Introducing spectrally resolved BSDF and other updates on the PG2 gonio-photometer

Peter Apian-Bennewitz
pab advanced technologies Ltd
info@pab.eu

13th *Radiance* workshop, London
PG2 gonio-photometer layout
large sample mount with rotation ($\phi_{in}$), 1m radius

standard sample diameter up to 760mm, adjustable mounting of different sizes
closest angle $0.3^\circ$ to incident direction
PG2 news 2014: high angular resolution with HeNe

comparison of solar mirrors (for DLR):

solved with 1mm aperture (1m distance), filtered, focused 7mW HeNe, special drive software

Peter Apian-Bennewitz (pab Ltd)  spectral BSDF and PG2 updates
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- and:
  - first working spectral measurement heads in service:
    VIS and IR
BSDF, the formal way, (with wavelength)

Definition

\[ \mathcal{L}_{out}(\vec{x}_{out}, \lambda) = \Omega_{in=2\pi} \int_{\vec{x}_{in}} BSDF(\vec{x}_{in}, \vec{x}_{out}, \lambda) \mathcal{L}_{in}(\vec{x}_{in}, \lambda) \cos(\theta_{in}) \, d\Omega_{in} \]

- 4 variables: \( BSDF(\vec{x}_{in}, \vec{x}_{out}) = BSDF(\theta_{in}, \phi_{in}, \theta_{out}, \phi_{out}) \)
  plus (optionally) wavelength \( \lambda \)

\( \mathcal{L}_{out} \) outgoing, \( \mathcal{L}_{in} \) incident radiance, \( \lambda \) wavelength, \( \Omega_{in=2\pi} \) integral over hemisphere,
\( \Omega_{in} \) inf. solid angle, see talk at 2010 workshop for more math
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- ideal white diffuse surface: \( \operatorname{BSDF}(\vec{x}_{in}, \vec{x}_{out}, \lambda) = \text{const} \)
- often applied approximation:
  \[ \operatorname{BSDF}(\theta_{in}, \phi_{in}, \theta_{out}, \phi_{out}, \lambda) = \underbrace{\operatorname{BSDF}^*(\theta_{in}, \phi_{in}, \theta_{out}, \phi_{out})}_{\text{angular part}} \rho^*(\lambda)_{\text{spectral}} \]

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spectral BSDF, key parameters

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How to understand and check spectral BSDF

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- new challenge to Radiance: handling spectral BSDF.
yellow, glossy paint, $\theta_{in} = 30^\circ$, @490nm, standard display
yellow, glossy paint, $\theta_{in} = 30^\circ$, @490nm, spectrum off-peak
yellow, glossy paint, $\theta_{in} = 30^\circ$, @490nm, spectrum at base of peak
yellow, glossy paint, $\theta_{in} = 30^\circ$, @490nm, spectrum at peak
spectral BSDF graph of inplane scattering

yellow, glossy paint, $\theta_{in} = 30^\circ$, $\phi_{out} = 180^\circ$
conclusion:

- PG2 is a fairly configurable machine  
  (... get one today!)
- spectral BSDF: lots of fun, even for "simple" materials
- works for more complex scattering too
- inspires more questions on modelling and materials
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- more BSDF math at 2010 pab workshop talk
- more measurement details: http://www.pab.eu

- happy rendering
- thank you for your attention
- 256 pixel, mean pixel pitch: 3.3nm
- resolution, half-width at 1/10 max : 7nm
- pixel-wavelength function: 3rd order polynomial
- spectral range, nominal: 310nm to 1100nm