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

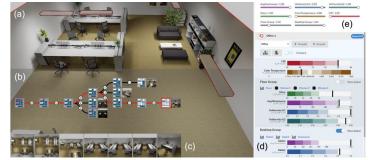
The process of placing light such that the emitting light fulfills technical and aesthetic requirements.

Lighting design is complex

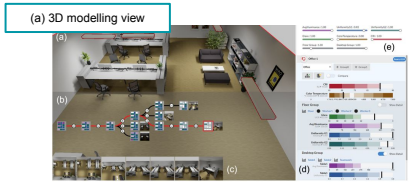
- Must satisfy design constraints
- Must look good
- Simulating lighting is computationally expensive
  - Select, place, and align lights → run simulation
  - Check if illumination constraints are satisfied
  - Repeat until all constraints are fulfilled and design looks good
- Designers generally converge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

LightGuider

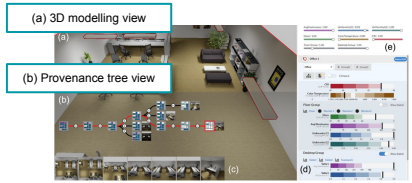
Simulates potential next modeling steps and shows how well current designs meet specified quality criteria.



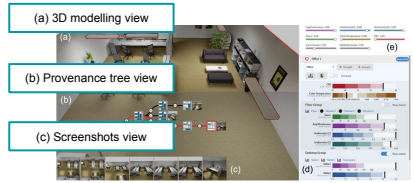
LightGuider



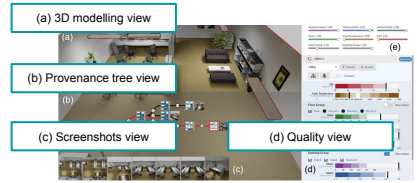
LightGuider



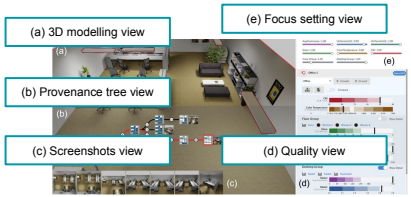
LightGuider



LightGuider



LightGuider

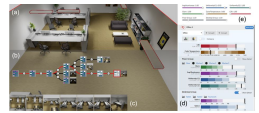


Video

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

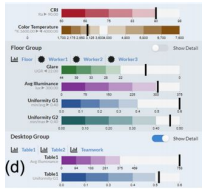
- LightGuider is built on top of a lighting design tool

Specific to LightGuider:

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

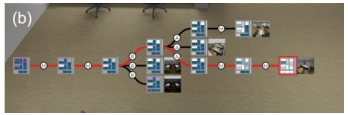
Quality View

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



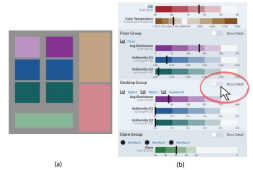
Provenance Tree View

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



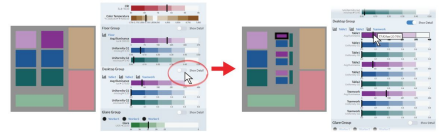
Provenance Tree View

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



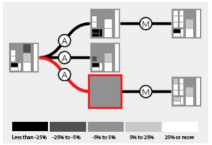
Provenance Tree View

- Can show more details on demand



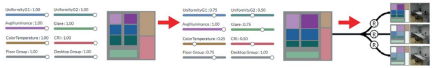
Provenance Tree View

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



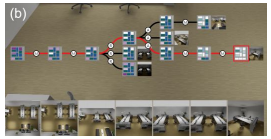
Focus Setting View

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



Screenshots View

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

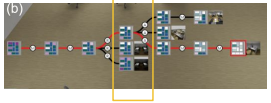


Provenance Tree View: Analysis

- Node-link diagram
  - Horizontal growth shows development through time
- Treemap summarizes modelling step
  - Color 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