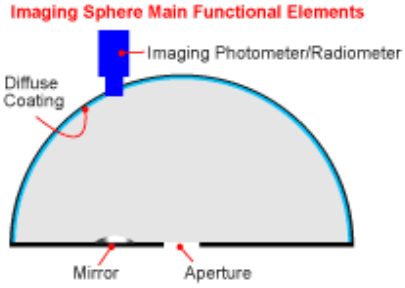
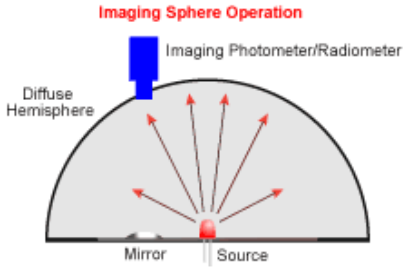
RADIANT IMAGING

The Imaging Sphere Theory

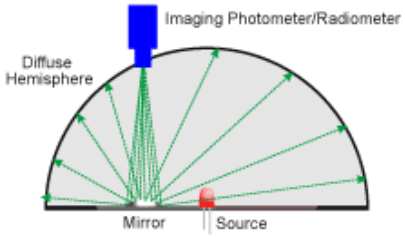
The Imaging Sphere™ is a novel tool that can be used to measure luminous intensity of light sources, view angle performance of displays, or light scatter from surfaces (bi-directional reflectance distribution function or BRDF). It is based on technology jointly developed by Radiant Imaging and Royal Philips Electronics. The exact configuration of the Imaging Sphere™ system depends upon the type of measurement being performed, but, in all cases, it includes a coated, diffuse, low reflectivity hemisphere, a curved secondary mirror and an Imaging Photometer or Colorimeter. The hemisphere is attached to a flat, non-reflecting baseplate containing a small aperture at its center. The entire assembly is light tight.



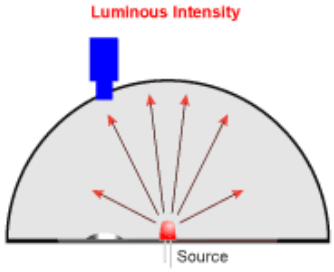
In operation, light emitted by the source or display, or reflected by the surface under test, enters through the aperture in the baseplate and strikes the inner surface of the coated hemisphere. Because the aperture is at the center of the hemisphere, the illumination on its inner surface is an undistorted map of the angular emission profile of the spot under test – all captured at exactly the same distance. The drawing shows a schematic of this operation for the case of an emissive source.



A convex mirror located on the baseplate enables the Imaging Photometer or Colorimeter to view the entire inner surface of the hemisphere at once. This image thus contains all the information necessary to reconstruct the entire angular intensity profile of the illumination at a resolution determined by the camera's image sensor. Spot size can be arbitrarily set by selecting the aperture in the baseplate (when measuring displays or surfaces).

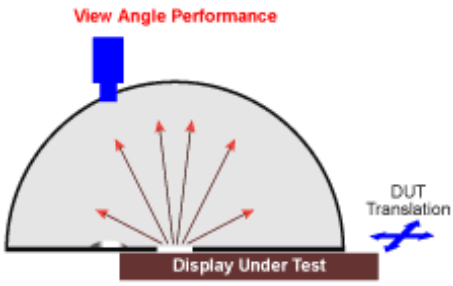


A key element of the Imaging Sphere is a novel coating on the inner surface of the hemisphere. This gray 18-20% reflective coating is designed to deliver only diffuse (scattered) reflections. The baseplate is coated black to approach zero reflectivity. As a result, the imager sees an intense image of the first order illumination pattern with a very weak, uniform background created by second reflections and beyond. This background level depends on the total light flux and it is typically below 1% of peak image intensity. It can be easily subtracted out by the instrument software.

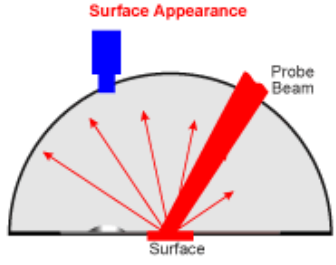


Because the secondary mirror is a spherical convex mirror, located away from the center of the hemisphere, the image acquired is actually a distorted, off-axis view of the inside of the dome. Nonetheless, it is a view of virtually the entire hemisphere inner surface. This data is then converted into an undistorted view, providing angular-resolved performance data in industry-standard formats. System software, developed by Radiant Imaging, performs these transformations.

In terms of absolute calibration, the software offers several dimensions of calibration that can be factory optimized or optimized by the end user. Specifically, the software allows the data to be calibrated for dome size, camera size and off-axis location of the mirror, i.e. to correct the image distortion. Second, it provides flat field or cosine field and offset calibrations to match the brightness and background conditions. And, just as important, the software enables quantitative calibration of the system response for color, in commonly-used color coordinates such as CIE.



Radiant Imaging offers three different products based on Imaging Sphere™ technology, each configured to perform a different task. These are the IS-LI™, used to measure luminous intensity of LEDs and other small sources, the IS-VA™, intended for view angle measurements of FPDs, and the IS-SA™, which performs surface scatter measurements. A schematic of each of the instruments is shown in the figure.



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