

ATTENUATION-BASED LIGHT FIELD DISPLAYS

Bachelor Thesis

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June 3, 2016

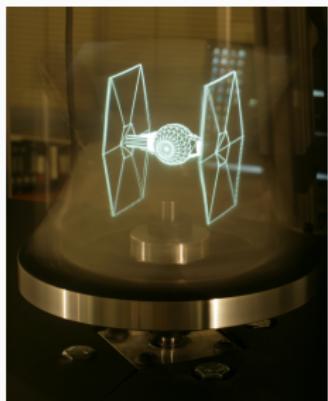
Institut für Informatik und angewandte Mathematik

OUTLINE

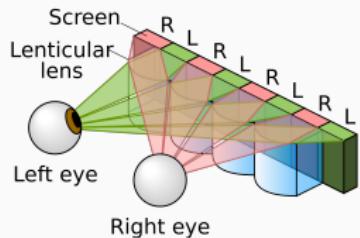
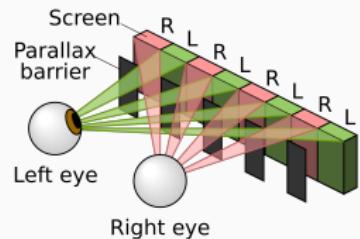
1. Motivation
2. Introduction to Light Fields
3. Problem Statement
4. Results
5. Assessment
6. Conclusion

MOTIVATION

EXISTING 3D DISPLAYS



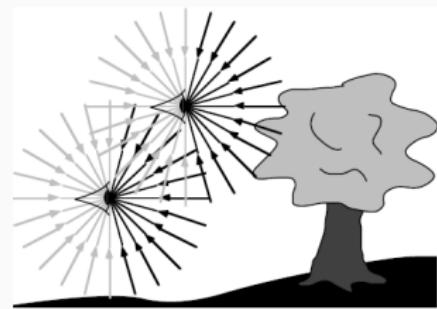
Add more images



INTRODUCTION TO LIGHT FIELDS

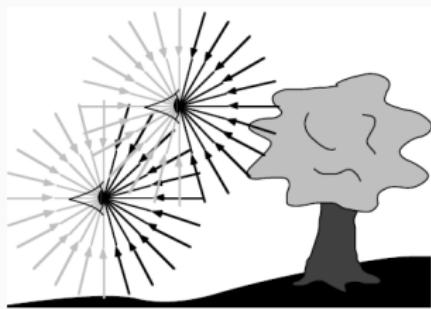
THE PLENOPTIC FUNCTION

- Measures light in the world



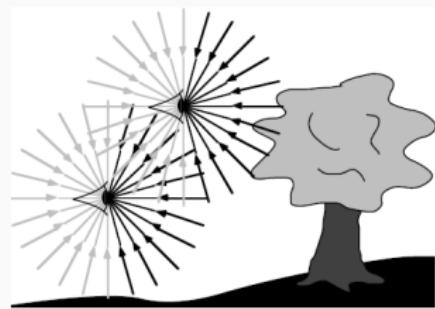
THE PLENOPTIC FUNCTION

- Measures light in the world
- $P(x, y, z, \theta, \phi, t, \lambda)$



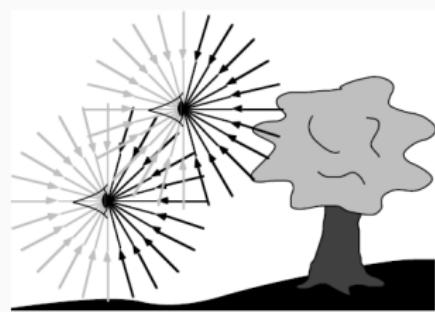
THE PLENOPTIC FUNCTION

- Measures light in the world
- $P(x, y, z, \theta, \phi, t, \lambda)$
- Position and viewing direction



THE PLENOPTIC FUNCTION

- Measures light in the world
- $P(x, y, z, \theta, \phi, t, \lambda)$
- Position and viewing direction
- Time, Wavelength



THE 4D LIGHT FIELD

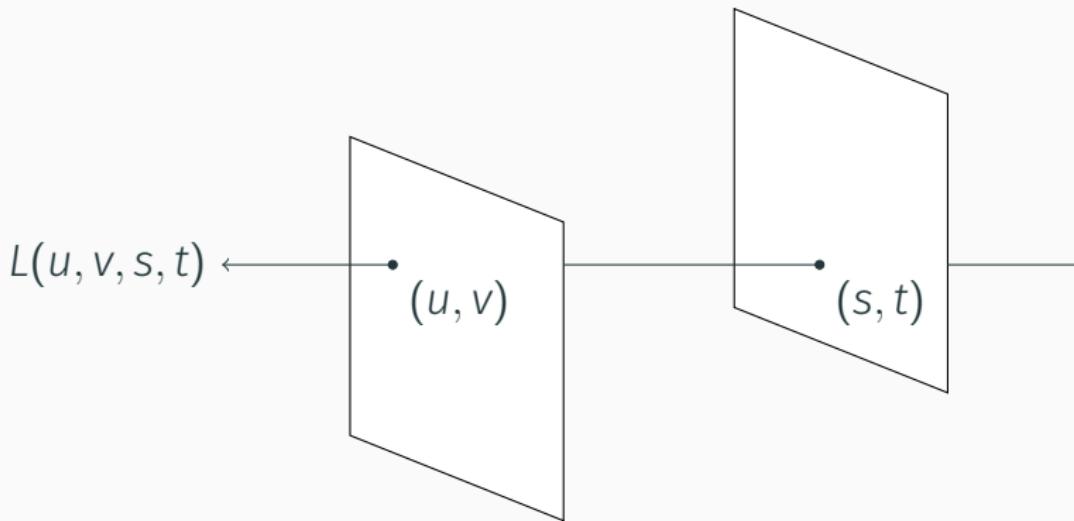
- Reduce dimensions of P

THE 4D LIGHT FIELD

- Reduce dimensions of P
- $L(u, v, s, t)$

THE 4D LIGHT FIELD

- Reduce dimensions of P
- $L(u, v, s, t)$
- Defined by two planes



LIGHT FIELD ACQUISITION

- Camera array



LIGHT FIELD ACQUISITION

- Camera array
- Gantry

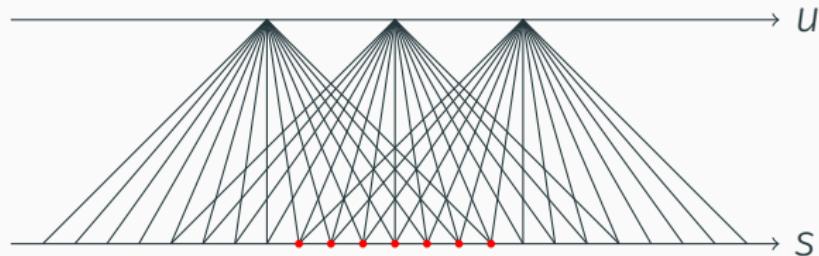


LIGHT FIELD ACQUISITION

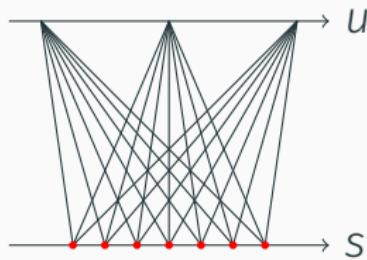
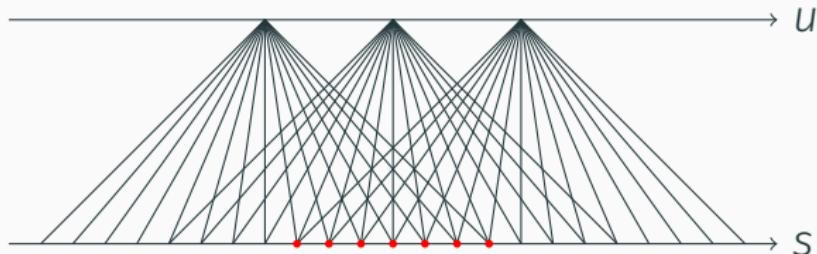
- Camera array
- Gantry
- Plenoptic camera



PARAMETERIZATION



PARAMETERIZATION



PARAMETERIZATION

Raw



Rectified



PARAMETERIZATION

Raw

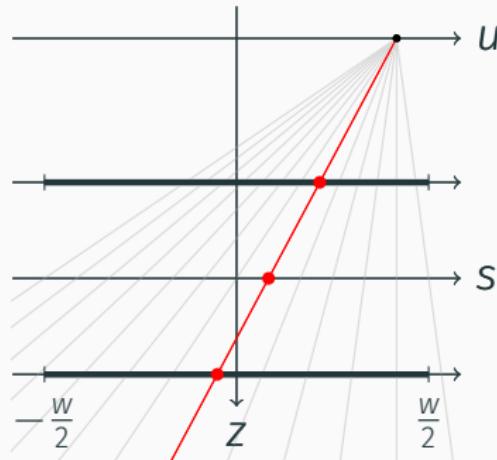


Rectified



PROBLEM STATEMENT

RAY CASTING



$$L_m = L_0 \prod_{n=1}^N t^{(n)}(h(m, n))$$

L_m Color of ray m

t Transmission

h Intersection

LIGHT TRANSMISSION

- Hard to solve directly

$$L_m = L_0 \prod_{n=1}^N t^{(n)}(h(m, n))$$

LIGHT TRANSMISSION

- Hard to solve directly
- Transform to log-domain
- Solve for absorbance

$$L_m = L_0 \prod_{n=1}^N t^{(n)}(h(m, n))$$

 $t = e^{-a}$

$$\bar{L}_m = \bar{L}_0 - \sum_{n=1}^N a^{(n)}(h(m, n))$$

LIGHT ABSORBANCE

$$\bar{L}_m = \bar{L}_0 - \sum_{n=1}^N a^{(n)}(h(m, n))$$

LIGHT ABSORBANCE

$$\bar{L}_m = \bar{L}_0 - \sum_{n=1}^N a^{(n)}(h(m, n))$$

 $L_0 = 1$

$$\bar{L}_m = - \sum_{n=1}^N a^{(n)}(h(m, n))$$

OPTIMIZATION PROBLEM

$$\begin{aligned} \operatorname{argmin}_{\alpha} \quad & \|P\alpha + \bar{L}\|^2 \\ \text{subject to} \quad & \alpha \geq 0. \end{aligned}$$

RESULTS

ASSESSMENT

CONCLUSION

The *mtheme* is a Beamer theme with minimal visual noise inspired by the HSRM Beamer Theme by Benjamin Weiss.

Enable the theme by loading

```
\documentclass{beamer}  
\usepackage{m}
```

Note, that you have to have Mozilla's *Fira Sans* font and XeTeX installed to enjoy this wonderful typography.

SECTIONS

Sections group slides of the same topic

```
\section{Elements}
```

for which the *mtheme* provides a nice progress indicator

...

TYPOGRAPHY

The theme provides sensible defaults to `\emph{emphasis}` text, `\alert{accent}` parts or show `\textbf{bold}` re-

becomes

The theme provides sensible defaults to *emphasis* text,
accent parts or show **bold** results.

LISTS

Items	Enumerations
· Milk	1. First,
· Eggs	2. Second and
· Potatos	3. Last.

DESCRIPTIONS

PowerPoint Meeh.

Beamer Yeeeha.

ANIMATION

- This is important

ANIMATION

- This is important
- Now this

ANIMATION

- This is important
- Now this
- And now this

ANIMATION

- This is really important
- Now this
- And now this

FIGURES

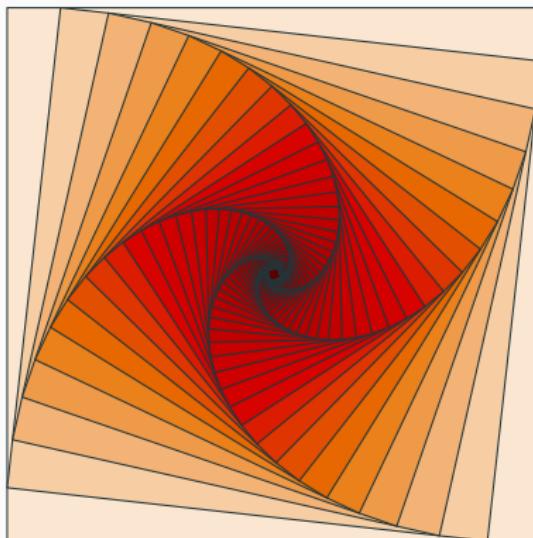


Figure: Rotated square from texample.net.

TABLES

Table: Largest cities in the world (source: Wikipedia)

City	Population
Mexico City	20,116,842
Shanghai	19,210,000
Peking	15,796,450
Istanbul	14,160,467

BLOCKS

This is a block title

This is soothing.

$$e = \lim_{n \rightarrow \infty} \left(1 + \frac{1}{n}\right)^n$$

QUOTES

Veni, Vidi, Vici

DARK BACKGROUND



SUMMARY

Get the source of this theme and the demo presentation from

github.com/matze/mtheme

The theme *itself* is licensed under a Creative Commons Attribution-ShareAlike 4.0 International License.



QUESTIONS?