The Use of Sketching and Spreadsheets in Lighting Design

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This interactive poster describes the use of *LightSketch* for analyzing and exploring visual aspects of lighting design [Glaser et al. 2004]. The lightweight sketch tool is capable of creating and simulating models with daylight, electric light, and controls for simulation with RADIANCE across a large and comprehensive parameter space. It provides a fluid spreadsheet-like infrastructure for depicting quantitative and qualitative aspects of light that largely remain hidden using conventional software representations. This poster will illustrate sample scenarios of use as well as provide a working prototype running on a TabletPC for participants to interact with.

GLASER, D., FENG, O., VOUNG, J., XIAO, L. 2004. Towards and Algebra for Lighting Simulation, Building and Environment, in press

Scenario 1: Sizing a north-facing window from 8' to 4'.

A user can construct a very simple model in about 15 seconds using the default values for surface reflectance, glazing transmittance, geometry, etc.
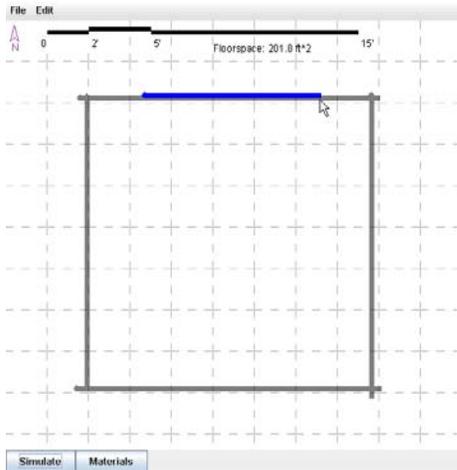

This plan view of a rectangular model with a 8' north-facing window was created with 5 strokes of a mouse or pen! The last stroke in blue drawn represents a window.

This sketch is converted into a 3D model that gets directly passed into to the RADIANCE simulation package. The user selects to see workplane illuminance points with default sampling intervals. The results are displayed graphically:
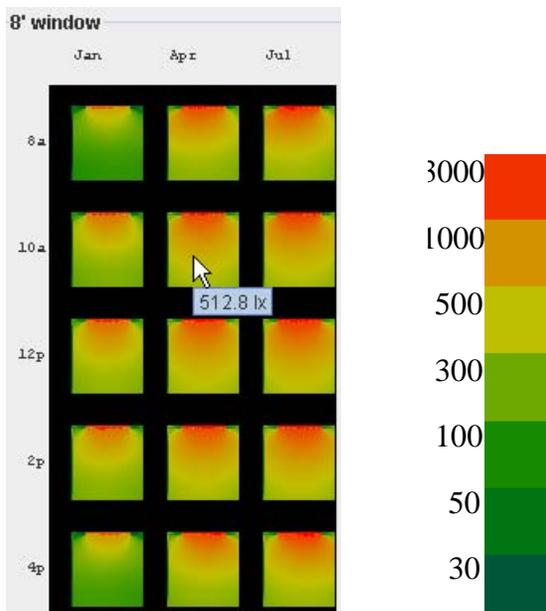

(left) A pattern labeled "8'" is shown showing the rectangular room's performance at 15 times along the workplane.
(right) Lux values are displayed through a user-definable false-colormap or numerically with the mouse.

The user can re-dimension the window to 4' to experiment with the tradeoffs of using less glazing:
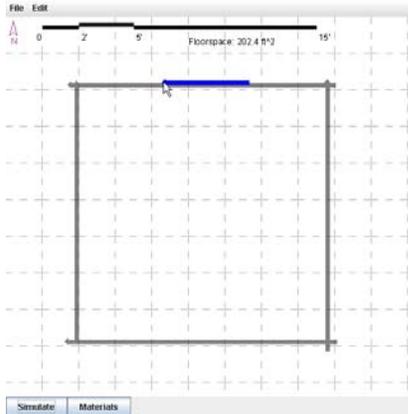

This shows the user re-dimensioning the window to accommodate a smaller aperture.

And run the simulation again to see side-by-side results:
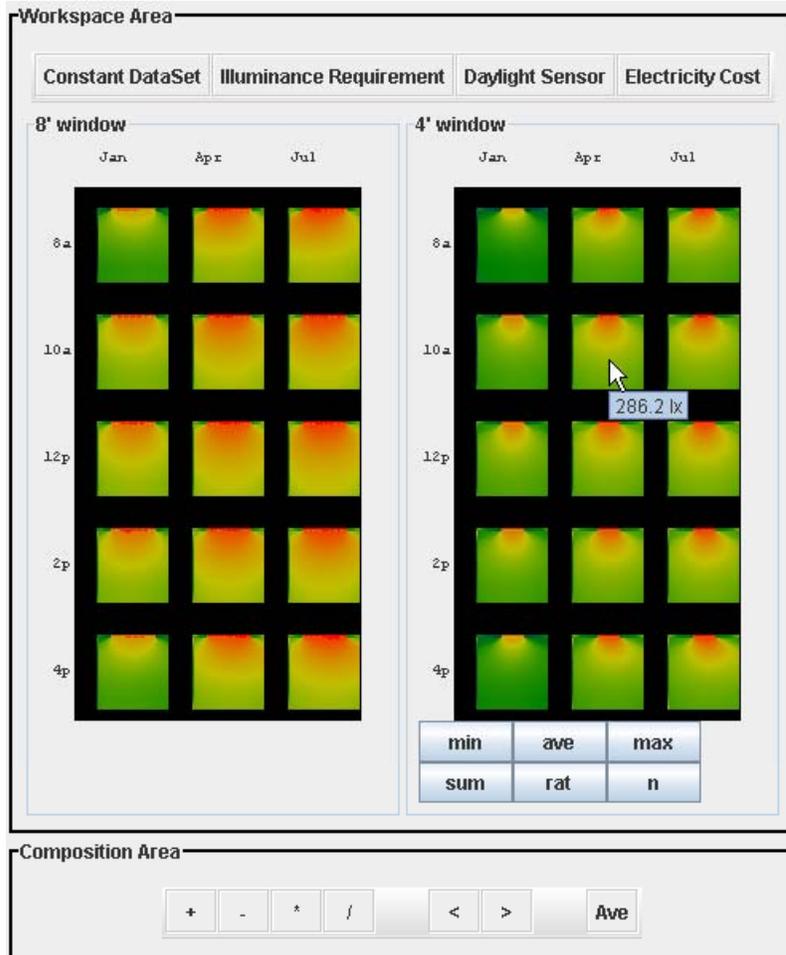
The full analysis workbench shows both simulations—"8' window" and "4' window". The workbench is capable of performing arithmetic operations both between simulation results (e.g. the *+, -, *, /, <, >, ave* operations in the Composition Area) and within the result (e.g. the *min, ave, max, sum, rat, n* next to the simulation result)
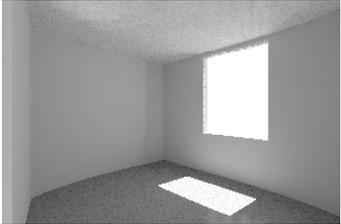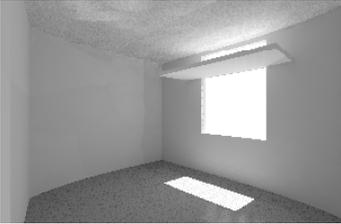
The results are also entities in themselves and can be manipulated as data in a spreadsheet!
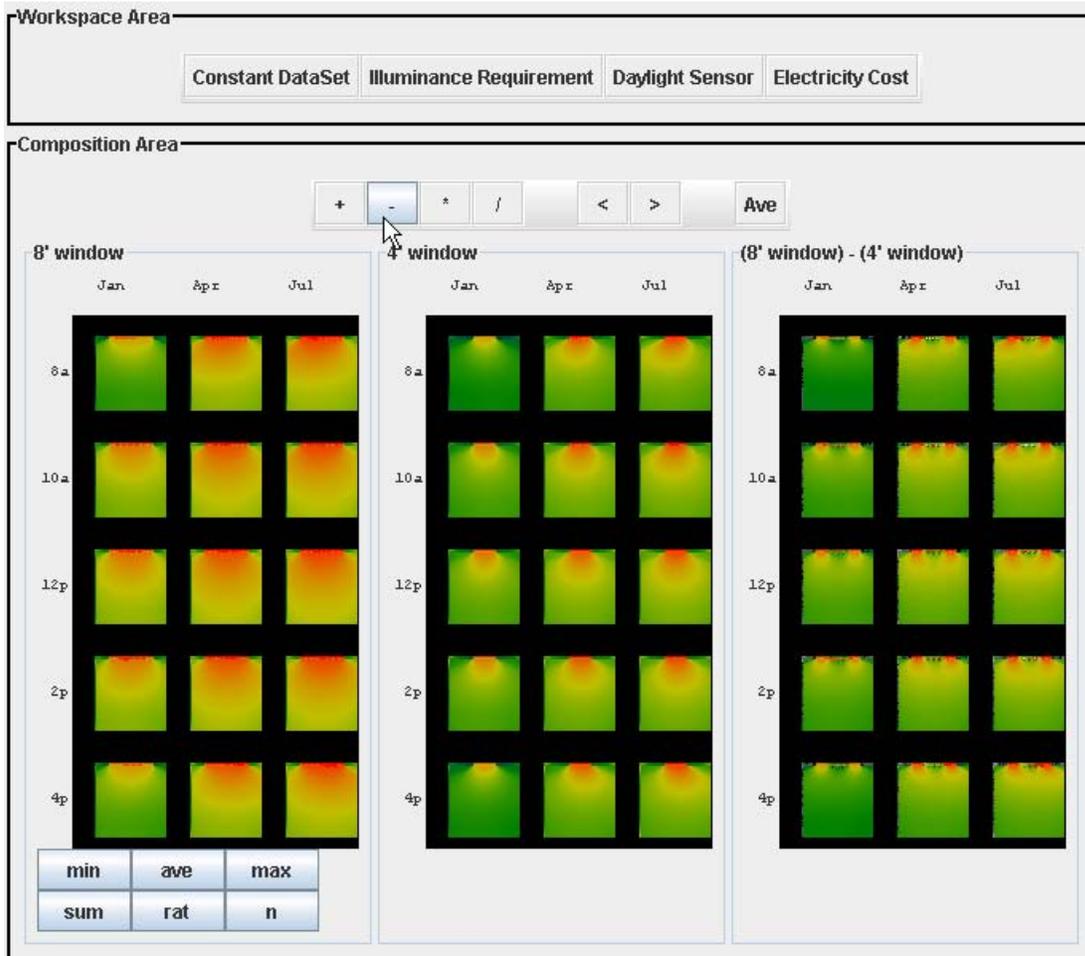
Here the user has chosen to subtract the results of "4' window" from "8' window" by pressing the "-" button. It can be seen in "(8' window) – (4' window)" that this reduction of the size of the window will have significant consequences. Using the "ave" operator (not illustrated), we can see that this re-dimensioning lost 247lx of light!

Scenario 2: Advising an architect for using a lightshelf/shade for a 70,000 sq. ft. school in Maryland.

First, some simple renderings are made to show fenestration possibilities to the architect:

A slide shown to an architect describing different fenestration strategies. The images were created in LightSketch.

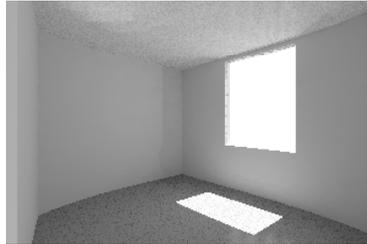LightSketch then produces quantitative results using TMY data:
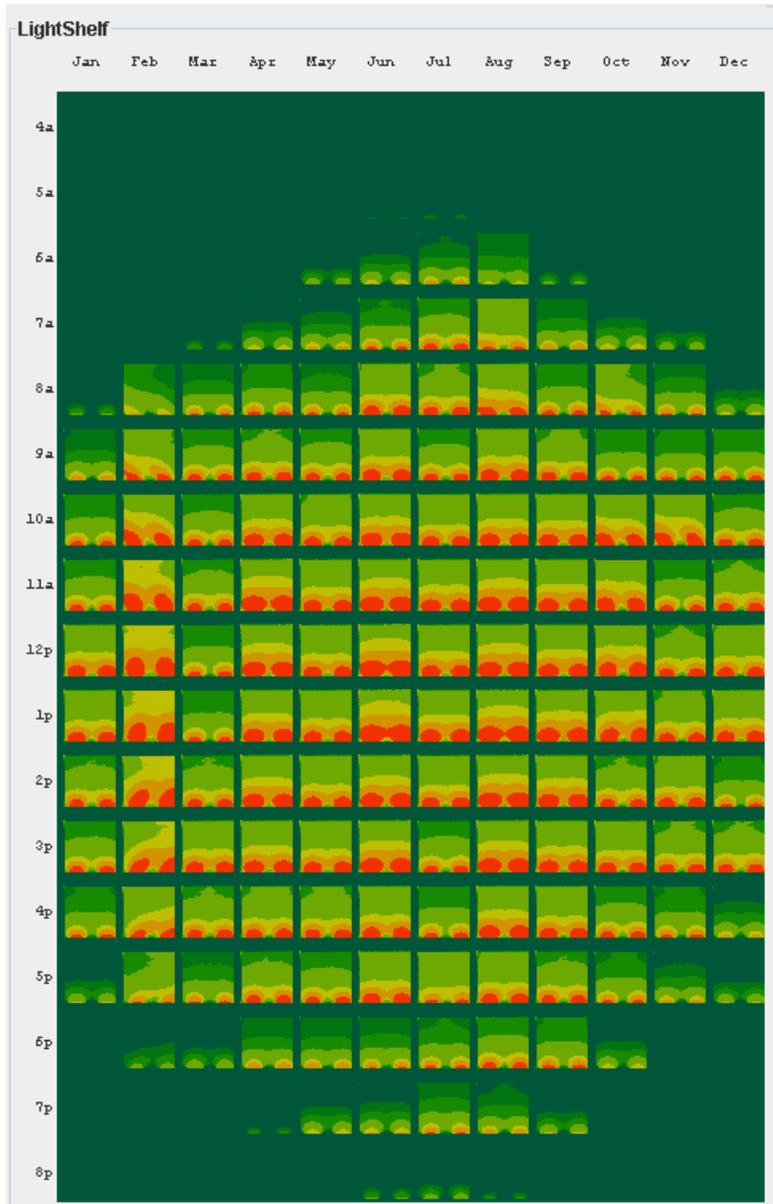
A yearly simulation, sampling 1x a month, 16x a day with the lightshelf. Note that a range of skies are used in this simulation.
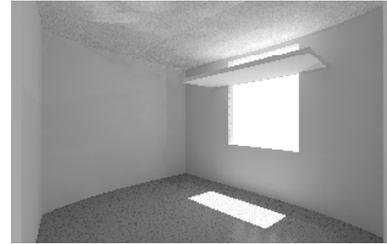
This data, along with simulations of the standard case shows exactly how many lux or footcandles are gained at the workplane by adding the shelf (30 lux on average, with peaks around noon of 70 additional lux).

In addition to looking at workplane measures, the architect was shown visual consequences of the shelf:
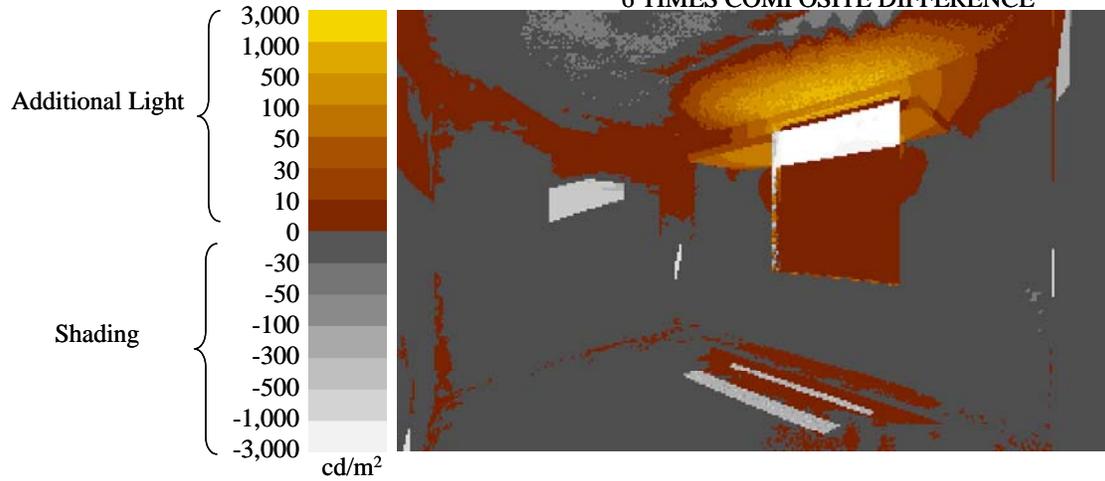
HIGH HEADER   LIGHTSHELF+SHADE

6 TIMES COMPOSITE DIFFERENCE

Additional Light

3,000
1,000
500
100
50
30
10
0

Shading

-30
-50
-100
-300
-500
-1,000
-3,000

cd/m^2

This complex image shows where a room will gain or lose light due to the shelf. It shows that there is a positive gain above the window (which will balance the contrast of the window and provide for additional light at the workplane), while at the same time eliminates light at multiple points in the room (reducing the glare).