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Working with NVIS

An Interview with Jim Collins
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Making cockpit equipment NVIS-compatible is more complex than the casual observer might expect.

An Interview With Jim Collins, PYNCO Inc.

***Lasers & Optronics:* What is NVIS and how did it come about?**

Jim Collins: NVIS stands for Night Vision Imaging System. That designation was chronologically preceded by ANVIS — the A referring to usage by aviators. Basically, it involves blocking (filtering) wavelengths in the red and near-infrared from the instrument panel so that that emission does not saturate the image intensifiers in night vision goggles.

MIL-L-85762A is the mil spec that underlies NVIS. The mil spec was originated as a tri-service document in the early to mid-1980s, with civilian and military personnel of the Navy, Air Force, and Army involved. In the past, the Army users of night vision compatible equipment had generally used a less definitive spec, but recently have seemed to become more accepting of MIL-L-85762A.

***L&O:* What about non-military applications, such as law enforcement?**

J.C.: Law enforcement and commercial users of night vision goggle compatible equipment usually don't have definitive requirements of any kind. However, by the time a conversion development plays all the way out, conformance to the mil spec is usually what is required. Actually the same thing applies to many military procurements: The initial contact by purchasing agents is for COTS (commercial-off-the-shelf) material, which, in the final analysis, usually requires compliance to MIL-L-85762A.

***L&O:* What wavelengths are involved?**

J.C.: NVIS Radiance is defined by MIL-L-85762A as:

$$NR \sim \int_{450}^{930} G(\lambda)N\lambda)d\lambda$$

where $G(\lambda)$ is the spectral response of the goggle, as defined by a table of values in MIL-L-85762A (and is represented here by Figure 1), and $N(\lambda)$ is the measured spectral radiance of the instrument, panel, or display. A representative sample of such data is plotted in Figure 2.

The measured values are then used to compute the performance parameters of interest. For the particular spectral radiance curve (measured in terms of W/cm^2-sr-nm) shown in the example of Figure 2, the filter under test passed, as its NR_a value was 8.215×10^{-11} W/cm^2-sr-nm, less than the upper limit value of 1.7×10^{-10}. The tristimulus values, CIE chromaticity coordinates, and UCS coordinates are also calculated using the measured spectral radiance values.

While calculating NR involves an integration from 450 to 930 nm, it is often necessary, when speaking about performance of filter materials for these applications, to test the parametric behavior of the material on both sides of this range. In this example, the measurements constituting $N(\lambda)$ were taken from 380 to 930 nm.

***L&O:* What about luminance levels?**

J.C.: The luminance level which must be measured in NVG-compatible cockpits is typically 1.0 FL for flight instruments and displays. In addition, sunlight illumination levels up to 10^4 FC are encountered and must be measured when such devices are required to pass the contrast requirements of MIL-L-85762A.

***L&O:* How are these measurements made?**

J.C.: The luminance measurements are performed using standard photometric equipment. The spectral measurements which must be performed to determine compliance to MIL-L-85762A require usage of a spectroradiometer whose characteristics are also specified by MIL-L-85762A. We use an Optronic Laboratories (Orlando, Fla.) Model OL-750.

***L&O:* What were some of the early design challenges involved in NVIS?**

J.C.: The early design challenges mostly involved the unavailability of filter materials appropriate for usage. This, despite proclamations at the time by the Naval Air Development Center (Warminster, Penn.) that such materials were available. Availability has gotten a lot better over the years, but there are still applications for which many appropriate materials are not available. This fact makes a parody of COTS procurements for such applications. If the requirements described in MIL-L-85762A truly represent operational scenarios, the government will have to provide money for material development. Filter manufacturers simply will not support the risks required for such development costs.

***L&O:* What are some of the areas requiring future effort?**

J.C.: Some problems still exist and will have to be addressed in the future. To a considerable extent, the problems involve communication between the players. For example, many equipment designers remain unaware of the many factors that spell the difference between success and failure in converting existing product lines to NVIS-compliant models. In general, a more comprehensive understanding of the combined effects of all the components in the optical path is needed.

Also, there exists some degree of non-correlation regarding measurements performed by various agencies and firms in determining compliance to MIL-L-85762A. It would seem to be a natural place for government, presumably the National Institute of Science and Technology, to step in and provide a resolution in the form of standardizing measurement techniques.

Some efforts of this nature have been initiated by industry itself. However, they have been rather feeble and short lived. Another area worthy of investigation is the characterization of fluorescence effects regarding materials typically used in instruments, panels, and displays. As a related issue, development of deeper filters at stimulating wavelengths is needed.

***L&O:* Where does PYNCO fit into the marketplace?**

J.C.: We specialize in helping manufacturers convert existing non-NVIS cockpit devices into NVIS-compliant devices. You might think of it as contract engineering. We like to say that our niche is the investigation of a customer's performance requirement, and the iterative and empirical measurement of potential solutions in the NVIS conversion of the customer's products. In this regard, we possess in-house machining capability of all known filter materials for the NVIS application. We have also developed numerous "specials," parametrically undefined by MIL-L-85762A, yet being used in such applications.

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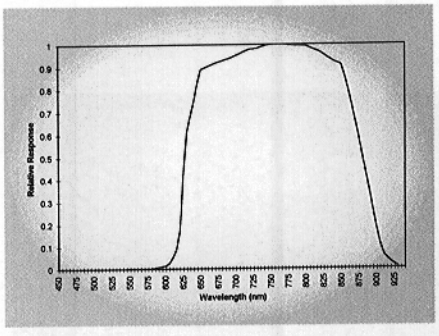

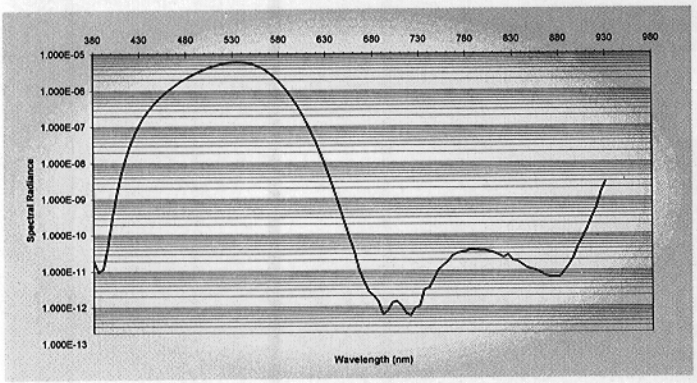

Figure 1. (top) A data plot of the defined (in MIL-L-85762A) spectral response of NVIS goggles.
Figure 2. (bottom) A representative measurement of the spectral output of a flight instrument.

Good News for NVIS Display Manufacturers

Optronic Laboratories' OL 750-NVG system, recognized as the best equipment in the world for measuring NVIS compatibility of displays, is now even better. In comparisons, the OL 750-NVG out-performs competitors in every respect and establishes new standards for excellence within the industry. Intense continued development and new innovations over the past year have widened the gap between the OL 750-NVG and all other systems still further.

Traditionally, NVIS compatibility tests have been difficult and time consuming. The OL 750-NVG changes all that, and makes these measurements extremely quick and reliable.

Better Performance Than Competitors

In previous comparative studies, the OL 750-NVG was shown to out-perform competitors in all important respects. Critical extra features, which are unavailable or options in competitive instruments, are included as standard in the OL 750-NVG system.

In a recent analysis, it was shown that some competitors' systems fail to meet the mandatory requirements of MIL-L-85762A when measuring displays brighter than 0.1 fL, as illustrated in Figure 1. Many, if not most, manufacturers make displays that are brighter than 0.1 fL and they should note these competitive systems are unusable for their products. The OL 750-NVG system has a 10 decade dynamic range, providing measurements to MIL-L-85762A for all common (and most rare) displays.

Recent Innovative Improvements

Working with users, the OL 750-NVG software has adapted to suit the changing requirements of the industry. The pass/fail procedures have been expanded to include user programmable customer/vendor requirements and international standards as well as the MIL-L-85762A thresholds. A separate "production" software (available free to users) ensures correct results are obtained even by inexperienced operators.

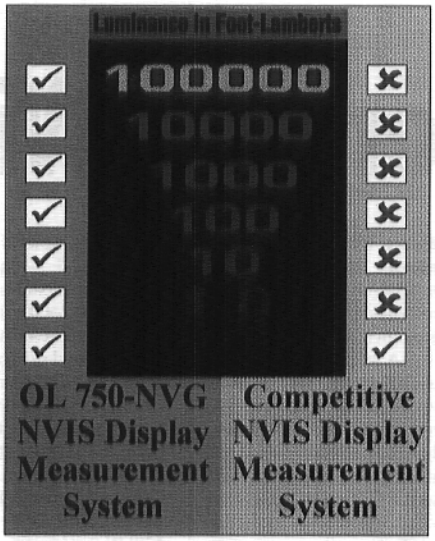

Figure 1. A recent analysis shows that some competitive NVIS display measurement systems fail MIL-L-85762A for luminances greater than 0.1 fL. The OL 750-NVG performs within specifications at all common and high luminance levels.

OL 600-NVG telescope features "Pritchard" design optics which eliminates parallax and alignment errors. This type of telescope is recognized as the ideal for all display measurements. The OL 600-NVG has been recently improved in several ways:

- Diffraction limited performance resulting from a new optical design provides sharper, high contrast, images.
- The high throughput lens design gives higher sensitivities and allows low light levels and small spot sizes to be measured with less noise.
- The highly magnified image (up to 10 times larger than competitive systems) means that the identification and selection of the measurement area is exact and eye-strain is avoided.
- An actual-scale reticule provides measurement of distances within the image area.
- The adjustable eyepiece may be focused for different individuals to the most relaxed conditions for viewing and will easily accommodate glasses and contact lenses.
- The small depth-of-focus of the image makes recognition of the exact focal position easy, and the same for all users.

In addition to these important improvements in viewing, an integral high sensitivity photometer option has been added. With this, the luminance of displays can be measured almost instantly to give rapid feedback on adjustments or uniformity mapping. This unique design enables users to switch between photometer and spectroradiometer measurements without re-alignment and ensures that the same conditions apply to both types of result.

User feedback indicates that versatility is an important factor in instrument selection. Systems may be required to make cockpit or outdoor measurements in addition to laboratory tests, or may determine the reflectance/transmittance of filters and simulated calculations for new product development. The OL 750-NVG has been shown to be the best system to provide all these needs.

Future Trends

Optronic Laboratories, Inc. brought many new innovations to the field of NVIS measurements when the OL 750-NVG was first introduced. Users are already seeing the benefits of Optronic Laboratories' free upgrade policy as further improvements continue to be made.

Research and development continues into every aspect of the OL 750-NVG system design, effectively setting the pace of display industry requirements and future standards. For instance, although the OL 750-NVG is by far the best system available anywhere, some recent studies show great promise for even greater improvement in the near future.