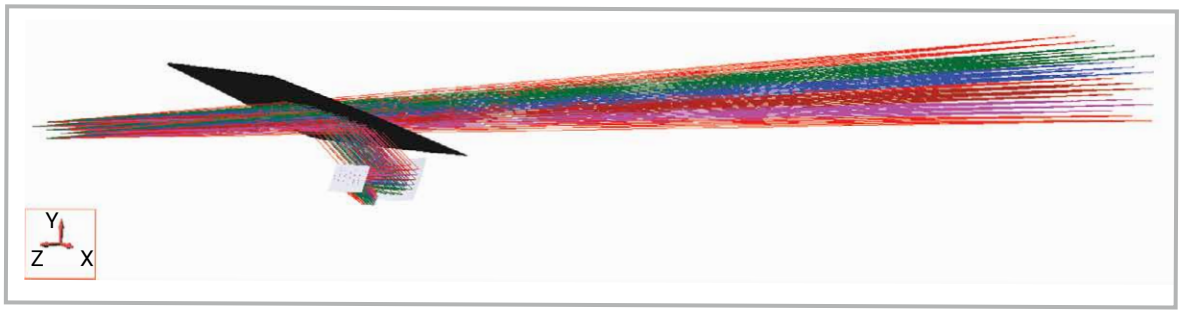
SYNOPSYS®

APPLICATION NOTE

Synopsys TIS Pro

Using Synopsys TIS Pro Measurements in HUD Design

Head-up displays (HUDs), now available in many cars, can superimpose important driving information on the road view, directly in the driver's line of sight.



To get accurate results when you use optical software to simulate a HUD, you need to define the shape of the surfaces as well as the optical properties of surfaces that compose your elements.

The optical properties of a material can be described using two quantities:

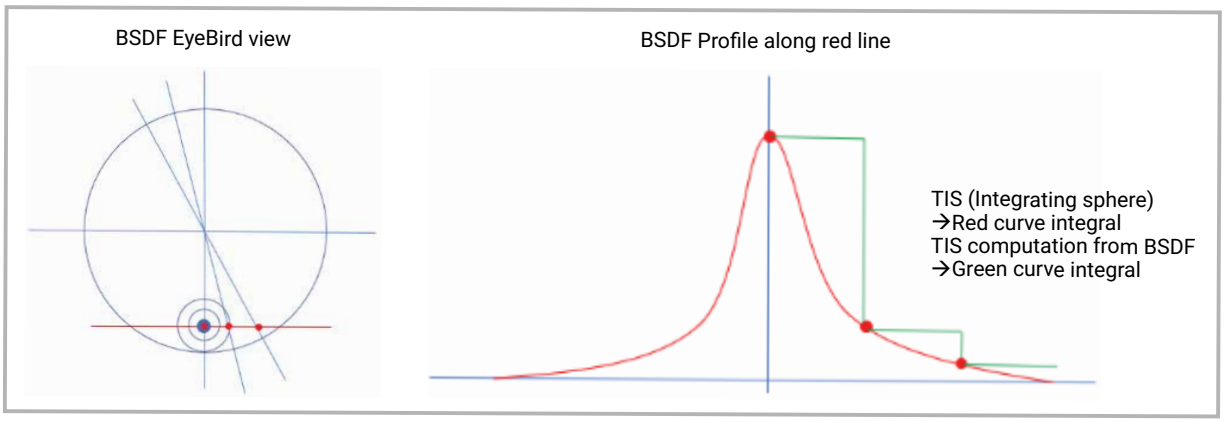
- The bidirectional scattering distribution function (BSDF), which characterizes how light is scattered at different angles from any surface relative to the incident angle.

  This value is useful to understand if a mirror is correctly specular. In other words, it helps you to understand if light correctly propagates with the same angle as it came in, with respect to the surface normal.

- Total integrated scattering (TIS), which is equal to the ratio of:

  Reflected or transmitted power / incident light power at an optical interface.

  This value should be used together with previously measured BRDF or BTDF to achieve better precision for the value of the quantity of light reflected or transmitted. TIS can be computed from the BRDF or BTDF measurement, but an accurate value depends on both, on measurement sampling and accuracy.

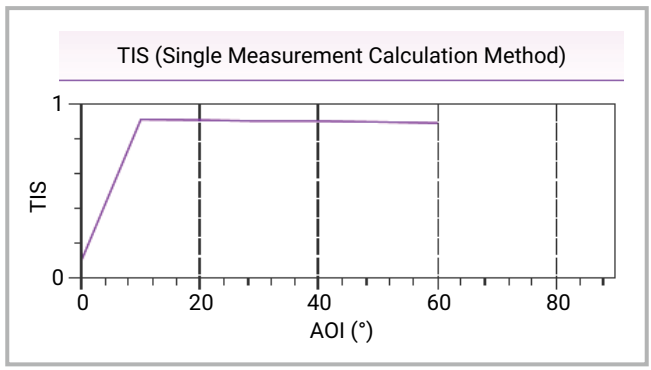


The correlation between computed TIS from BSDF and integrating sphere measurement may not be as good as expected, especially when the BSDF is peaked (specular surface) and the azimuth measurement sampling is coarse.

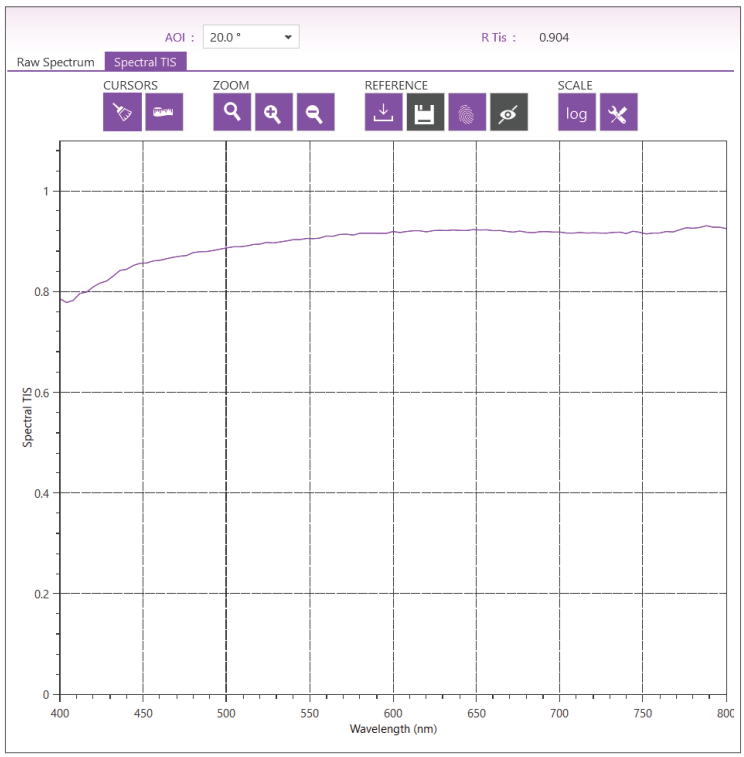
Using Synopsys TIS Pro, we can measure TIS based on the incident angle of the light source, as well as spectral TIS. Spectral TIS provides access to an additional parameter: wavelength.

When a sample is a mirror, like this one:

We can measure the TIS.

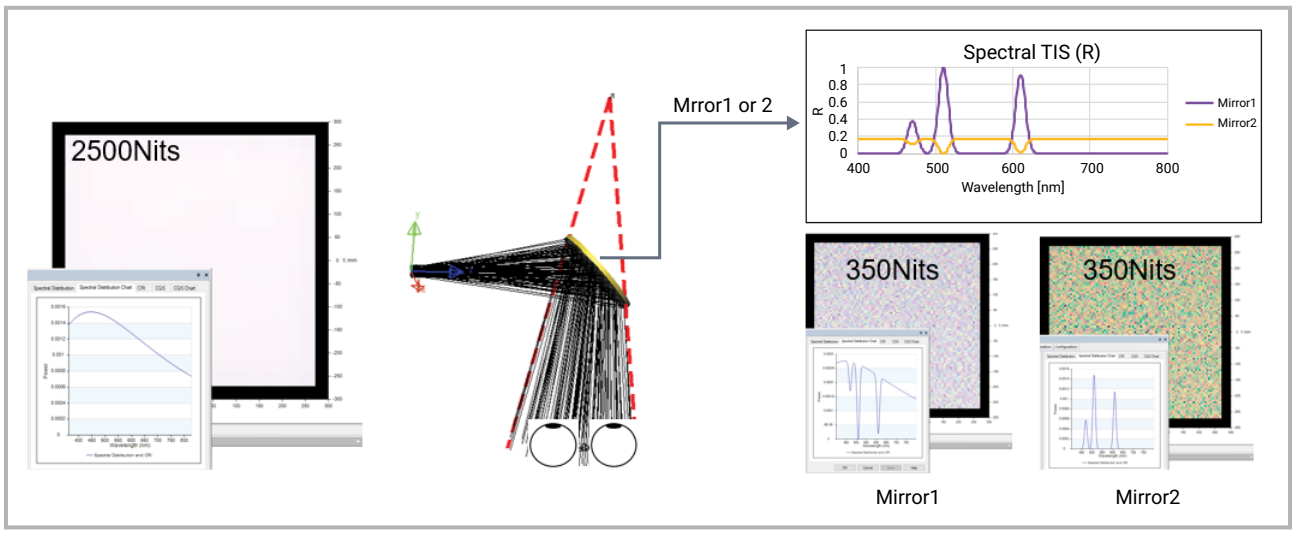


In addition, we have access to the spectral TIS:



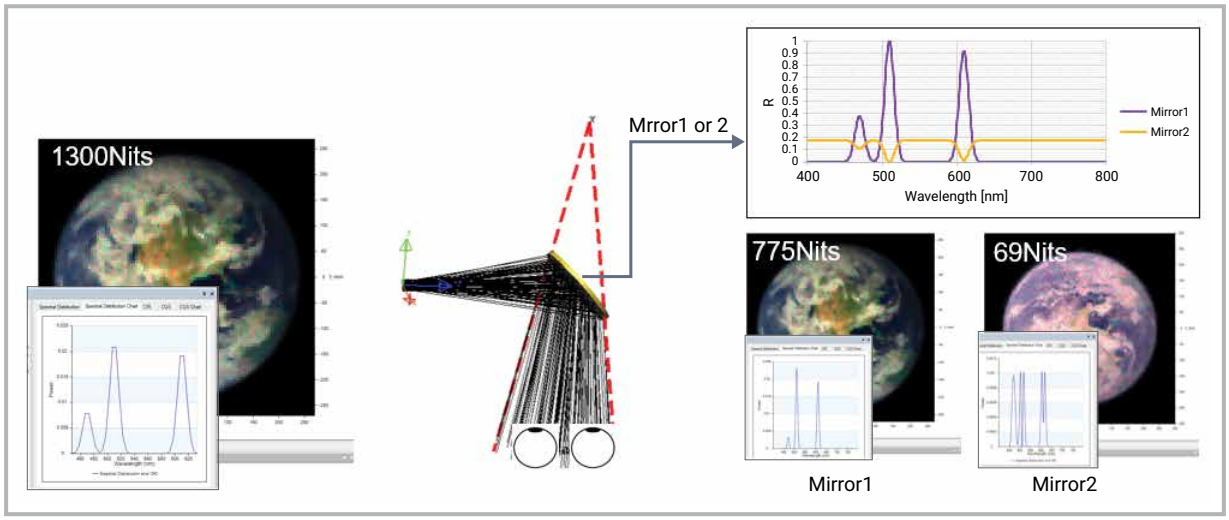
In the case of a HUD, it may be important to correlate the light used in the display and the combined reflectivity in order to increase the efficiency of the product.

In this first example, we use a black body source.



There are two mirrors with different spectral TIS which are compared and the results show the same quantity of light reflected.

In this second example, we use the same mirrors, but the input light source is an RGB OLED.



This time, the results show a big difference in the amount of reflected light.

This small example illustrates how spectral data is important to perform accurate simulations and test the global system before production.