Measuring Retroreflection of Traffic Signs Using Synopsys Mini-Diff Instruments

Retroreflection occurs when light is returned to its source. It is important to measure retroflection effects in many types of optical systems, but it can be a challenge. For example, a classical goniometer measurement doesn't capture retroreflection because the detector hides the light source.

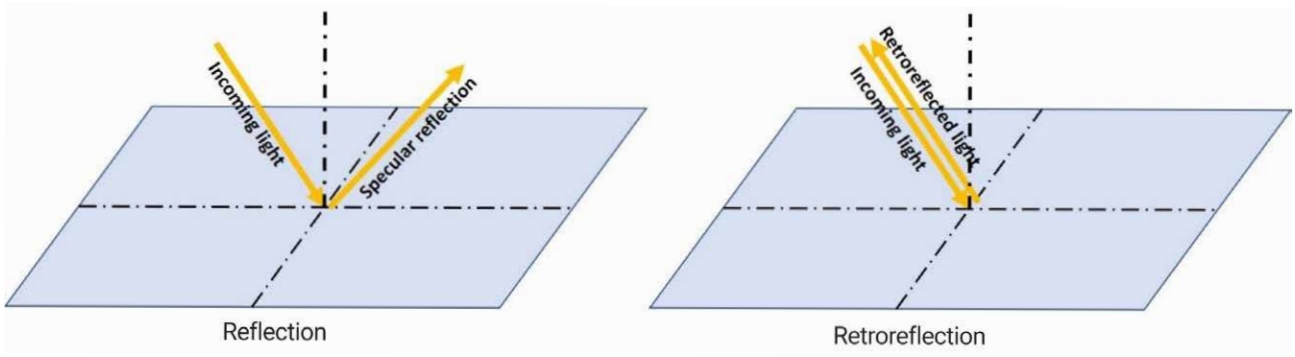


Figure 1: Illustration of reflection and retroflection

Synopsys Mini-Diff instruments easily support retroreflection measurements, as described in this example featuring a traffic stop sign. Retroreflective paint is used on traffic signs to reflect approaching vehicle headlights and make signs easily visible to drivers at night. This is an important safety factor, and therefore it is important to measure the retroreflection of traffic sign paint to ensure it meets safety requirements.

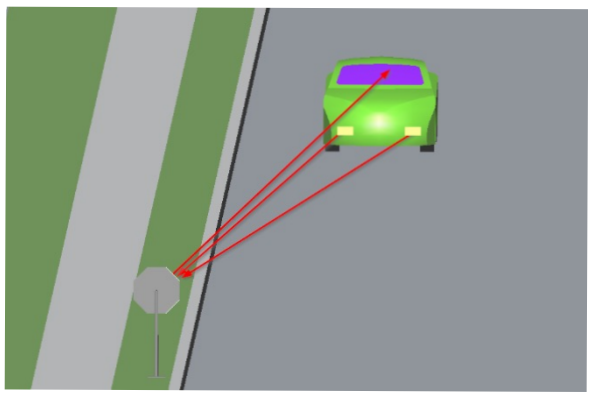


Figure 2: Simulation of traffic sign paint retroreflection

Mini-Diff systems are portable and can measure retroflection directly on a traffic sign. The Mini-Diff measures angles of incidence at 0°, 20°, 40° and 60° and for all colors (red, green, blue) on the red and white areas of the sign.

In the following figures, the measurement results correspond to the angle of incidence at 20° for the red area (RGB measurement at top) and for the white area (green light measurement at bottom).

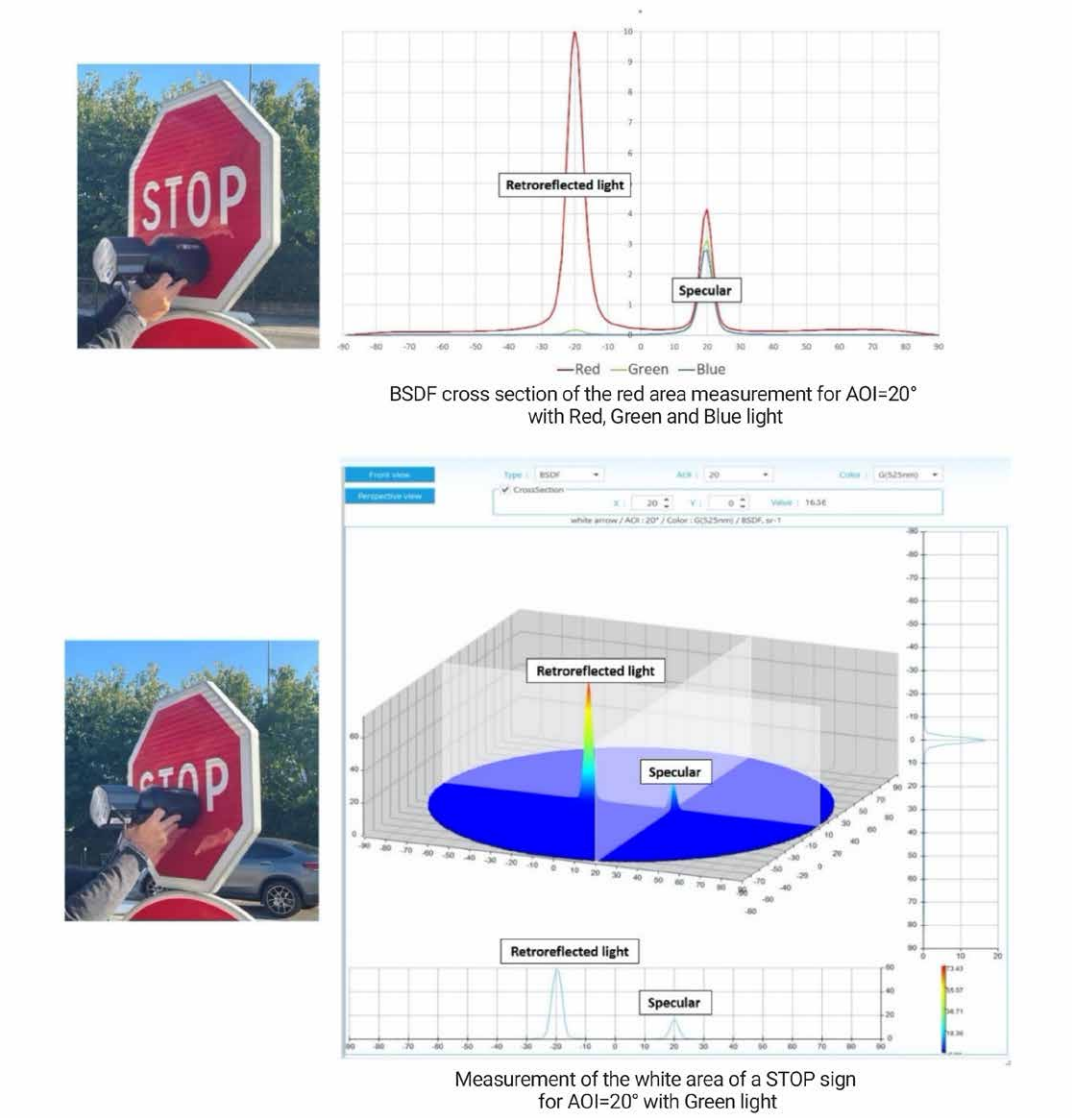
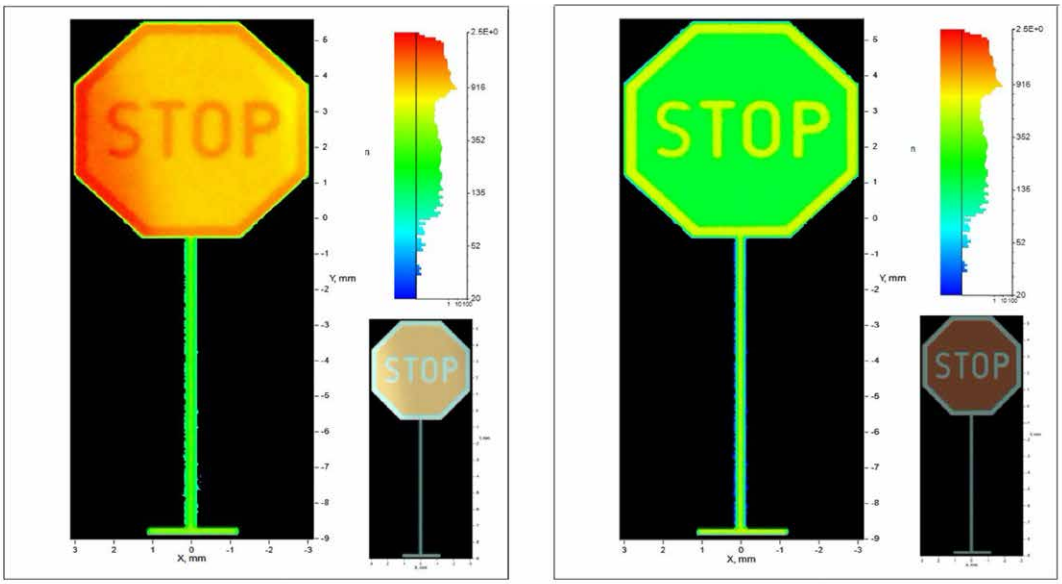


Figure 3: RGB measurement for red area of the sign (top); green light measurement for the white area of the sign (bottom)

The Mini-Diff is able to measure the retroreflected light; a peak is visible in the specular orientation. In addition, the RGB measurements show the color appearance of the different areas of the sign.

The Mini-Diff also allows you to measure and quantify, via a BSDF measurement, the retroreflection of a luminous sign and determine whether the sign will have sufficient night visibility. You can then export measurements for use in optical simulation software such as LightTools.

LightTools simulation results obtained from stop sign measurements are shown in the following figure. The simulations provide a luminance map from the driver's perspective.



Stop sign with retroreflective paint lighted by a car at 50m

Stop sign with classical paint lighted by a car at 50m

Figure 4: LightTools luminance simulations using Mini-Diff stop sign measurements

A stop sign with the surface properties extracted from the measurement of a retroreflective paint (left) is compared to the same sign with a standard non-reflective paint (right). Both signs are illuminated by a car's headlights at a distance of 50 meters.

The retroreflectivity level is clearly higher for the sign on the left than the sign on the right. In addition, you can distinguish the retroreflective lob effect (left side of the road sign) compared to the regular diffused component of the paint BRDF.

Using a portable Mini-Diff instrument, it is easy to gauge the visibility of traffic signs from different angles and distances. This can be useful for assessing the deterioration of an existing sign, choose the best location for a sign, or evaluate the quality of retroreflective paint during manufacturing.