphics.tudelft.nl/Publications-new/2017/SLE17/
References


