

WHITE PAPER

Automated Solutions for SAE Standard HUD Measurement

Establishing an Efficient Implementation of SAE J1757-2



A Konica Minolta Company

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Introduction

Head-up display (HUD) technology is one of the largest growth areas in the automotive market, with a key focus on increased passenger safety through improved vehicle operations and operator awareness. According to research, HUD technology has a compound annual growth rate (CAGR) of 21.67%, and is expected to achieve a market size of USD 1.33 Billion by 2021.¹ This growth is due largely in part to advances in display technology that enable the projection of light onto an infinite plane. This includes advances in augmented reality (AR) applications, where virtual images are superimposed onto real-world environments to display relevant and timely driving condition information.



Figure 1 - As with AR displays, HUD projections must be visible at precise locations projected onto an infinite plane. Ensuring correct position, color, brightness, and clarity of HUD images augments the operator experience and limits error that may cause distraction.

As with any display, visual performance is critical to the function of HUD systems. Accurate system design and final inspection for quality control ensure that projections are properly aligned and clear for in-focus binocular viewing, and that light and colors are vivid enough to be clearly discernible from surroundings in any lighting condition. Low-quality projections not only harm a manufacturer's brand reputation, they put passengers at risk if observers are unable to interpret poorly-projected objects in the viewing area of the display. This can lead to misinterpretation, loss of critical environmental data (such as navigation, object proximity, and other alerts), and driver distraction.

Because poor-quality systems pose such a risk to consumers, automotive standards for HUD performance have been established to ensure that manufacturers evaluate HUDs to baseline thresholds for quality and safety. SAE J1757-1 (“Standard Methodology for Vehicular Displays”)² and ISO 15008 (“Road vehicles – Ergonomic aspects of transport information and control systems – Specifications and test procedures for in-vehicle visual presentation”)³ are the two standards in the U.S. that outline baseline quality measurement criteria for automotive HUDs.

Display test and light measurement systems are quality control solutions that offer an effective means of ensuring compliance with these standards, but variations in system performance and geometries may lead to discrepancies in quality from one manufacturer to another. For this reason, a new standard will be published in summer of 2017 to further control the measurement systems used to evaluate HUD quality. This paper introduces the requirements of the new SAE J1757-2 standard⁴ and describes approved methods for HUD measurement supporting SAE and ISO quality compliance. The paper also emphasizes the benefits of automated system features to achieve the optimal time- and cost-efficiency in measurement applications.

SAE J1757-2 Standard for Optical Metrology of Automotive HUDs

The safety implications of HUD quality have motivated manufacturers of automotive test and measurement equipment to partner with the Society of Automotive Engineers (SAE) Committee to define standard measurement criteria to assess the quality of HUDs in accordance to standards SAE J1757-1 and ISO 15008. The new standard (SAE J1757-2 “Optical Metrology for Automotive HUD”), to be published in late summer 2017, provides a methodology for optical measurement geometries and requirements for measuring vehicle HUDs, including AR-HUD (augmented reality head-up display) performance. Standardized test methods will ensure accurate projections of virtual images relative to an operator’s eye (including depth of field (DOF), field of view (FOV), diopter, focus, image location, and image distance), legibility of HUD virtual images in typical ambient light illumination (requiring luminance, chromaticity, uniformity, and contrast testing), and HUD image distortion, aberration, or ghosting measured by point deviation from a target virtual image. These measurements require an optical measurement device or meter calibrated per NIST/National Lab requirements, which is to be positioned at several measuring points within the operator’s eye ellipse area (to account for the scope of potential viewing angles).

All automotive HUD manufacturers and brands required to comply with SAE J1757-1 and ISO 15008 must define their measurement system based on the new SAE J1757-2 HUD measurement standard. Although no single measurement system is specified, there are several differentiating features among available SAE-compliant systems that enable varying levels of flexibility to improve setup and application. Advanced imaging systems that offer automated measurement features are beneficial in reducing measurement time and difficulty, optimizing design and quality control processes for reduced investment of resources and faster time to market. Automated systems are especially useful in HUD measurement since multiple measurements of each feature must be taken for complete SAE compliance.



SAE (Society of Automotive Engineers) has established standards for HUD measurement criteria and methods, including SAE J1757-1 and SAE J1757-2.

SAE-Compliant HUD Measurement Systems

Current Methods

Spot Meters

A spot meter measures light reflected or emitted from only one small spot within a large area. Spot meters provide highly-accurate luminance and chromaticity measurements, but because their measurement regions of interest are so small, they are unable to provide evaluations of uniformity, contrast, or luminance & chromaticity across an entire display in a single measurement. To account for this, manufacturers using spot meters for automated display measurement must employ additional equipment such as an actuator or robotic arm that is able to position the spot meter at each measurement point in an XYZ space. The spot meter then captures luminance and chromaticity data at each point and compares this data to interpret uniformity, contrast, and other measurements across the display. This is an acceptable solution for HUD measurement, but the cost and complexity of the equipment required for automated measurements (i.e., on the production line) is not ideal.

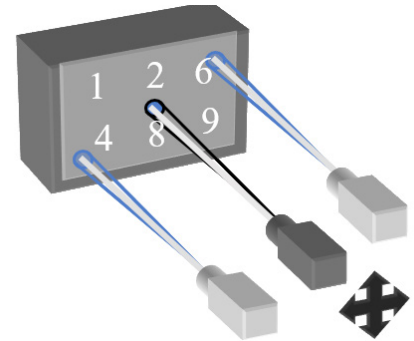
In addition to light value and uniformity measurements, SAE J1757-2 also requires an evaluation of the location, distance, and visual integrity of projected objects within a HUD's infinite plane. Spot meters do not capture two-dimensional images, and therefore are unable to analyze the scope, size, or shape of a projected object based on the total area of the pixels that comprise it. Because of this, spot meters cannot accurately characterize projected objects, or quantify total uniformity, contrast, or deviation from a target image in terms of skew, distortion, or ghosting. Additional equipment must be employed to supplement the spot meter to capture all of these required measurements.

Machine Vision Cameras

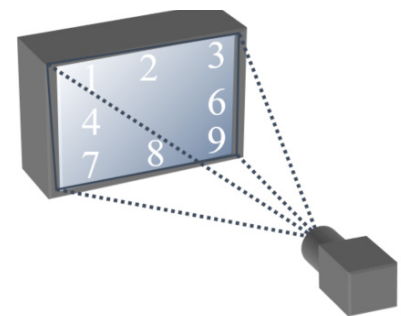
Machine vision cameras are two-dimensional imaging solutions that locate and measure images in a display using contrasting areas (or blobs) of connected pixels. Machine vision cameras can be used to supplement spot meters to provide measurements that spot meters alone cannot achieve, such as the evaluation of an object's shape, size, distortion, ghosting, or other characteristics based on pixel count or pixel blob location (such as optical character verification (OCV) of text). A machine vision camera alone is unable to perform the full range of HUD measurement tasks. However, solution that integrates a spot meter and machine vision camera marries the light measurement capability of the spot meter with the position, distance, and gauging capabilities of machine vision for complete HUD evaluation.

Humans

There are several reasons why humans continue to play a role in the HUD measurement process, primarily for measurement verification. Humans can make extremely fast determinations of display quality, evaluating an entire display at a glance, while applying context (rather than specific light values) to determine acceptability. In comparison, spot meters must capture as many as nine measurement points in a display image to compare brightness, color, or other features of measured light values, making these solutions time-consuming in terms of setup, execution, and analysis.



Spot meters are unable to provide evaluations of uniformity, contrast, or luminance & chromaticity across an entire display in a single measurement.



Machine vision cameras are two-dimensional imaging solutions that locate and measure images in a display using contrasting areas of connected pixels.

One area where human speed is beneficial for HUD measurement is in the evaluation of the contrast of projected images in a HUD. This evaluation is performed by comparing the dark and light areas of black and white images projected by the HUD system. Without performing a calculation, the human inspector can determine, by either a subjective assessment of the image or by comparing a series of baseline digital measurements, whether image contrast is acceptable.

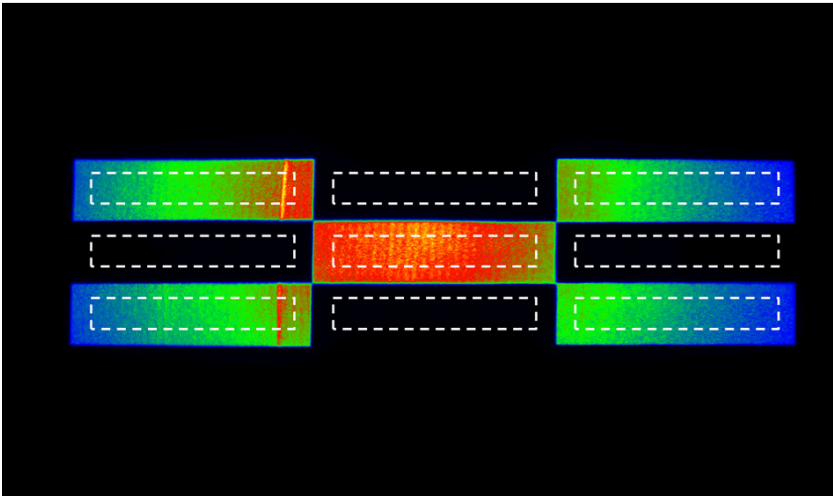


Figure 2 - A checkerboard test pattern projected by a HUD system is analyzed by light measurement software to calculate the contrast ratio by dividing the average white values with average black values. A human inspector, however, may not need to perform a calculation to make a quality determination.

The disadvantage of this method, as with any human inspection, is the lack of quantifiable measurement data. This lack of data impairs the precision and repeatability of the measurements being performed, and prevents an automated implementation of HUD analysis for continuous production-level evaluation. In addition, the majority of HUD measurements specified by SAE standards cannot be adequately performed by human inspectors because quantifiable data is needed to assess measurement accuracy. Humans may be able to evaluate certain aspects of HUD quality where quantifiable measurements are not required, but a mechanical system would still be required to provide a complete solution that is able to address the remaining measurement criteria required for compliance with SAE.

Automated Alternatives

Imaging Colorimeters and Photometers

Referenced in the SAE J1757-2 standard as a primary solution for HUD testing, imaging photometers and colorimeters provide automated visual inspection using optical components calibrated to NIST (National Institute of Standards and Technology) standards. Combining the capabilities of a spot meter for light measurement and machine vision camera for image acquisition and inspection, these systems provide absolute measurements of luminance, chromaticity, and contrast, as well as object presence, location, size, shape, and distance. Photometric imaging solutions offer several advantages in HUD measurement applications compared to alternative systems.



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These automated technologies enable automotive manufacturers and suppliers to implement SAE Standard measurement practices for HUD quality with little setup time and effort while maintaining accurate measurement data.

Comparing HUD Measurement Setups in Production

To fully understand the efficiency of an automated HUD measurement system, it is useful to visualize the equipment setup for SAE J1757-2 Standard HUD measurement. The below images illustrate the difference between two production-level measurement integrations. In both images, a camera is positioned in the eye box area relative to the position of a vehicle operator. The camera is pointed in the same direction as the HUD system, which is projecting digital images to the back surface (called a paravan) of a dark tunnel, used to occlude ambient light. Not pictured in both illustrations is a connected computer system where software is being run to control HUD system projections for testing, as well as to capture, store, and process measurement data.

In the first image (Figure 3), the manufacturer has employed a spot meter and machine vision system to measure light and evaluate the physical characteristics of projected images, respectively. As noted above, such a solution requires an actuator or robotic arm to automate the process of capturing multiple measurement points with the spot meter. In this illustration, a spot meter and machine vision camera are integrated to the end of the robotic arm. This solution may be further augmented by human inspection to verify contrast evaluations and speed up the process of comparing data acquired by the spot meter at several points.

In the second illustration (Figure 4), the manufacturer has employed an imaging photometer for in-line HUD evaluation. Because the imaging photometer provides both light measurement and visual inspection tools, and is able to capture two-dimensional images of the HUD projection, it can perform all measurements required for SAE HUD evaluation in a single image. If repositioning of the measurement system is needed, the imaging photometer's electronic lens (reviewed later in this paper) can account for differences in image distance and optical focus.



Imaging colorimeters and photometers are advanced imaging systems with optical components that simulate human visual perception of light and color. Many systems include beneficial features for automated HUD measurement such as electronic lenses, dynamic point-of-interest creation, and multi-step test sequencing software.

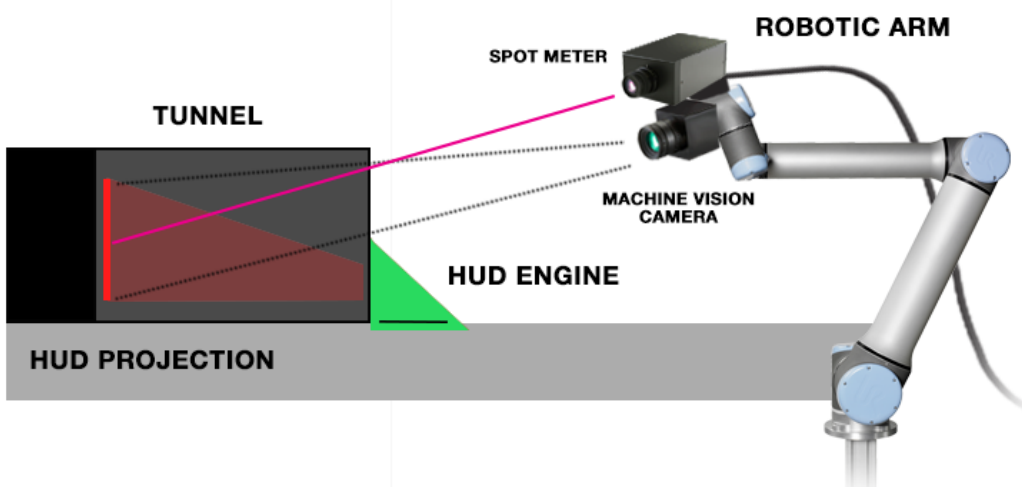


Figure 3 - Example of HUD measurement equipment in a production application; a robotic arm integrated with a machine a spot meter for light measurement, and a machine vision camera for 2D image analysis.

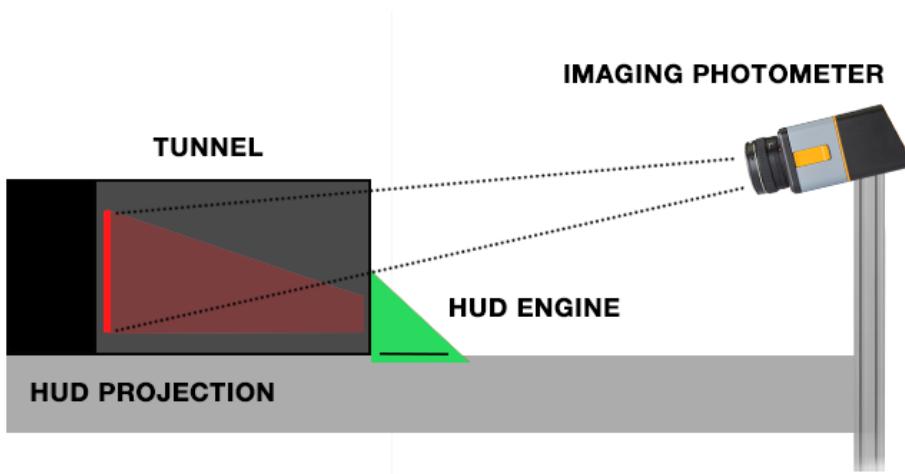


Figure 4 - Example of HUD measurement equipment in a production application; a stationary imaging photometer used for simultaneous light measurement and 2D image analysis.

Comparing these two illustrations, an argument can easily be made against the spot meter/machine vision integration based on the amount of equipment required, cost of the solution, and integration complexity, not to mention the number of variables that must be maintained for system stability. The time required to perform a complete evaluation of each HUD system should also be taken into account. While the spot meter/machine vision solution must capture measurement data at multiple points, the imaging photometer solution can evaluate a complete HUD system in a fraction of the time, making the system more suitable for production scale inspection.

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SAE Measurement Criteria Simplified by Automation

Calculating Object Distance and Location

SAE J1757-2 specifies that an optical measurement system for HUD evaluation must measure the “real distance” between the nominal eye center (from the operator’s nearest visual focal point) to an opaque monochlor paravan (surface) positioned at the perceived distance of the projected virtual image. In standard measurement systems, distance measurements from near to far are found using the camera’s focal distance to evaluate the points along the horizontal plane where the camera is able to image objects in focus. These measurements must be calculated as real distance units to understand the physical distance between the two points.

The calculations required to convert focal distance to real distance units can be performed manually, but there are also measurement systems that can perform this conversion automatically. Such systems provide focal-to-real distance conversion using built-in software algorithms, enabling operators to display measurement data in real distance units in the system’s software results. The obvious benefit in the application of such systems is time savings. Data in the required unit of measurement is available instantly, reducing time and the margin for error that is otherwise inherent in calculating and converting separate sets of data points.

Performing Multiple Measurements

To account for multiple potential viewing angles from the vehicle operator to the HUD projection, as well as to average out the margin of error, SAE J1757-2 requires that at least three measurements be taken at different locations on the paravan to determine the relative virtual image distance. Using standard fixed-lens measurement systems, the process of measuring multiple points is time-consuming and arduous. Manual adjustments must be made to the camera at each position in order to ensure the images are in focus for equivalent measurement data across measurement points. Alternatively, systems with electronically-controlled lenses greatly improve the speed and accuracy of measurements at multiple angles, positions, and distances. These lenses can be remotely adjusted to ensure proper focus and aperture settings for image location at the paravan, or on an infinite plane, as shown in the examples below. As the imager is repositioned to perform a successive measurement, a few simple adjustments can be made in the system software to quickly adapt the imager's electronic lens to focus on objects at any distance or location.

Measuring Luminance of Colored Objects

According to SAE J1757-2, minimum luminance thresholds must be achieved to ensure visibility of the HUD's virtual images superimposed upon the real-world environment in any ambient lighting condition (daylight or night). However, measuring the luminance of every virtual image in a HUD projection means accounting for a wide range of object shapes, sizes, colors, and locations. This process requires multiple steps when using a measurement system that locates objects based on static points of interest (POI). For each object projected into the HUD, a static POI system finds the target object within the inspection area by looking within a static POI window drawn in the software. The imaging system will use this POI to determine which set of pixels in the image to apply luminance measurements. If the projected object falls outside of this POI, an inaccurate luminance measurement may result. Additionally, as projections change or new virtual images are introduced on the display, new POI must be drawn to encompass each new object before luminance measurements are acquired.

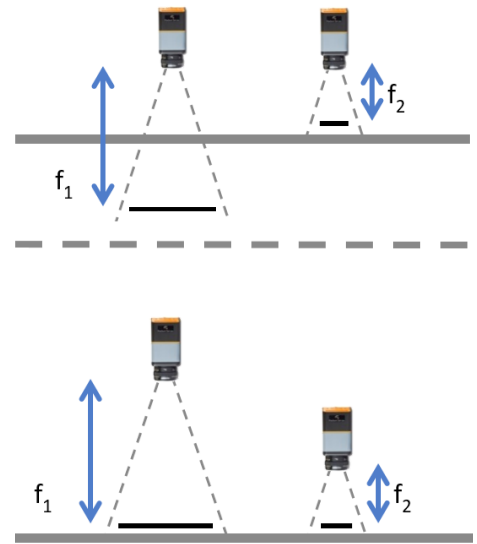


Figure 5 - An imaging system with an electronically-controlled lens is able to remotely adjust aperture and focal settings for projected images, whether images appear at varying distances to the eye, or if the camera is positioned nearer to digital images within the HUD projection.

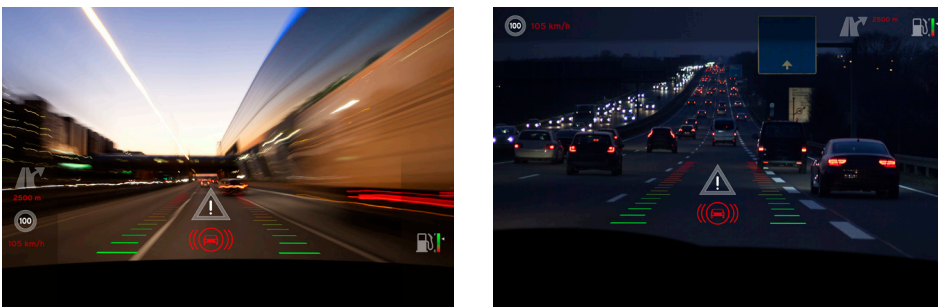
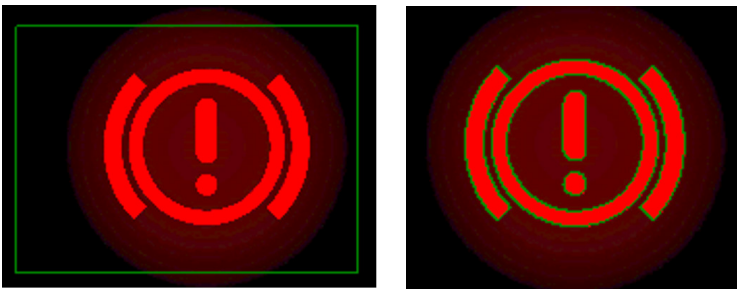


Figure 6 - HUDs superimpose digital images on top of real-world environments, like AR. For this reason, a critical safety concern is visibility of projected images against all backgrounds. Images must be bright enough to remain discernible both day and night, and in all weather conditions.

Some advanced light measurement systems provide software capability that fully automates the process of POI-setting for multiple and even unpredictable objects in a projection. A software feature called Auto-POI (Automatic Points of Interest), for instance, creates dynamic POI windows that automatically adapt to object pixels that

fall within a defined color tolerance. A manufacturer may wish to evaluate the luminance of all red objects in a projection at once. For this measurement, the manufacturer would set minimum and maximum CIE color coordinates (Cx, Cy) in the software to encompass the range of red values represented in the target set of objects. Leveraging Auto-POI, the software would then “snap to” any set of continuous red pixels that match the defined criteria, creating accurate measurement regions regardless of object shape, size, or location. Even as new projections are introduced, objects matching the defined color tolerances in Auto-POI would be captured and measured for luminance values at once and on demand.



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Figure 7 - Comparison of static POI manually drawn in the software and Auto-POI (Automatic Points of Interest) adapted to an object based on color tolerances.

Auto-POI allows multiple color sets to be programmed at once, enabling manufacturers to measure all objects in an image simultaneously, regardless of color. Additionally, when specifying color value tolerances, the manufacturer has the option to enter CIE coordinates as data, or to draw color regions on a CIE color chart (using the cursor to create an ellipse, rectangle, or polygon) to specify POI tolerances. These features fully automate the measurement process, offering the manufacturer a “point-and-shoot” method for luminance measurement once all object colors have been defined. Combining Auto-POI with an electronically-controlled lens offers the ultimate flexibility in object location and evaluation for nearly instant data acquisition at each defined measurement point.

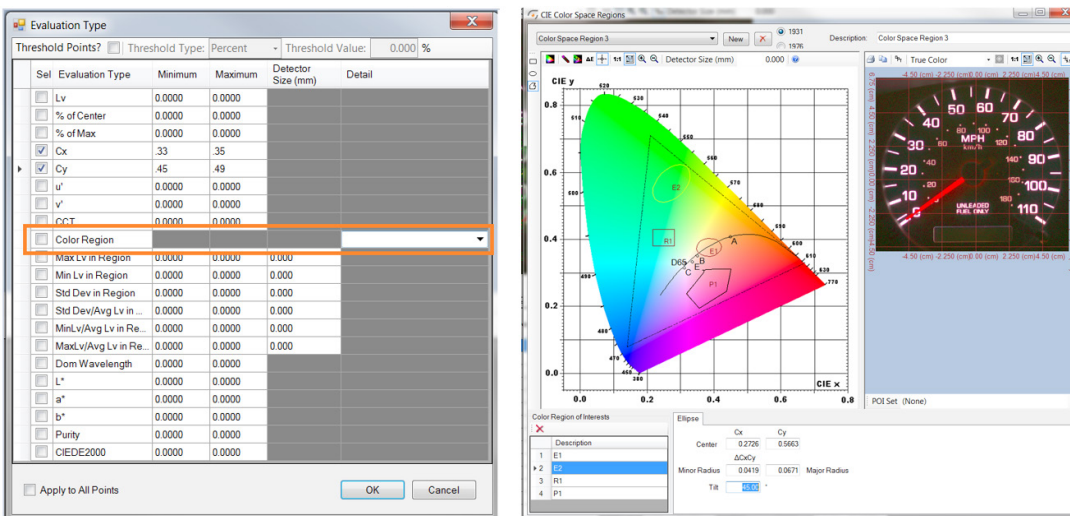


Figure 8 - By selecting “Color Region” in the Auto-POI software tool, the user can draw shapes within the CIE color chart to define Cx, Cy tolerances for colored objects that should be included in the measurement POI set.

Measuring the Ghosting Effect

Objects in a HUD projection are visualized as a combination of reflections of light emitted by the HUD system. The primary display surface, the windshield of a car, is comprised of both an inner and an outer glass interface, each receiving HUD emissions and reflecting them back to the driver's eyes at a unique angle. These reflections create the target virtual image of the HUD projection, as well as a "ghost image," if the angular light emissions are not directed properly. This double image, when not aligned perfectly, will result in blurring that can significantly impact the visualization of important HUD projections.

In order to detect and evaluate the scope of ghosting in a HUD projection, the measurement system must be able to locate the position of correlating points from the ghost image to the target image. These locations must then be compared to determine the extent of deviation and provide the information necessary to perform corrections to the HUD. Measurement systems that offer image processing such as Register Active Display Area (RADA) in their software can automate the process of comparing the location of points on a distorted image with those of a target image in a single evaluation. RADA is typically used to process skewed, warped, or misaligned images and render them in the correct shape and aspect ratio. Since RADA must acquire object positioning data about the actual and ideal virtual images to perform this process, an inspection system with RADA functionality is pre-equipped to capture and compare coordinates that indicate object location, thereby automating the detection and measurement process for image ghosting.

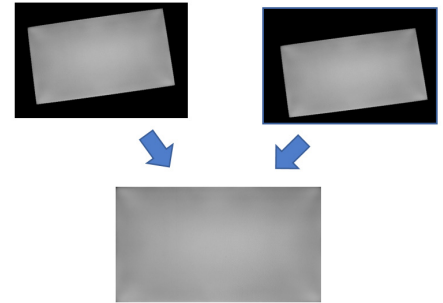
Measuring Image Distortion

SAE J1757-2 defines distortion as the geometric deviation for each measured point in the virtual image as compared to target coordinates.³ Distortion may include aberration, image wrapping, or warping, all of which are calculated using the distance between edge pixels of a primary or measured virtual image and those of a secondary or target virtual image. In HUDs, this defect may result in improperly-perceived object focus or depth of field, due to the misalignment or non-uniformity of projected images that must be reconciled as a single image by binocular human vision. Improper positioning of projected images may also occur, where the HUD fails to augment data in the appropriate relative position to real-world objects. Not only can this have safety implications, but distortion plays one of the most significant roles in the perceived quality of the display, and the vehicle manufacturer that integrates it.

Modulation transfer function (MTF) is integral for accurate, automated distortion detection. MTF is a measurement of the imaging performance of an optical system, specifically defining a camera's ability to produce an image of an object that accurately reflects the same resolution and contrast (sharpness) of the object as viewed in the real world. There are several reasons that cameras do not produce images that are indistinguishable from reality, starting with the behavior of light waves that are received by the camera and augmented by the limitations in the camera's lens, sensor resolution, and dynamic range. These factors affect image quality, which will determine measurement accuracy as software tests are run against the image. The MTF of an optical system is the measurement of the system's ability to compensate for its own technical limitations and process light as correctly as possible.



Ghosting of the image is caused by misalignment of HUD projections that are reflected back from the windshield.



RADA automatically rotates and crops images to align images for measurement. RADA can be used to report corner pixel locations for both actual HUD projections and ghost images.



Distortion of an HUD projection caused by misalignment of the optical path within the HUD engine.

MTF plays a significant role in measuring distortion, since accurate measurement requires an understanding of where distortion is originating. Just as aberration may appear in a projection due to anomalies in the HUD system, aberration can also be caused by the camera as it captures light from the HUD projections to create a CCD image. If the camera does not provide high enough optical performance to produce a clear image, the measurement system may return a false negative, indicating HUD image distortion where none is present. This can cause problems in subsequent tests where digital objects cannot be accurately measured for size, location, or even total luminance because image features and edges are not clearly defined by the camera.

Advanced measurement systems that offer MTF testing in their software allow users to test the camera's optical performance and ensure the accurate evaluation of HUD image distortion. Some systems employ ISO 12233 methods measure MTF using a slant-edge pattern to determine the performance of the imaging system, which provides an especially discerning evaluation of the camera's performance. Using this method, the object to be imaged is positioned at an angled orientation so that dark-to-white boundaries in the object do not match the perpendicular axes of the camera's CCD pixels. Since the luminance value received by each pixel is not uniform, the camera must be capable of determining sub-pixel differences in luminance to project the location of an edge between light and dark areas as it crosses the sensor pixels. This process illustrates the effective resolution of the camera's sensor and its ability to produce sharp, accurate images by evaluating the system's response to an "edge." This response is referred to as the "Edge Spread Function." Measurement systems with the ability to evaluate their cameras' performance based on these methods are the most reliable for determining the cause of HUD image distortion, and greatly reduce the margin for error in image analysis.

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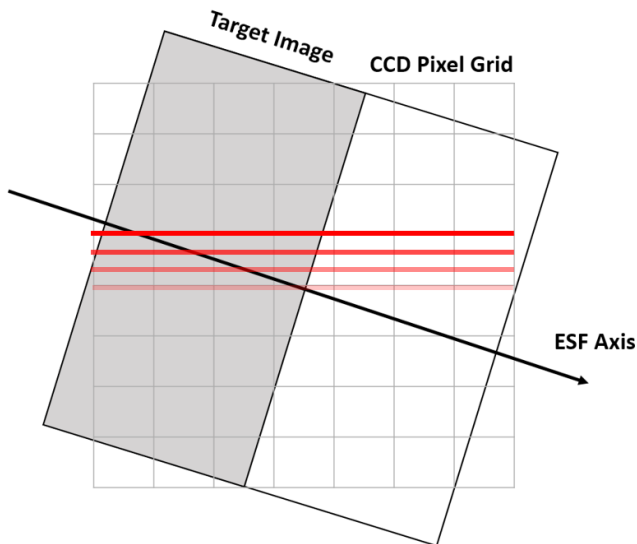


Figure 9 - The target image is rotated 5 degrees off axis from the CCD pixels in a slant-edge measurement used to calculate the camera's ESF. The red lines indicate the luminance cross-sections of the region of interest for each pixel line.

Multi-Measurement Test Sequencing

Due to the unique nature of HUD projections and observer visibility requirements, including the object brightness and positioning criteria described above, the HUD test and measurement process invariably involves several steps for complete quality evaluation. Per SAE J1757-2, the measurement system must perform luminance measurements on checkerboard images with alternating patterns to determine virtual image contrast for white and black projections in ambient light. The system must also determine luminance uniformity and non-uniformity of the virtual image, as well as chromaticity as compared to the target virtual image. Additional measurements must be taken to determine image distortion and aberration, as discussed above, to ensure accurate image shape and location as compared to the target virtual image.

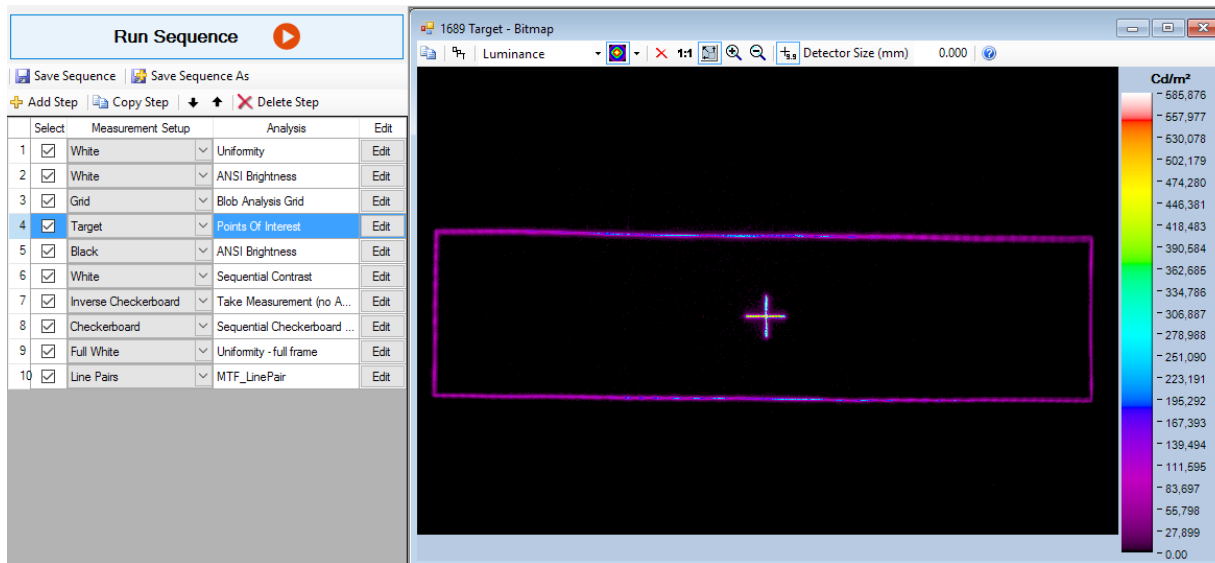


Figure 10 - The test sequencing software above is programmed with ten steps, from uniformity to MTF line pair analysis, to perform multiple measurements of the HUD projection at once.

The complexity of performing all measurements required for complete HUD evaluation is dependent not only on the flexibility of the hardware, but also on the limitations of the measurement software. The complete measurement process can be extremely time-consuming if the chosen system employs software developed to run a single measurement at a time, or, if the system employs multiple software packages engineered for unique measurement applications. For example, applications employing a photometric system for light measurement, with an additional visual inspection system capable of object position measurement. Alternatively, automated test sequencing software may be applied to enable several measurements to be performed in rapid succession using a single system. Test sequencing software programs allow distinct measurement criteria, POI, and inspection tolerances to be programmed into a series of separate steps within one software environment and then run as a multi-part evaluation of the HUD. This allows luminance, chromaticity, location, and distance measurements to be performed to measure multiple aspects of the HUD automatically without reprogramming the measurement software for entirely new criteria or system replacement.

Test sequencing software programs allow distinct measurement criteria, POI, and inspection tolerances to be programmed into a series of separate steps within one software environment and then run as a multi-part evaluation of the HUD.

Conclusion

With the finalization of the SAE J1757-2 standard coupled with the rapid growth of the HUD market, the demand for efficient measurement systems is due to increase to ensure automotive manufacturers and suppliers achieve compliance and remain relevant and competitive in their industry. As SAE standard compliance becomes the baseline qualification for HUD selection, the competitive advantage for manufacturers will be the speed and efficiency to produce quality products that ensure optimal value of their technologies. Automated HUD measurement systems that include imaging photometers or colorimeters with advanced test sequencing software greatly reduce HUD evaluation time, enabling production-level measurement, ensuring compliance, and limiting cost and time to market.

References

¹ MarketsandMarkets. (2016, April). Report Code AT 2973: “Automotive Head-up Display (HUD) Market by HUD Type (Windshield & Combiner), Application (Premium, Luxury & Mid Segment Cars), and by Geography (Asia-Oceania, Europe, North America & RoW) - Industry Trends and Forecast to 2021”.

² SAE International. (2015, May). *Standard J1757/1_201505: “Standard Metrology for Vehicular Displays”*. http://standards.sae.org/j1757/1_201505/

³ ISO. (2017, February). *ISO 15008:2017: “Road vehicles – Ergonomic aspects of transport information and control systems – Specifications and test procedures for in-vehicle visual presentation”*. <https://www.iso.org/standard/62784.html>

⁴ SAE International. (2015, December). *SAE J1757-2 (WIP): “Optical Metrology for Automotive HUD”*. <http://standards.sae.org/wip/j1757-2/>



Head-up display (HUD) technology is one of the largest growth areas in the automotive market, and standard measurement criteria are rapidly being defined to evaluate HUD performance for quality and safety. This paper introduces methods for meeting the requirements of the new SAE J1757-2 standard and outlines the advantages of automated measurement systems.

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