LightGuider: Guiding Interactive Lighting Design using Suggestions, Provenance, and Quality Visualization

Andreas Walch, Michael Schwärzler, Christian Luksch, Elmar Eisemann, Theresia Gschwandtner. TVCG (Proc. VAST/InfoVis/SciVis 2019 Special Issue).

https://www.computer.org/csdl/journal/tg/5555/01/08807288/1cG6djufx96

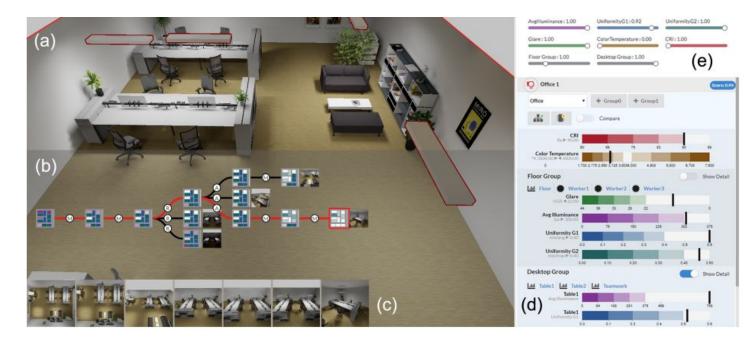
Lighting design

The process of placing light such that the emitting light fulfills technical and aesthetic requirements.

Lighting design is complex

- Must satisfy design constraints
- Must look good
- Simulating lighting is computationally expensive
 - Select, place, and align lights \rightarrow run simulation
 - Check if illumination constraints are satisfied
 - Repeat until all constraints are fulfilled and design looks good
- Designers generally converge on solutions: single local optimum

Simulates potential next modeling steps and shows how well current designs meet specified quality criteria.



(a) 3D modelling view

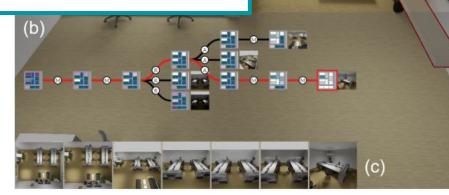




(a)

(a) 3D modelling view

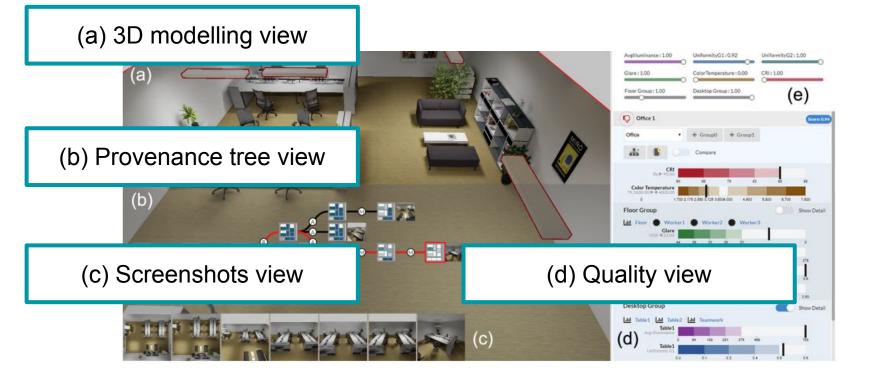
(b) Provenance tree view

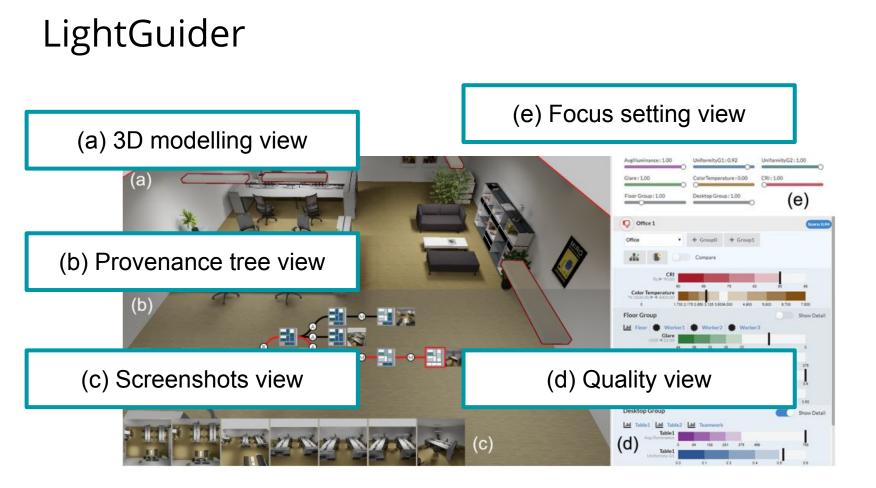


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(a) 3D modelling view Avgliuminance: 1.00 UniformityG1:0.92 UniformityG2:1.00 (a Glare: 1.00 ColorTemperature: 0.00 CRI:100 Floor Group: 1.00 Desktop Group : 1.00 (e) -----Office 1 • + Group0 + Group1 Office (b) Provenance tree view 4 Compare Color Ter (b 6 700 2,175 2,650 3,125 3,6004,000 4.000 5.500 6,700 Floor Group Show Detail Worker2 Worker3 - -Ave Illuminance 0 (c) Screenshots view Uniformity G1 Uniformity G2 8.20 0.30 Desktop Group Show Detail Lad Table1 Lad Table2 Lad I a sind offer (c) (d)





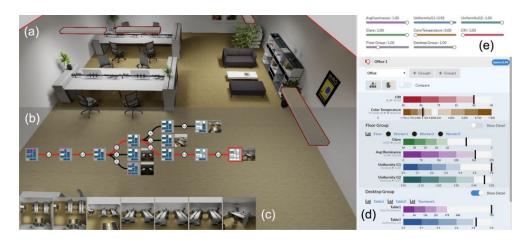


Video

https://vimeo.com/360154391

Components of LightGuider

- 3D modelling view
- Quality view
- Provenance tree view
 - Displays design suggestions
- Focus setting view
- Screenshots view



3D Modelling View

• LightGuider is built on top of a lighting design tool

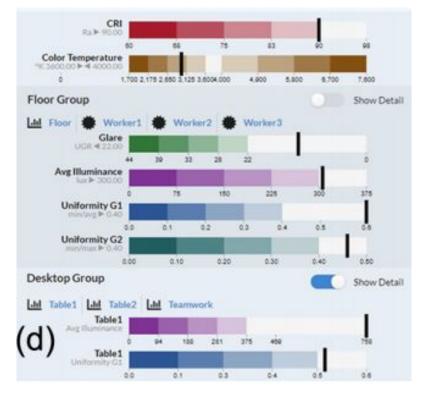
Specific to LightGuider:

- Camera animations towards poorly performing objects
- Displays colored outlines around selected objects

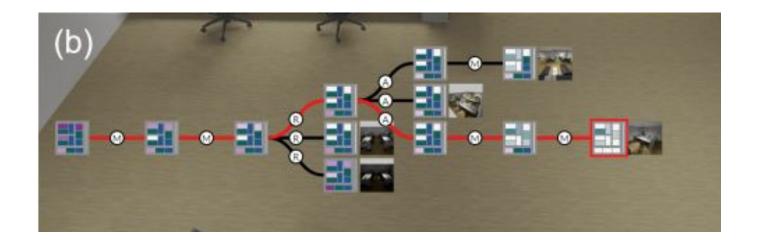


Quality View

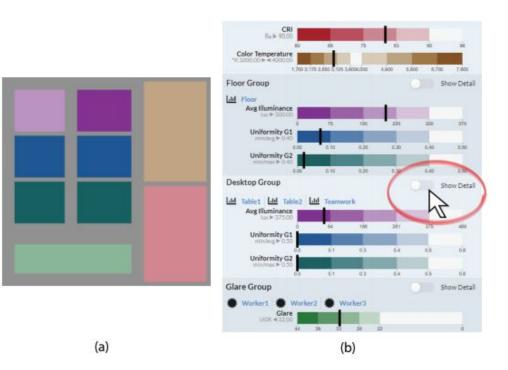
- Shows all illumination constraints and current status
- Positions on aligned but not common scales
- Hue maps to different constraints
- Dark, saturated \rightarrow solution is far off
- Light \rightarrow solution is close
- Scales have equal brightness values on all levels



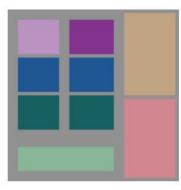
- Node-link diagram that shows workflow history
- Letters indicate different actions
- Select a node to highlight path towards it

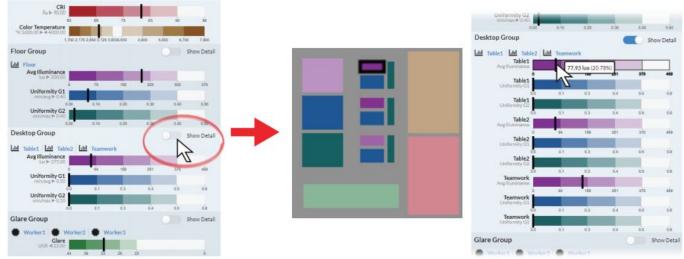


- Treemap in each node
- Each constraint associated with distinct color
 - Same as quality view

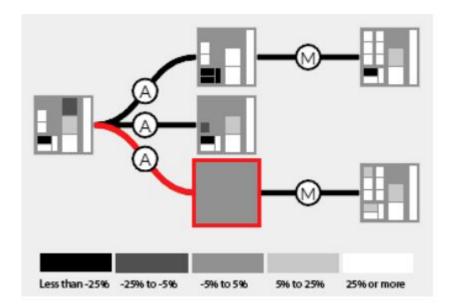


• Can show more details on demand



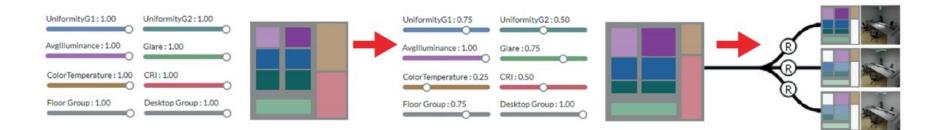


- Can compare modelling states globally
- Grayscale
- Selected node acts as reference; all other nodes encode the difference to it
- Darker \rightarrow worse
- Lighter \rightarrow better



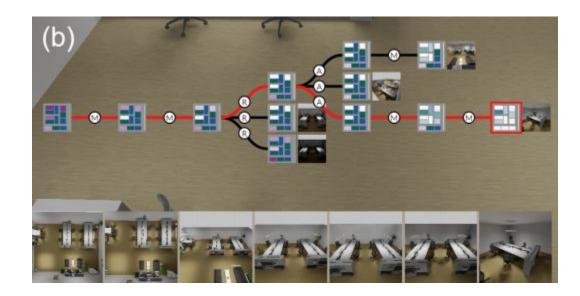
Focus Setting View

- Set weights for illumination constraints and user-defined groups
- Slider colors match the colors in the tree nodes
- More weight \rightarrow larger corresponding area in tree node
- More weight \rightarrow more important when generating design suggestions



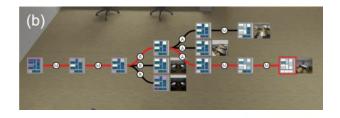
Screenshots View

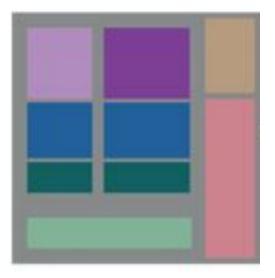
- Shows thumbnails for linear path through tree to current state
- Thumbnails also shown at leaf nodes



Provenance Tree View: Analysis

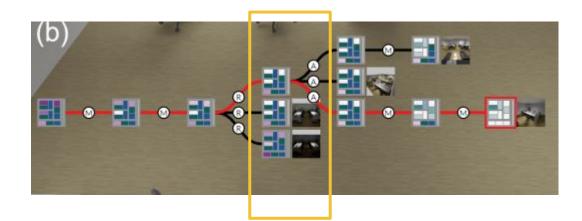
- Node-link diagram
 - Horizontal growth shows development through time
- Treemap summarizes modelling step
 Color appendix constraint status
 - Color encodes constraint status
 - Area encodes constraint weight
 - Spatial position does not encode data
- Difficult to read hierarchy info from treemap, but not important in this scenario





Generating lighting design suggestions

- Can add, remove, dim, or change lights
- Can **change height** of one or all lights



Generating lighting design suggestions

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Process:

- Compute scores for all actions, accounting for weights assigned to illumination constraints
- Pick top 2 actions, simulate 3-5 randomized parameterizations for each
- Compute scores for random simulations, accounting for weights assigned to illumination constraints
- Show 3 highest-scoring solutions to user

Summary

- What
 - Workflow history (network), design quality (quantitative values)

• Why

- Generate and verify satisfactory designs
- Discover alternate design paths

• How

- Encode: node-link diagram, treemap, horizontal scales
- Manipulate/facet: update scene, select step to compare it to all other steps
- **Reduce:** aggregate constraint statuses

Overall Critique

Strengths

- Justifies design choices for specific tasks
- Implements overview then details on demand
- Follows "eyes beat memory"
- Recognizes limitations in scalability
 - Hues
 - Nodes in provenance tree

Weaknesses and limitations

- Examples of scalability of provenance tree
- Justification for randomly generated suggestions
 Came up in user study feedback
- Clarity of LightGuider's 3D modelling view contribution

Thank you