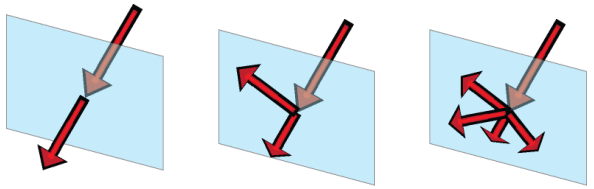
BTDF2RADIANCE: BTDFs and Radiance

Introduction	Method	Examples	Conclusion



10th International Radiance Workshop, LBNL, Berkeley, CA, 2011

Dr Jerome Kaempf (jerome.kaempf@epfl.ch)
Prof. Jean-Louis Scartezzini
Presented by: Carsten Bauer (bauer@relux.ch)

Introduction
- Goniophotometer
- IEA 21 format
- BTDF2prism2
- XML format

Method
- Conversion
- XML sample

Examples
- Laser cut panel
- Lumitop

Conclusion
- Future work

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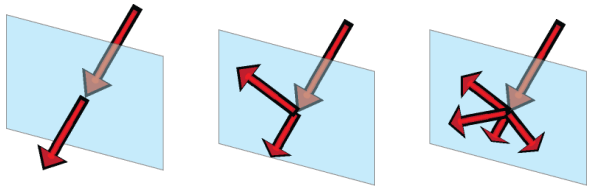
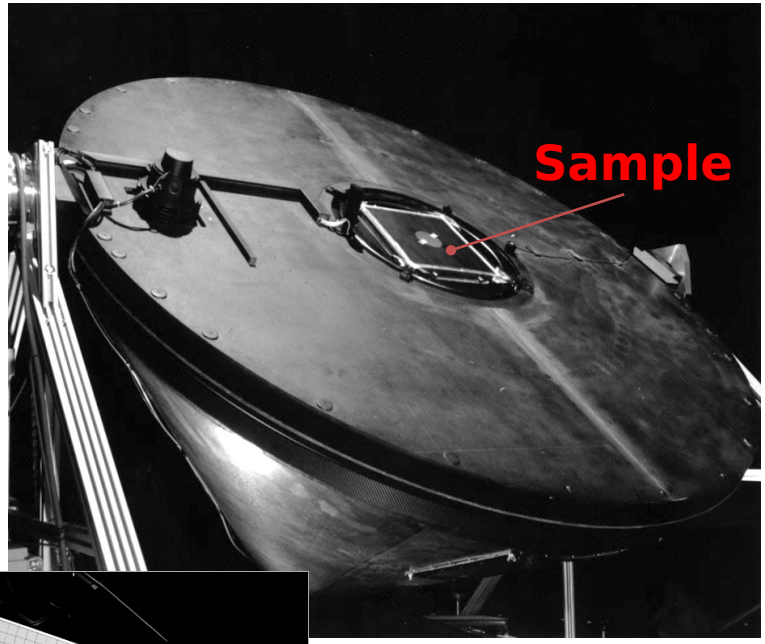
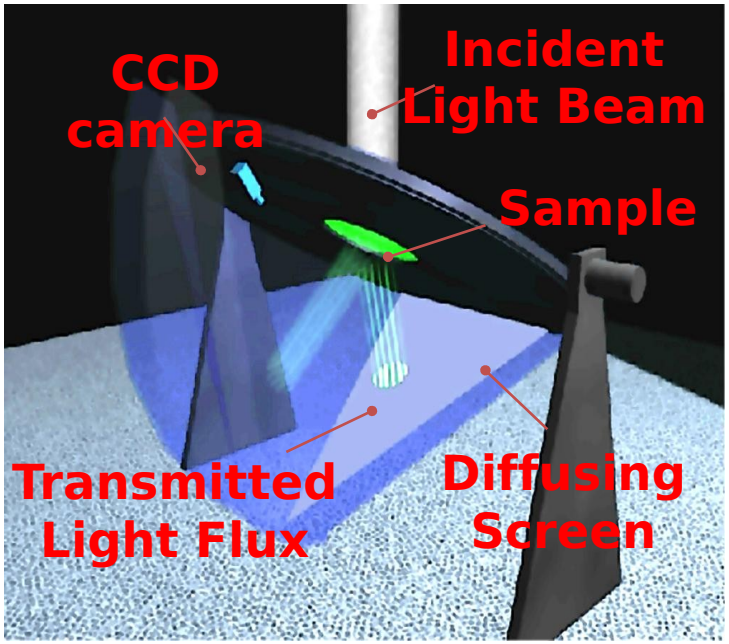
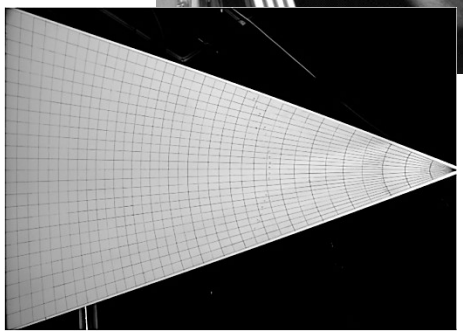


LESO-PB's Goniophotometer







Input: 145 Tregenza zones, Output: 5° x 5° (at best)
PhD Thesis, Marilyne Andersen, LESO-PB, EPFL, 2004
→ Recalibration of machine

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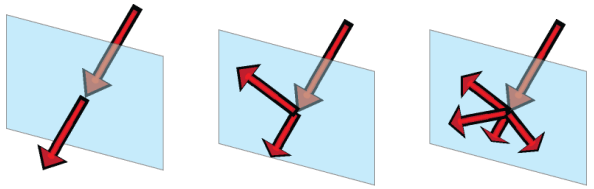
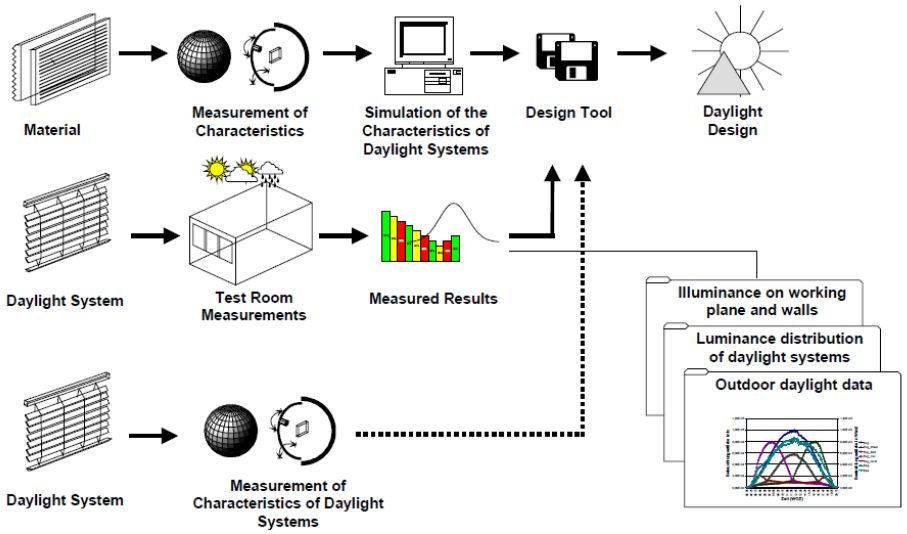


IEA 21 standard




```
#material: sun directing glass (Lumitop)
#manufacturer: Vegla
#Isym=3 ! symmetry indicator: 0 no symmetry (phi_1 = 0°...360°)
#       1 rotary symmetry (only for one phi_1)
#       2 symmetry to phi=0°  and phi=180° (phi_1 = 0°...180°)
#       3 symmetry to phi=90° and phi=270° (phi_1 = -90°...90°)
#       4 symmetry to phi=0° & phi=180° and to phi=90° & phi=270°
(phi_1=0°...90°)
#measurements done at TU Berlin Fachgebiet Lichttechnik, TUB
#measurements and processing by Berit Herrmann, Sirri Aydinli
#date of measurement: 29. September 1998
#contact aydinli@ee.tu-berlin.de  for details
#light incidence:
#phi_1: 0° (azimuth)
#theta_1: 0° (altitude)
#light transmittance: 0.45

#data
#phi_2          theta_2          btdf
0.000000e+000    9.590000e+001    2.497359e-002
0.000000e+000    9.940000e+001    2.619607e-002
0.000000e+000    1.028000e+002    2.703650e-002

                  ...

0.000000e+000    1.437000e+002    6.901417e-002
END
```

International Energy Agency Task 21, Source Book on Daylighting Systems and Components, Chap. 8.3: Optical Characteristics of Daylighting Materials, pp. 8.16 - 8.22, Paris, July 2000.

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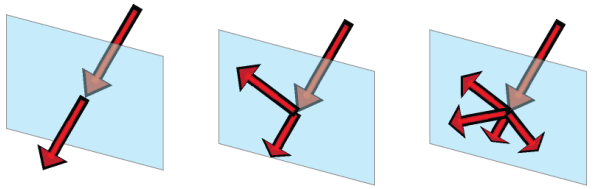
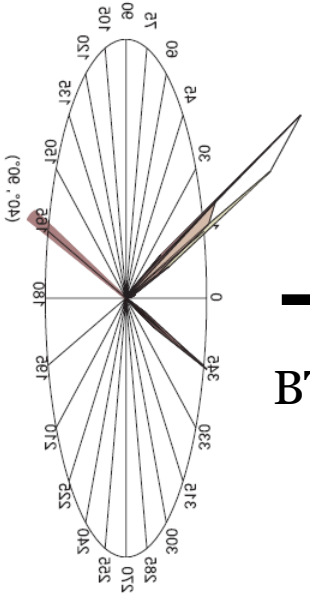


First attempt to use BTDF data with Radiance (2004)

Laser Cut Panel

IEA21



BTDF2prism2

J. Kaempf, J.-L. Scartezzini, Integration of BT(R)DF Data into Radiance Lighting Simulation Programme, Technical Report, CTI Project 4881.1 "Bidirectional Goniophotometer", LESO-PB/EPFL, Lausanne, 2004.

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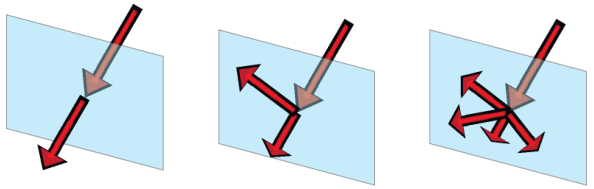
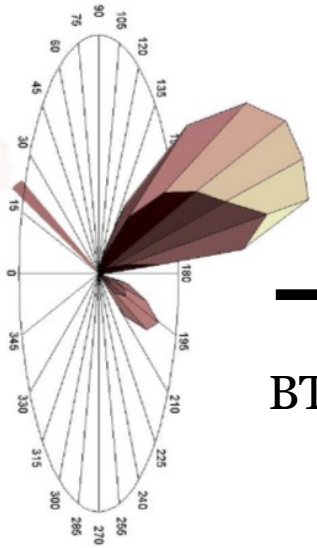
BTDF2RADIANCE: BTDFs and Radiance



First attempt to use BTDF data with Radiance (2004)

Mirrored Reflective Binds

IEA21



BTDF2prism2

J. Kaempf, J.-L. Scartezzini, Integration of BT(R)DF Data into Radiance Lighting Simulation Programme, Technical Report, CTI Project 4881.1 "Bidirectional Goniophotometer", LESO-PB/EPFL, Lausanne, 2004.

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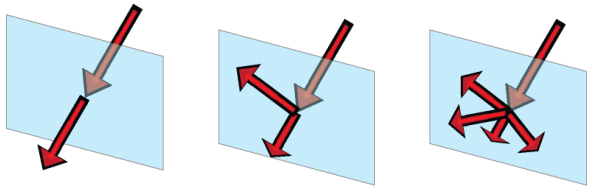
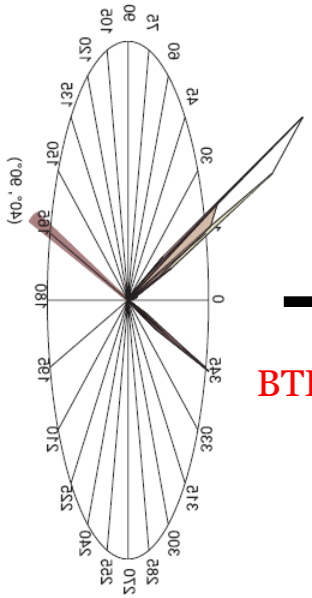
BTDF2RADIANCE: BTDFs and Radiance



New attempt to use BTDF data with Radiance (2010)

Laser Cut Panel

IEA21



BTDF2RADIANCE

2010: mkillum pre-process
2011: bsdf material

} Using an XML file format to describe the BTDF

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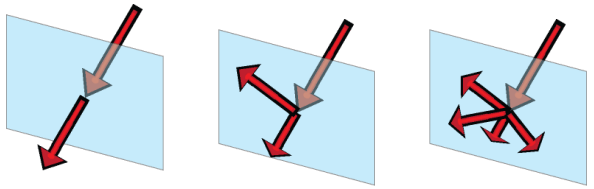
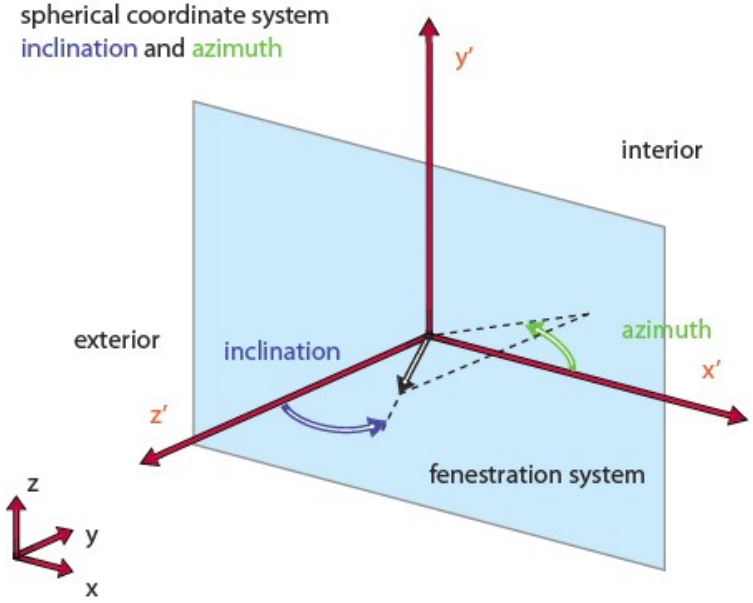
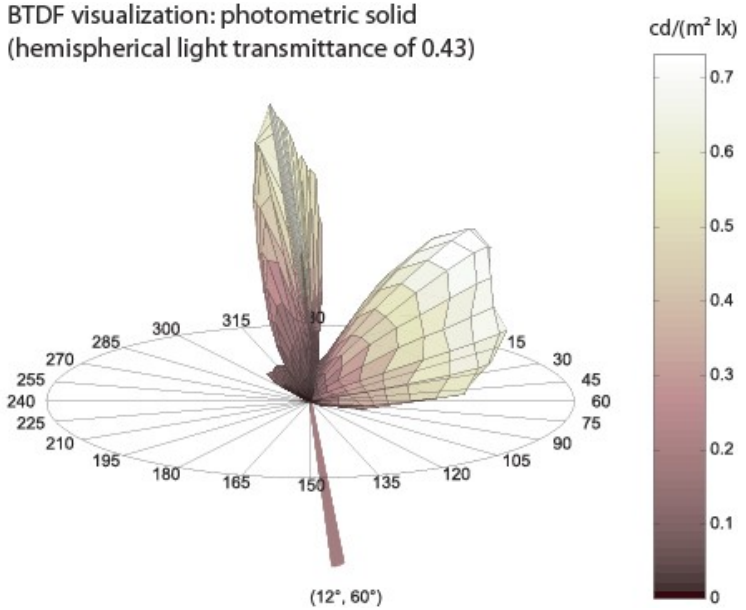


Conversion from IEA21 to the XML format





Reference frame attached to the sample:
- z' pointing outside, y' vertical, x' horizontal

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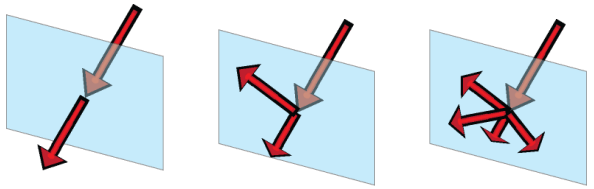
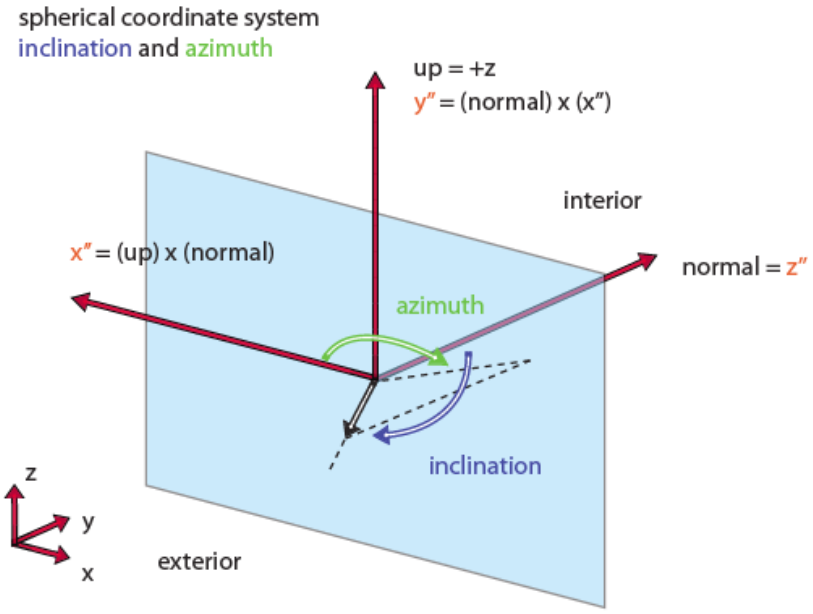
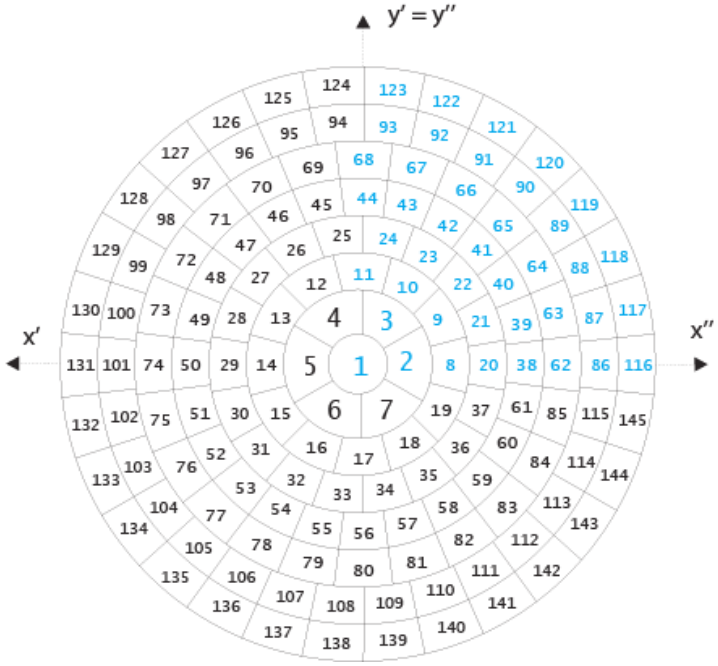


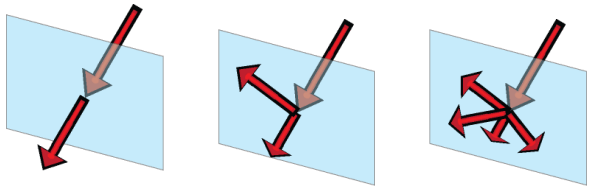
Conversion from IEA21 to the XML format



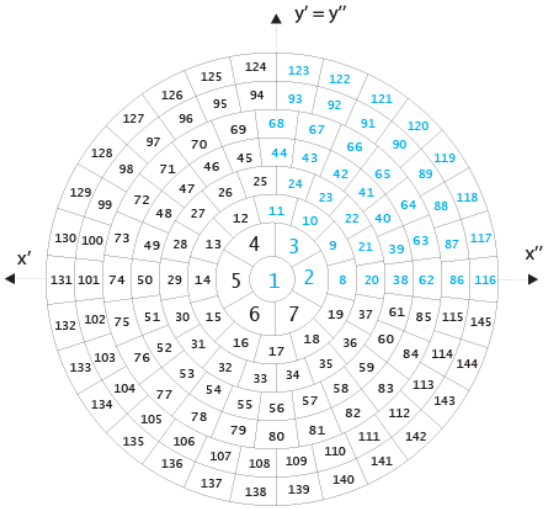


Reference frame attached to the sample (with up=+Z or direction 0 0 1):
- z'' pointing inside, y'' vertical, x'' horizontal

BTDF2RADIANCE: BTDFs and Radiance



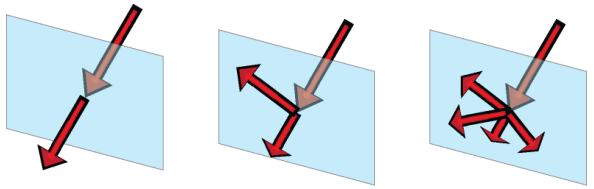
Sample of the XML format



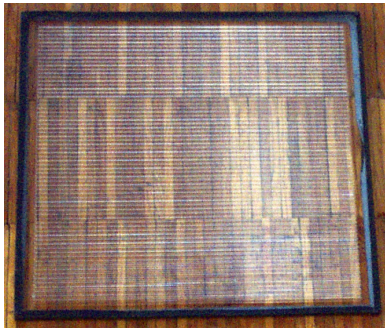

```
<?xml version="1.0" encoding="UTF-8"?>
<WindowElement>
 <Information Material="Lumitop" Source="BTDF2rad"/>
 <Optical>
  <Layer>
   <DataDefinition>
    <IncidentDataStructure>Columns</IncidentDataStructure>
   </DataDefinition>
   <WavelengthData>
    <Wavelength>Visible</Wavelength>
    <WavelengthDataBlock>
     <WavelengthDataDirection>Transmission Front</WavelengthDataDirection>
     <ColumnAngleBasis>EPFL/Tregenza Full</ColumnAngleBasis>
     <RowAngleBasis>EPFL/5deg Full</RowAngleBasis>
     <ScatteringData>
     ...[145 x 1297 values]...
```

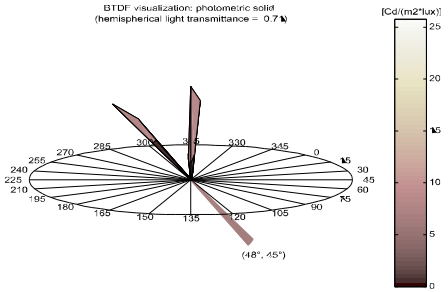
Input 145 Tregenza zones, Output 1297 zones (5° in azimuth and elevation)
Radiance 4.0 (official release) – added two basis in the file bsdf.c
Radiance 4.1 (head version) – (new) define the two basis in the XML file

BTDF2RADIANCE: BTDFs and Radiance



Laser Cut Panel

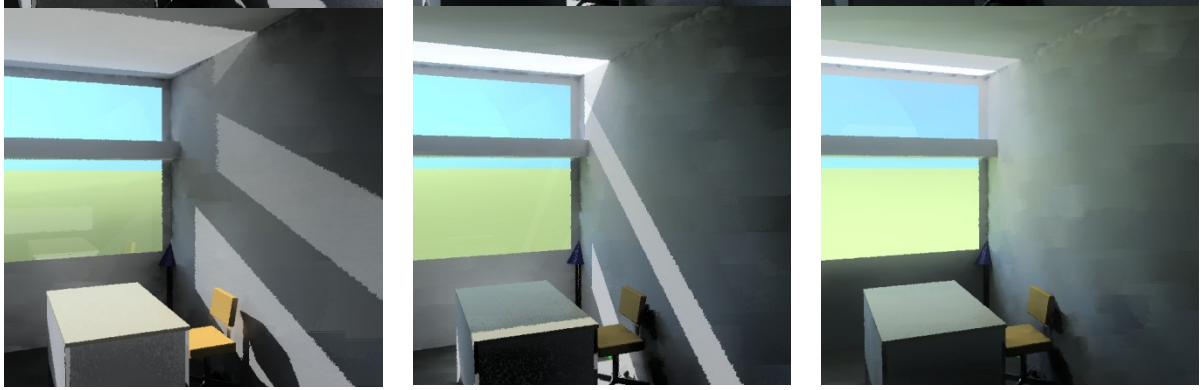




winter solstice | equinox | summer solstice

mkillum

prism2



Fast renderings (< 2 minutes), similar behaviour for the sharp redirecting material
Comparison between real (1:1), scale (1:10) and virtual models: Dr A. Thanachareonkit

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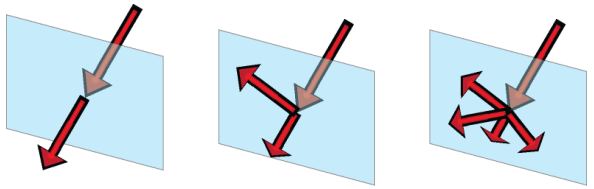
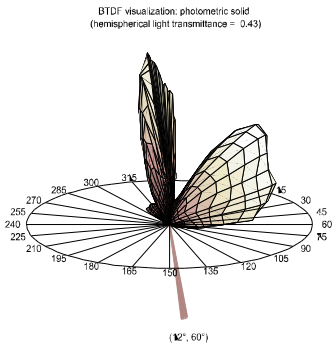


Lumitop



	winter solstice	equinox	summer solstice
mkillum			
prism2			

Fast renderings (< 2 minutes), directional-diffuse components make the difference

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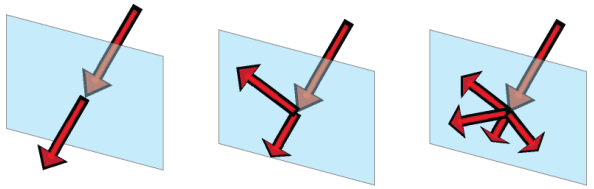

→ Conversion from IEA21 to XML format for rendering of CFS: BTDF2RADIANCE
+ Better renderings for directional-diffuse complex fenestration systems
- Increased rendering time
- Random sampling of the light source

Future work

Verification of the procedure by ways of:
- Virtual Gonio-Photometer
- Comparisons between real (1:1), scale (1:10) and virtual models

PhD thesis on the subject:
- "Optimization of Daylight in Educational Buildings in prevailing clear Sky Conditions and its consequent Influence on Energy Efficiency", by Chantal Basurto, make use of Complex Fenestration System

Import other data format from different goniophotometers

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