Science, Theatre, Sculpture, ....

“an ongoing journey with Radiance and Light”

-Rob Shakespeare
Summer 2006
Commissioned to develop a light sculpture celebrating the 25th anniversary of the I.M.Pei designed Indiana University Art Museum
LIGHT TOTEM

early concept sketch
attract Bloomington - sky tracker
campus visibility - tower and luminous lighting
atrium allure - interior light sculpture
Exploring location and color patterns
30” Square
Design Development

Exploring truss column and patterns
TOTEM Lighting Design Concept
by Rob Shakespeare SLI, September 2016
Guestimate costs include Search Lights.

Design
Development

Ver 1
~$30,000

Ver 2
~$86,000

Ver 3
~$80,500
Design Development
Explore luminaires
Selected Color Kinetic’s Color Blast

- good track record
- weather proof IP66
- linear dimming curve
- long lamp life ~50,000 hrs
- 50 w max Lumens: R212 G379 B137
  (estimated 50w x 50 x .5 avg - 250w = ~1Kw)
- useful beam spreads 8, 10 & 23 degrees

Aiming sketches to determine coverage and quantity
Wall: 70’ tall 100’ wide

GLOW rods to check aiming
Spread sheets were useful to write the in-line ies2rad commands used to facilitate simulation sequences of undulating color changes.
Unistrut 1-5/8" green or galv @ $3.50/ft (slotted)
aluminum @ $6.86

Plan/section

Unistrut secured by 2" U BOLT
Rigged PVC waterproof conduit & boxes MINE to back
Fixture bolted to UNISTRUT face 1/2" bolt
Cable to Fixture(s) through WP strain relief on PVC boxes

30" O.C.

Side Elevation/Section
Attach B-Line>

6 units
1 upright

63'

60' top of unit 3

57'

54'

51'

50' Unistrut joiner

1 x 10' + 1 x 9'-7''

offset center joiner by 2.5''
setback 2'' from truss ends
Keynote was used to:

- explore Radiance image transitions
- create rapid fundraising presentations
- develop final lighting sequences from renderings
TOWER & WALL
street view
celebrating 25 years!
Light TOTEM

70’ freestanding aluminum truss tower
6 LED RGB arrays - tower lighting
44 LED RGB arrays - wall lighting
1 230 million candlepower searchlight
2 1200w mini-searchlights
40’ linear LED RGB acrylic luminous tube
Designing Visually Accessible Spaces (DEVA)  National Institute of Health grant 1 R01 EY017835-01

Our long-term goal is to provide tools to enable the design of safe environments for the mobility of low-vision individuals and to enhance safety for others. We conceive of a computer-based design tool in which complex, real-world environments (such as a hotel lobby, large classroom, or hospital reception area), could be simulated with sufficient accuracy to predict the visibility of key landmarks or obstacles (e.g., steps or benches) under a variety of natural and artificial lighting conditions. Design guidelines will be developed to optimize the visibility of hazards.

Principal Investigators: Prof. Gordon Legge, University of Minnesota
Chair of Psychology, Low Vision Specialist
Prof. William Thompson, University of Utah
Computer Graphics
Prof. Rob Shakespeare, Indiana University
Lighting Design and Lighting Simulation

http://www.cs.utah.edu/research/areas/percept/DEVA
"We seek to predict, in an illuminated scene, edges which are difficult to detect or which are not visually detectable. We will then explore how to determine which of these low/non-visible edges is potentially hazardous to low vision individuals, and develop design guidelines to improve the visibility of hazards and/or mark them."

First steps...
High frequency lighting simulations of lab
- create a valid model of lab
- compare simulation and HDR photos
- compare edge detection
- simulate lighting conditions not viable in lab
Collected data...
Collected data...
Collected data...
Collected data...
Objects & photometric distribution

Diffusely lit raw photo for color analysis and potential texture mapping
Photometry detectives
Reflectance adjustments
Autocad drawings of room geometry
Construct reasonable geometry, textures, photometry, then render
cinder blocks with paint layers

void texfunc block-rough
8 xwrick ywrick zwrink wrinkle.cal -s 2 -rz 90
0
3 0.02 .05 .05

block-rough plastic block_clr
0
0
5 .804 .789 .709 .02 .1

## cinderblock grout color
void brightfunc specks
4 dirt dirt.cal -s .05
0
1 .1

specks plastic block_clrg
0
0
5 .804 .789 .709 .004 .02

wood partitions

void brightfunc mottled
4 dirt dirt.cal -s .01
0
1 .03

mottled brightfunc maple
4 zgrain woodpat.cal -s .3
0
1 .25

maple texfunc grainy
6 xgrain_dx ygrain_dx zgrain_dx woodtex.cal -s .3
0
1 .04
#1 .05

grainy plastic Wood3
0
0
5 0.5600 0.2900 0.0500 0.015 0.03
What familiar/expected objects should be included?
Validating the model..
Validating the model..
The platform-ramp boundary experiment...
Positioning control..
Lighting control..
(Trial: 26w CFL downlights)

1” trip hazzard
Lighting control..
(Trial: 50 watt Par30-NFL)

1” trip hazzard
Lighting control: (Trial: 50 watt Par30-NFL) 1" trip hazard
Lighting control.

(Trial: 50 watt Par30-NFL)

1" trip hazard
Depth map:
can provide Ground Truth to test edge
detection in an illuminated scene

vwrays -vf views/platv.vf -ff -x 1800 -y 1200 \ 
| rtrace `vwrays -d -vf views/platv.vf -x \ 
  1800 -y 1200` -ff -oL x.oct\ 
| pvalue -r -df -b -e .0022 > depthpic3.hdr

vwrays [view options] -ff -x $XRES -y $YRES \ 
| rtrace -x $XRES -y $YRES -ff -oL octree \ 
| pvalue -r -df -b -e 1/$MAXDIST > depth.hdr
Almost ready for experiments...
Stage Lighting is my true passion
I met Radiance in about 1990
and it remains vital to my art
Here is glimpse from back then to now...
Many scenographic devices needed to be defined before succeeding in accurately simulating the stage.
Shaping light: hard and soft shutters
Illusions of illusions... simulating scrim (1)

Technical analysis and measurements...

incident light

reflected light

diffuse transmission

direct transmission

absorbed light
Illusions of illusions... simulating scrim (2)

- Direct transmission
- Diffuse transmission
- Reflected light
- Absorbed light
- Luminous object

(All light energy is accounted for)
light in front
light behind
Theatre material: scrim

light in front and light behind
“cutting out” an image shape...

Concept: convert image “black” into a void

1. Create a pixel value file which can be read by .cal

   pvalue -d -b scrim.pic > scrim.dta

2. Massage the scrim.dta file.
   - comment out the header and set up array info

   example:
   # Data file produced from a picture
   ##?RADIANCE
   #ra_tiff -r
   #pvalue -d -b
   #FORMAT=ascii   # -Y 569 +X 695
   2
   1 0 569
   0 1.221 695
   
   0.000e+00
   0.000e+00
   ...

   ...
“cutting out” an image shape...

The function:

mymapping.cal
{ a trimming function where:

   A1 = clipping threshold
   0 cuts away to void

}

mymapping(b) = if(b-threshold, 1, 0);
my_u = Px;
my_v = Py;
threshold = A1;
Combining cutout, image, and trans into a shaped scrim

Scene description:

void trans whitex
0
0
7 1 1 1 0 0 .8 1.0
# r g b spec rgh trans transspec

void mixdata my_mixture
7 whitex void mymapping scrim.dta mymapping.cal my_v my_u 0
0
1 .001

void colorpict data
9 clip_r clip_g clip_b scrim.pic picture.cal pic_u pic_v -s 1
0
0

my_mixture alias col_scrim data

col_scrim polygon scrim
0
0
12 0 0 0
1.221 0 0
1.221 1 0
0 1 0

Combining cutout, image, and trans into a shaped scrim
Joseph Svoboda and Laterna Magika
1958 World’s Fair in Brussels
Czech Pavilion
validated a new art form

“apparent interaction”
between actor and image
Visionaries such as Svoboda computer graphics in movies inexpensive data projectors the rise of powerful PC’s shifting aesthetics...

Is leading me and other artists to explore Virtual Scenography in Live Performance
Background

...the resolution of stage lighting
Soon to become the size of a pixel!!

Overlapping Acting Areas or zones are individually lighted

2 – 3 meters
How discerning are we of source, highlight, and shadow relationships? How far can we deviate highlight and shadow direction, before we prickle the consciousness of the audience and distract them?

(Shakespeare, 2001)
At a glance, can you accept both of these images? Is either correct?

(Shakespeare, 2001)
Live stage illusion
...apparent direction of light on an actor

(Shakespeare, 2000)
It appears that we are not good judges of accurate highlight and shadow direction within certain bounds.

GOOD... this weakness provides us with design opportunities

(Shakespeare, 2000)
Project virtual light onto actor standing in front of rear projection screen.
Data projectors

Light "appears" to come through window

Shakespeare 2000 (Helsinki)
Plan of a “set” representing a castle interior

A Proof of Concept Experiment (2006)
Render the set as viewed through an RP screen.
Render sunset sequence through window
Virtual Camera 1
Light Capture Panels in Radiance
Virtual Camera 2
Virtual Camera 3

Render continuous lighting changes on panels, where actor will stand
Renderings synced into a single movie.

“Lighting” played on actor using a 4 VGA out card and keyed data projectors
Towards shadowless stage light...
...reducing visual clutter (Current work)
Shadowless light exists
(well almost!)
But rarely on the stage

Though the actor’s lighting appears similar to the research, the shadow patterns create added noise.

Add more face light, see another shadow!
Shadowless light. in our VS future?

Each lighting direction could be matted to the performer.
Shadow placement
Start with the traditional key light....
Shadows from fill light!
...in our VS future!
Fill light “matted” to the performer...
Shadow could be projected from the key of from downlight
Recall that shadow accuracy is not critical..
Challenges of creating a dynamic projection only on the performer in a lit stage environment.

- Chroma-key. Too constricting (green or blue sets)
- Binocular depth keying. Fails at distance. $$$
- Luminance-key. Tough in a lit environment
- Moving pattern capture. No light/actor discernment
- Consider Infra-red.
A step forward:

The following performance, staged in January, helped to better grasp the issues of real-time actor tracking and projecting “virtual, shadowless light”.

Another step towards migrating to data projectors as light sources on stage.
This experiment in realtime IR mattes was developed from Mark Coniglio’s work.

LED InfraRed backlight on CYC

Produces InfraRed silhouette of dancer
Radiance images helped to:

- determine the ideal placement of the camera/projector system
- anticipate image reference issues
InfraRed camera view

Inverted in Isadora
Framed in Isadora
Basic matt was filled with video data
Basic Matt was filled with video data.
An offset colored image was added for interest.
Basic matt was filled with video data. An offset colored image was added for interest. Then distorted.
Time delay.. dancer interacts with luminous shadow

Found fabric invisible to IR but partially translucent to visible projection. Created multiple images.

“cold” stage light high lights dancers
Lessons... undesirable latency (became a tool)

need high resolution to outline details

need projection “black” to be NO light

dges of projected area hard to reference

800 nm IR emitting materials needed!

Awaits continued development!
Laterna Magika, in Prague, is the only theatre in the world dedicated to the exploration of live performers and projected image.

I have been privileged to observe their work for the past month.
Svoboda’s last gift to Laterna Magika in Prague is the current **Graffiti Virtual Scrim** (1st explored in Past/ the Trap, 1999) developed from the Pepper’s Ghost principle.

![Picture by David Wall](image-url)

- **Pepper's Ghost Made Simple**
  - Flat black walls
  - Spotlight or Blacklight
  - Wall (shown transparent for clarity)
  - Transparent 'ghost' image of organist in glass
  - Plate glass (outlined in blue for clarity)
  - 45-degree angle
  - Design in floor to hide glass
  - Organist animatronic

[www.phantasmechanics.com](http://www.phantasmechanics.com)
Graffiti

photo by: Vojtech PISARIK
Graffiti
My old Radiance theatre lighting benchmark, to challenge other simulation systems.... Las Vegas Bounce!
A virtual scrim study..
..no shape clipping required!

photos by: Vojtech PISARIK
VIRTUAL SCRIM appears opaque

VIRTUAL SCRIM limited by mirror
The dancer’s domain
Dancers clearly visible when strongly lit and when aligned with dark sections of the projection.
First attempt.. one week ago!

Current front surface matching...

Future iteration..

front surface  back surface
First rendering pass: Blank projection & no louver
Distracting overhead screen

Project an image
Louver effect

shallow louver detail
Add upper louver
2” deep
Overhead
essentially
dark
On with the show:
Opening full “opaque” projection
Add rear projection screen
Side seat view: zoomed
Audience view...
What the dancer sees!
Vivid spacial memory and IMAGINation needed
anything goes..!
Explore a variation
So far, so good..
pivot 10 degrees... hmmm
pivot 20 degrees.. yikes
pivot 30 degrees..
back to the drawing board!
Before moving into the final topic, some wise words from two visionary artists...

Ansel Adams - photographer

Joseph Svoboda - scenographer
By the 1970’s he had achieved a print that equaled the deep tones, greater intensity of light and striking contrast he has envisioned 30 years earlier.
“Image quality is not the product of a machine, but of the person who directs the machine, and there are no limits to imagination and expression.” - Ansel Adams
“Those who work in the future... enter upon the adventure of discovering the secret network of relationships between humanity and the world around it.

- Joseph Svoboda  The Secret of Theatrical Space
EFFECT is a Radiance interface first designed to introduce stage lighting. It is now also a collaboration tool.
- rapid learning curve (2 min avg) ideal with a 3 button mouse

- four actors, some props, a backdrop and basic cyc (gensky)

- uncomplicated
  - 10 dimmer channels
  - 80 gel colors
  - unlimited photometry
  - fixed aimpoint at headheight
  - launches rvu
  - renders 3 qualities
  - saves settings
Created in collaboration with Indiana University’s CICA (1998) and updated by AVL, it will be available for free download.

http://www.avl.iu.edu/?projects/effect

Requires a Radiance installation :-), Python 2.5 and OS X 10.5+
Thank You!