Advantages of the PG2 scanning gonio-photometer

Key feature of the principle of a *scanning* gonio-photometer

- detector system is mechanically moved to position around sample
- clear separation of angular position and signal processing
- detector response identical at all positions
- detector can be verified externally
- multiple parallel detectors are possible
- detectors are adaptable to task (spectral range, solid angle)
- no intermediate components in beam path that add to scattering and cross-talk, leads to lower errors and detailed understanding of residual error sources
- instrument signature is well defined and might be adaptable to task

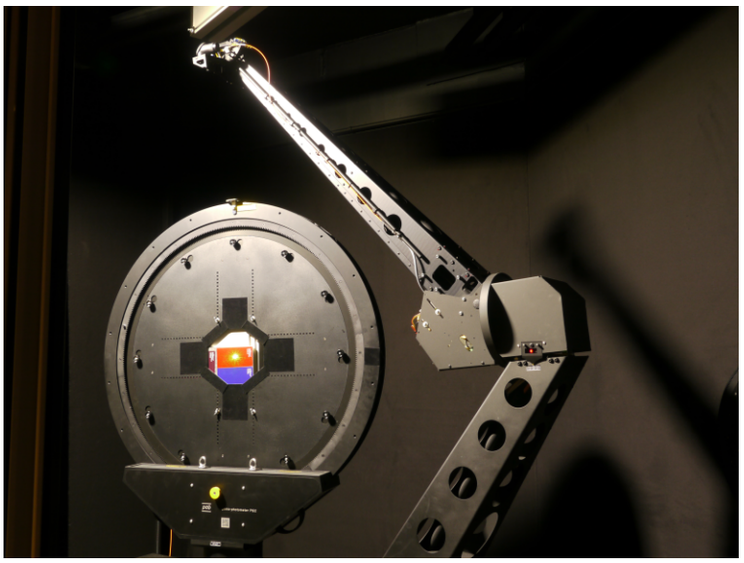
Specific key feature of the pab PG2

- full 3D: allows to set two incident angles, two outgoing angles
- allows measurement of transmittance and reflection
- scan-area was maximised, covers nearly the full sphere around sample
- minimised self-shading by arm in reflection measurements
- the size of 1m between sample and detector achieves small solid angle offering high resolution
- modular design, adaptable to client's tasks
- precision in angular positioning, achieved by high-end drive systems
- intrinsic cross-checking of angular position by using both arm configs for one outgoing direction
- uses beam as reference requires no reflective standard as reference
- speed of positioning
- in-house developed fast sensor technology
- fast measurements on-the-fly, while detector is moving
- detectors for UV, VIS and IR available
- extension with Zeiss spectral detectors, 330nm to 1.7um
- optional extra light-sources installable by end-user
- as selection of sample mounts match user's task and projects
- control program and data-storage interface easily to user's site requirements
- direct contact with PG2 development
- 25 years of experience in BSDF measurement, 10+ years of international PG2 support

• some details of installed PG2 are given on the following pages

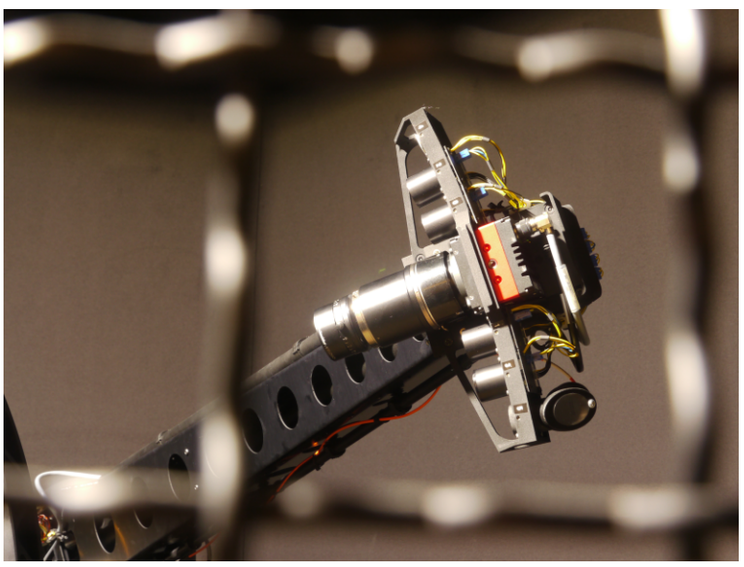
- Heavy-duty armB
- 4-channel standard sensors
- Spectrometer option
- *phirot* sample mount
- Ceiling rail for crane to lift *phirot* sample mount

RealisticGraphicsLab (RGL),
EPFL, Lausanne



- 4-channel standard sensors
- Spectrometer option (lower sensor in image)
- Multiple cameras and lenses, selected by client
- Each camera is mounted on a sled, user exchangable

RGL, EPFL



- Client supplied camera control sub-system at armB
- Component rotates together with detector-head
- Mechanical adapter and power supply with sliprings by pab Ltd

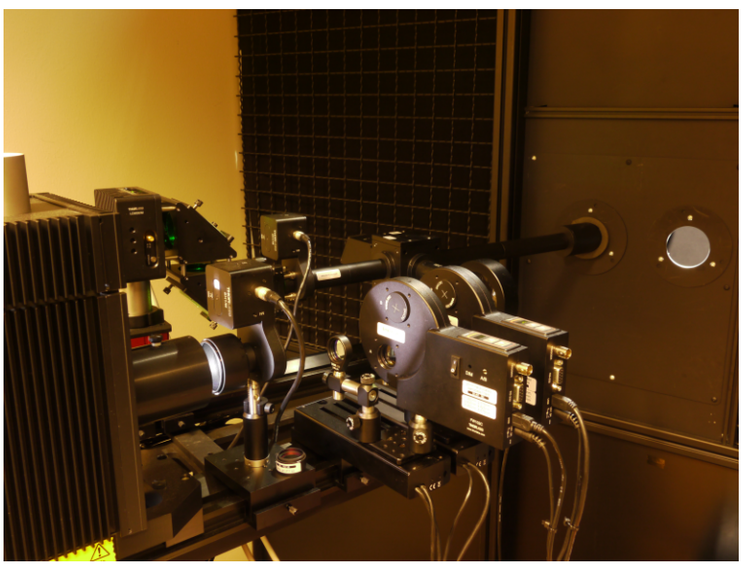
RGL, EPFL

- *phirot2* mounted on PG2
- overhead crane for *phirot* mounting
- ceiling light used during mounting of sample and maintenance
- all PG2 installations use high-power outdoor LED light fittings to achieve sufficient light levels during maintenance despite the black walls and ceiling

RGL, EPFL

- Merge of classical PG2 light system and client supplied extra set-up
- Specifications of carrier systems by pab Ltd
- Control of components through USB at PG2-control-PC running Linux

RGL, EPFL



- Measuring refraction of a prism
- PG2 Manual sample mount combined with a standard mount for optical components

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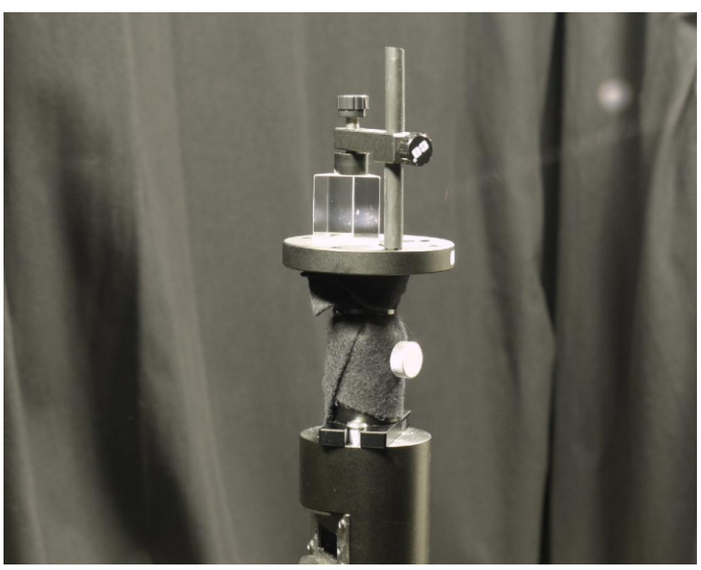
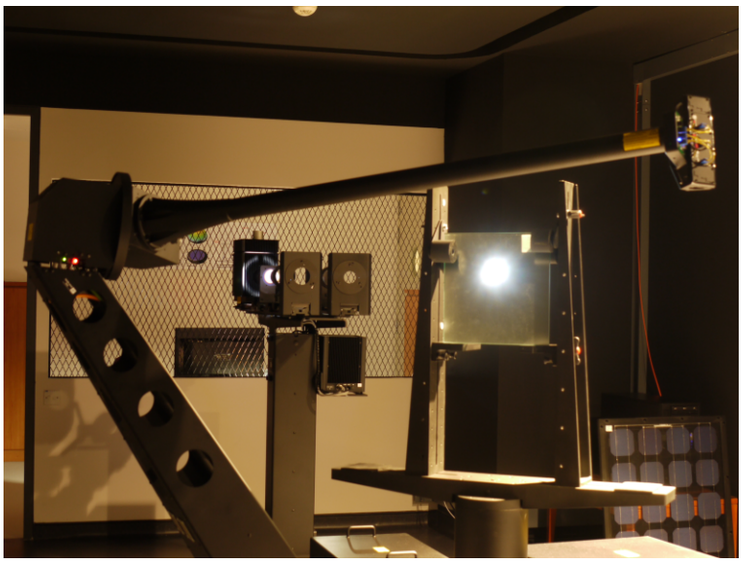


- *LargeSampleMount* with glazing sample during set-up of PG2
- Dual light sources: Halogen and Xenon
- 4-channel std sensors
- Shown here before installation of black curtains

Solar Energy Research Institute of Singapore (SERIS)



- Manual sample mount during setup of PG2
- Xenon light source in foreground
- 4-channel std sensors

HSLU, Lucerne

- special Si sensor with smaller shadow region around sensor
- used for measuring reflection BSDF very close to the retro-reflected peak
- custom developed for consulting project with retro-reflectors used in industrial light-curtains

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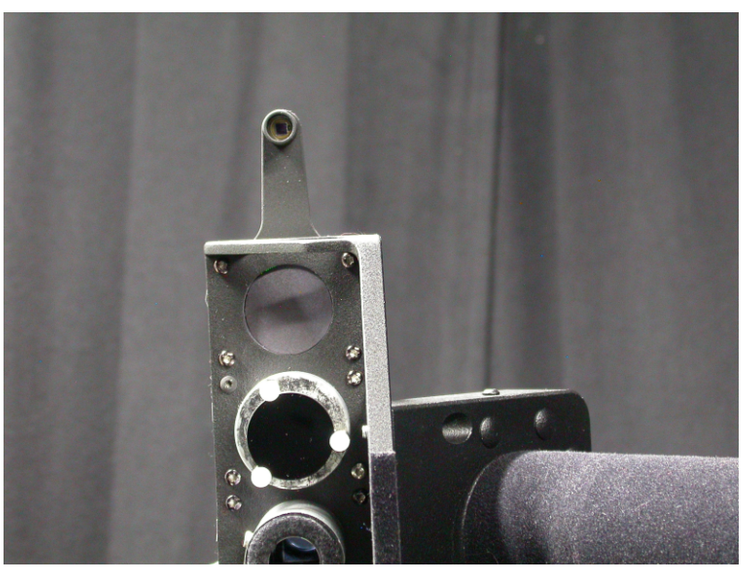

- BRDF visualisation using the program *mountain*
- Plot shows reflective part of BSDF for incident angle 10deg
- A "classical BSDF" of a rough Aluminium sample:
  material scatters around the ideal reflected peak
- Plot uses linear Z-scale

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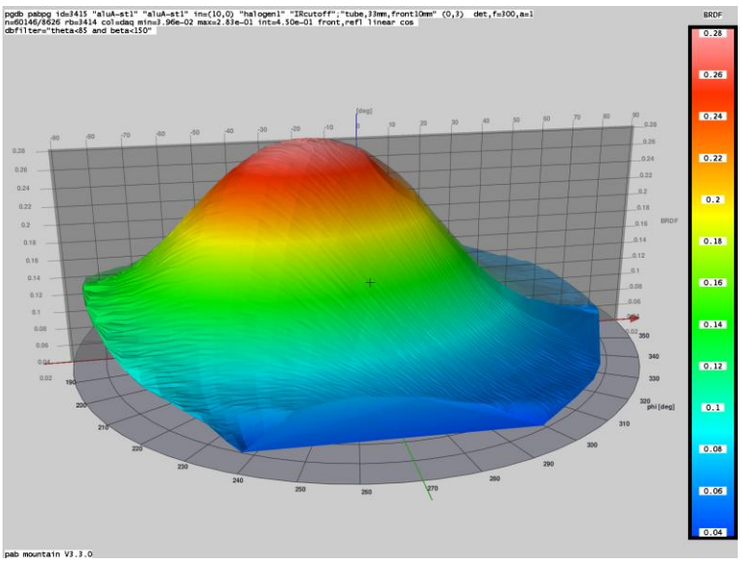

- Detail of above dataset, showing individual data points with 0.3deg spacing
- Each dataset contains two configurations of the PG2 for the same position of the the detector head:
  one is shown with pink-colored datapoints, the other one with yellow-colored datapoints.
  Their matching values intrinsically cross-check positional accuracy,

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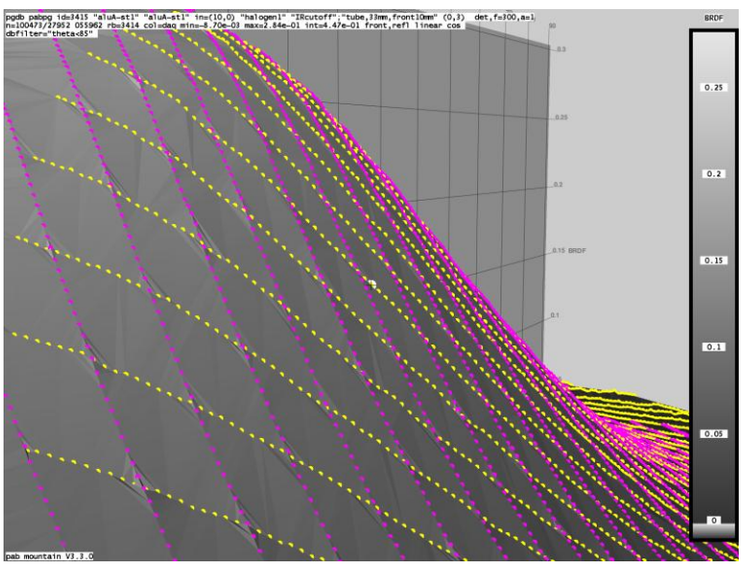

- Transmision DSF visualisation of a light-redirecting material, used for daylighting indoor spaces
- Peak on left side of centre is directly transmitted light
  Peaks on right side are light redirected.
  In an installed glazing this would be redirected towards the ceiling
- Peaks and 'ridge' use an adaptive refinement with closely spaced measurement points
- Plot uses a logarithmic Z-scale

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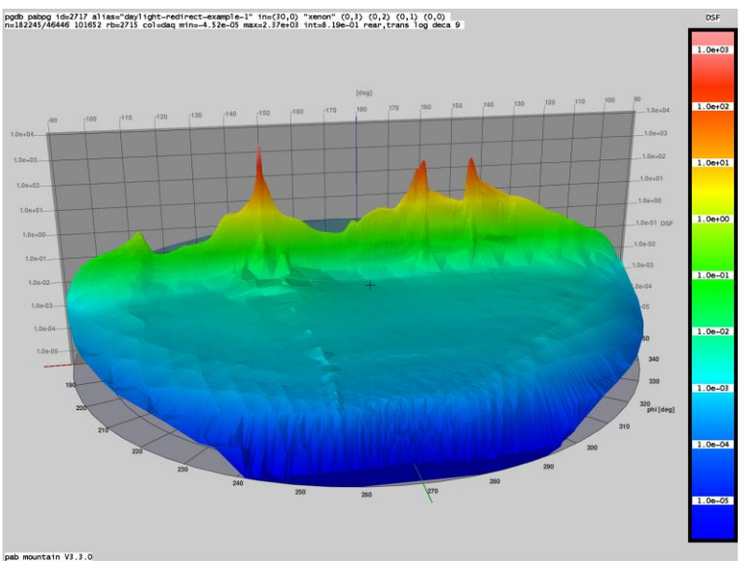

- Transmision DSF visualisation of a light-scattering material, used for daylighting indoor spaces
- surface is regularly embossed with small geometric pyramids
- normal incident direction
- Note that peaks are not artifacts, since each peak is resolved by the scan pattern
- The region of interest uses an adaptive refinement with closely spaced measurement points
- Plot uses a logarithmic Z-scale

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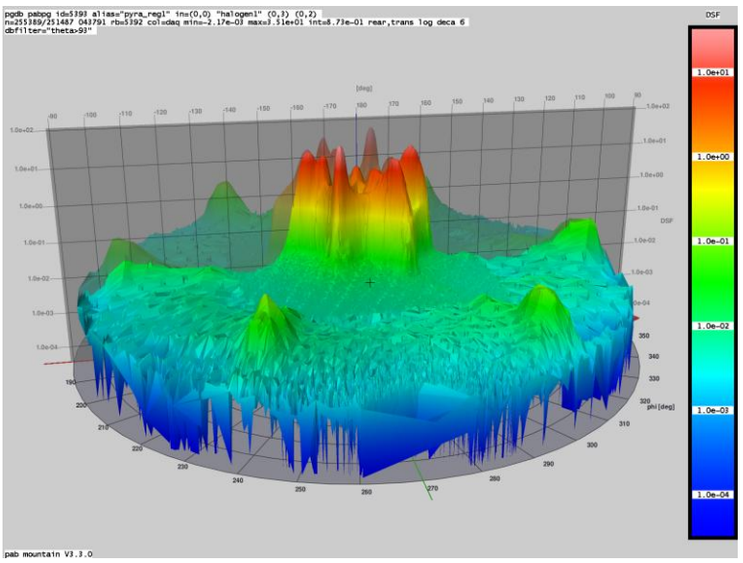

- Spectral BRDF for glossy yellow paint
- incident direction 30deg, plot is centred around ideal reflected peak
- spectrum shown for one outgoing angle
- interactive display, using program *mountain*
- Angular plot uses a log Z-scale spectral plot uses linear scales

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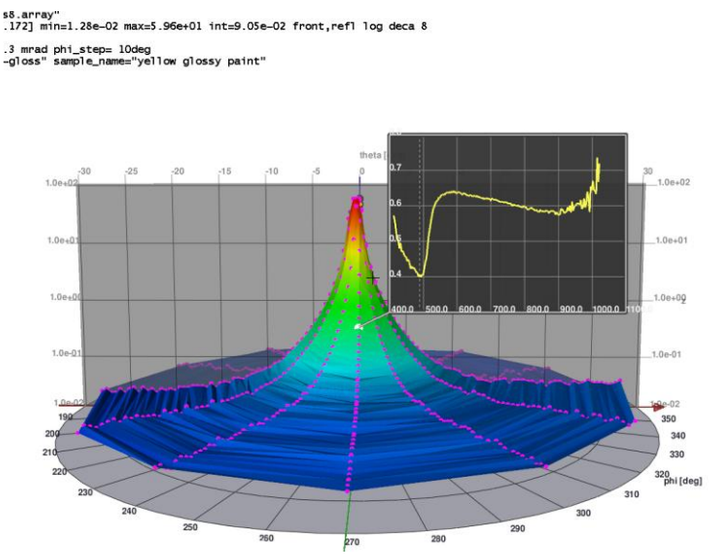

- Two PG2 during assembly at a local steel building company

pab advanced technologies Ltd
reg in England&Wales #5794152
German manufacturing:
pab®advanced technologies Ltd,
79114 Freiburg, Germany
Dr. Peter Apian-Bennewitz
Tel +49-761-4766302
web-site: http://www.pab.eu
example data: http://bme.pab.eu

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