Mini-Diff
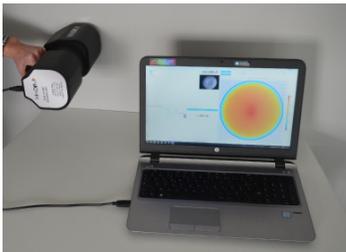# 3D (Hemispheric) Scatterometer
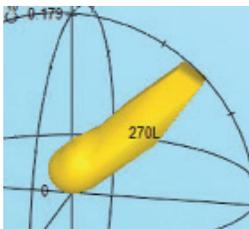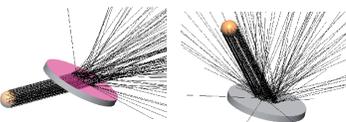# BRDF/BTDF

For 3D Scattered Light Measurements

Mini-Diff V2

Mini-Diff VPro

BSDF 3D Scattering Example

Description

Our **Mini-Diff** product line includes camera-based 3D hemispherical scattering measurement instruments used to characterize scattering surfaces. It provides BRDF and BTDF measurements as well as Total Integrated Scattering (TIS) calculations for red, green, and blue (RGB) colors and in the near-infrared wavelengths. Mini-Diff images hemispherical scattered intensity and delivers color data in reflection or transmission.

Mini-Diff V2 is our portable product that enables fast, accurate measurements of luminous energy distribution. This data can be used to characterize surfaces.

The incident light is provided by four collimated LEDs set up at 0°, 20°,40° and 60° incident angles for reflective and transmissive measurements.

Mini-Diff VPro is our laboratory version of the Mini-Diff. Incident angles can be chosen from 0° to 60° for reflective and transmissive measurements. The instrument has AR-coated lenses and a dark box to eliminate stray light. The system includes a high-quality CMOS sensor, and is temperature controlled to improve measurement stability.

The results (relative scattered intensity and BRDF/BTDF) can be saved in text formats, or can be exported to optical software format.

Applications

- Reflector/diffuser material characterization for automotive design
- Photorealistic rendering: accurate measurement of diffusing behavior
- Cosmetics characteristics
- Roughness controls in production
- LCD backlighting: BEF, DBEF inspection, diffusing films
- Diffuser/display quality control
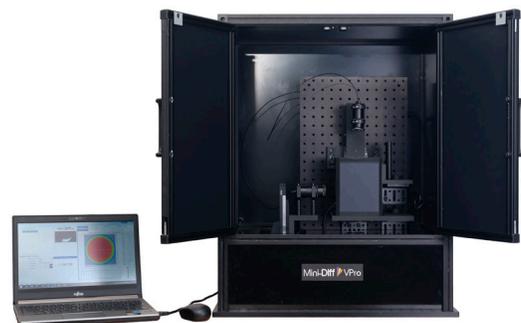- Material characterization for many incident angles

Mini-Diff V2


BRDF
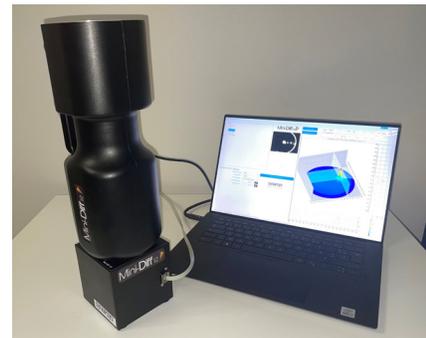
BTDF

Mini-Diff VPro

Reflective Materials

Mini-Diff instruments provide a quick measurement of the BRDF for several incident angles and three colors.

- After a two-step calibration (one step with a black standard to cancel the stray light and one step with a Lambertian standard to calibrate the response of the camera), it is possible to measure:
  - Reflectors
  - Paints
  - Diffusing material
  - Sockets
  - Optical mounts and more
- The measured relative scattered intensity can be saved in text files, slices files, mesh format, BSDF format, ABg (Harvey Shack) and Gaussian/Lambertian model.
- TIS measurements is estimated by the Mini-Diff V2 software. This feature allows you to compare samples directly with the efficiency of the diffusers.
- Mini-Diff V2 software also accounts for anisotropic material measurement and is capable of directly generating files for illumination design software.

Example: Reflector Alanod Miro5

Reflector material can have complex behaviour depending on the incident plane. The Mini-Diff series allows users to capture scattering for angles of incidence, parallel and perpendicular to stripes (anisotropic material).
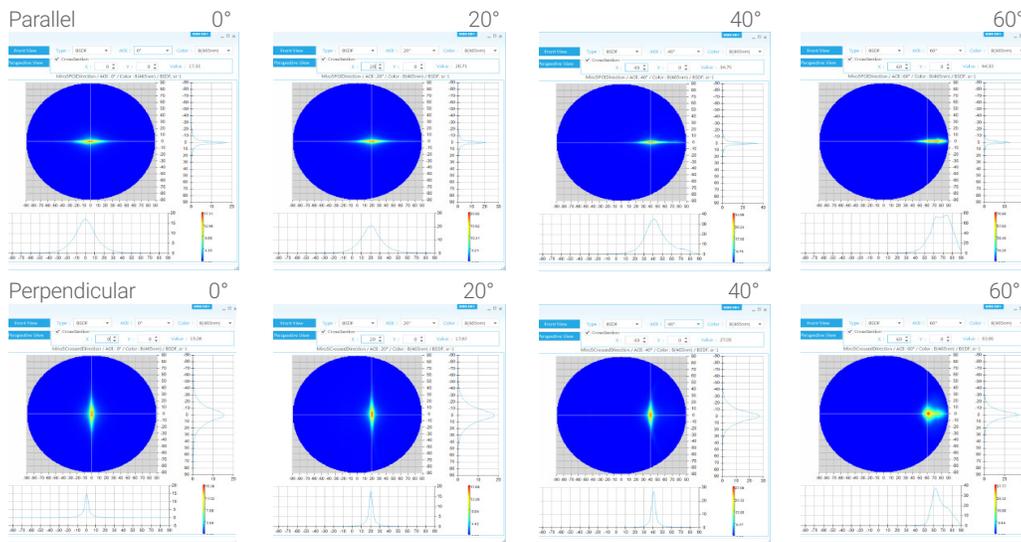
Transmissive Materials

- Mini-Diff products allow a quick measurement of the BTDF for several incident angles.
- One external part "transmission module" can be supplied with the Mini-Diff V2 as an option , but is included in Mini-Diff VPro, which includes collimated LEDs on a large area (diam 10mm) in order to be insensitive to the sample placement.
- After a one-step calibration using one Lambertian transmissive standard (supplied), it is possible to measure diffusing materials:
  - Opal glass
  - Diffusing plastics
  - Brightness enhanced film (BEF)
  - Beam shaper (diffractive optics)

40° Circular   60°x10° Elliptical

Example: Luminit Diffuser

Reflective and Transmissive Materials

Mini-Diff devices enable to measure BRDF and BTDF on one diffuser (front and back side measurement) and can be used to build a ready-to-use BSDF file for illumination design software.

Color Measurements

Mini-Diff products have RGB light sources used for BRDF and BTDF and allow BSDF measurement for each color. It can give a global color estimation in CIE L*a*b* space using the TIS estimation. You can look at the RGB 3D BSDF from the Mini-Diff software.

Color Info : L* = 34.31- a* =21.32 - b* = 7.87

Color Info : L* = 61.31- a* = -13.71 - b* = -6.84
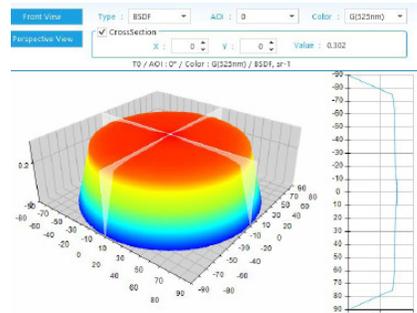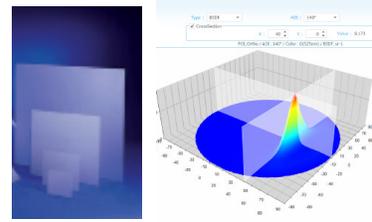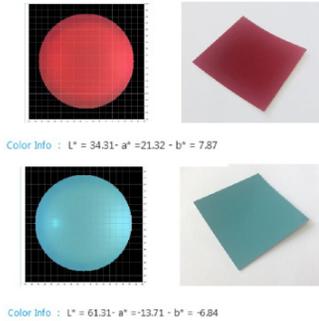
Example of measurement with one Spectralon sample
(Lambertian standard)

Calibration and Accuracy

Mini-Diff instruments include three standard calibration samples: black, reflective Lambertian, and transmissive Lambertian.

Technical Specifications			
Instrument	**Mini-Diff V2**	**Mini-Diff V2 IR**	**Mini-Diff VPro**
Sources	• Red: 630nm [b.A=25nm] • Green: 525nm [t.A=35nm] • Blue: 465nm [b.A=25nm]	• 850nm [t.A=40nm] • 940nm [t.A=30nm]	• Red: 630nm [b.A=25nm] • Green: 525nm [t.A=35nm] • Blue: 465nm [b.A=25nm]
Camera	• 640*480 pixels	• 640*480 pixels	• 2048*1088 pixels
Angle of incidence for reflection and transmission	• 4 Incident angles: 0°; 20°; 40°; 60°	• 4 Incident angles: 0°; 20°; 40°; 60°	• Tunable Incident angles: 0° to 60° with a step of 1°
Spot size on the sample surface/measured Area	• 1 mm diameter	• 1 mm diameter	• 1 mm diameter
Field of view	• + /-75° (150° total)	• + /-75° (150° total)	• + /-75° (150° total)
Calibration: Reflection (for 1 AOI) Transmission	• 20 Seconds • 10 Seconds	• 20 Seconds • 10 Seconds	• 1 Minute • 30 Seconds
Measurement: Reflection (for 1 AOI) Transmission	• 10 Seconds • 10 Seconds	• 10 Seconds • 10 Seconds	• 25 Seconds • 25 Seconds
Results: Dynamic Range Angular Resolution Accuracy Repeatability Stability	• 10^5 • 1° • <5% • <2% • 30 Minutes	• 10^4 • 1° • <5% • <2% • 30 Minutes	• 10^6 BTDF/10^5 BRDF • 1° • <2% • <2% • 10 Hours
Data exchange	• Text file (ASTM format) • BSDF format (imported in commercial software) • Fit to Gaussian/Lambertian format • Slice files (IES type) • Mesh file • Fit to ABg • Exportation to format: LightTools, Zemax, TracePro, OptiWorks, Relux and more ...		

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