DPR System for Projection Displays - Today and Tomorrow

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Abstract

With the advancements or LEDs and lasers in projection display applications, arc lamps still provide the most cost effective solution to high brightness display systems. When will arc lamps become obsolete, will be of great importance today and tomorrow? Given the fact that traditional elliptical and parabolic reflectors had been around for decades; Wavien's new dual paraboloid reflector (DPR) technology with its unique imaging property enhances various aspects of the arc lamp performance will shed some light to this question. In this talk, various applications that are feasible today and anticipated needs of tomorrow will be presented.

1. Introduction

In an illumination system, light collection is the first step in the process and determines critically on the efficiency of the projection system. In lens systems, the collection angle is usually small due to theexpense of large NA systems. As a result, reflectors are used in large NA systems, but due to the lack of constant light path from the light source to the target as provide by lenses, reflector systems introduce distortions, which degrades the brightness of the light sources as used in common parabolic and elliptical reflector systems. The Wavien's dual paraboloid reflector (DPR) system uses two reflections between the light source and the target, compensates the distortions introduced by the difference in path lengths of light such that the image of the light source is transferred to the target with little or no distortion. The resulting light collection system provides higher overall coupling efficiency especially for larger arc gap lamps. The same mechanism also provides a longer effective operating lifetime of standard UHP lamps, thus opening up new applications. This paper describes the essence of the system and provides insights into the current and future applications in the projection market and its impact on the development of the LED and laser illumination systems.

2. The DPR System

The DPR system as shown in Figure 1 consists of a dual paraboloid reflector, a UHP lamp, a retroreflector, and a tapered light pipe. The retro-reflector reflects light form the arc back into itself, increasing the brightness.

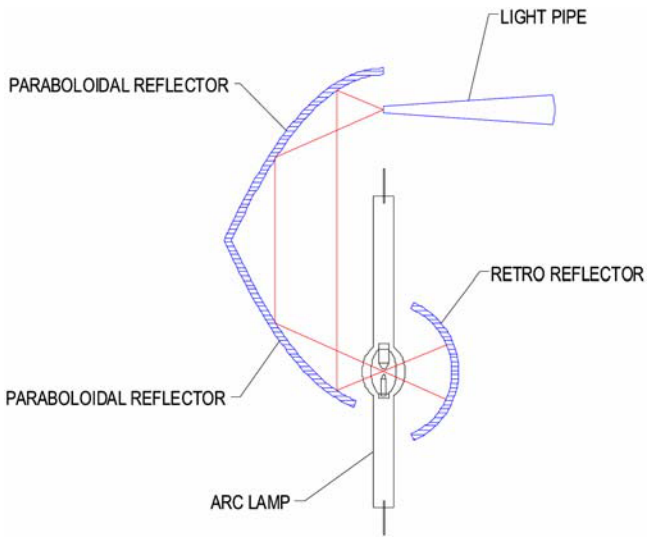

Figure 1 – Schematic diagram of DPR

The two sections of the paraboloid reflector compensates each other and removes the distortion

introduced by a single reflector as in the standard parabolic and elliptical reflector system.

3. Extension of Lamp Lifetime

The end results of the compensation of distortion by the DPR are shown in Figure 2. As shown in the figure, the output is plotted against the arc gap for both the elliptical reflector and DPR systems. As the arc gap increases, which are the characteristics of the UHP lamps, the efficiency drops. Even if the lamp does not degrade over time, when the arc gap increases to a value at which the coupling efficiency drops to 50%, the defined end of life is reached. As shown in the figure, the output of the DPR system is relative independent on arc gap.

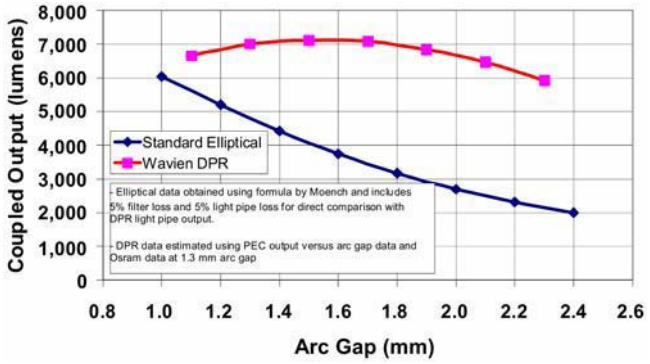

Figure 2 – Output of DPR (red) and elliptical reflector (blue) versus arc gap

The end result is that the 50% point will be reached at a much later point in time. This effectively increases the lifetime of the lamp to a much long time. Lifetest were conducted for using lamps of various powers using the DPR and the results are compared with published lifetest results from lamp manufacturers. Figure 3 shows the comparison of lifetime versus lamp power for various etendue values, which relates to the imager panel size.

The smaller the imager panel, the smaller is the etendue. In order to reduce cost, smaller panels are used, which has a smaller etendue. As smaller panels are used, higher power lamps are needed to provide sufficient brightness at the screen. Both of these factors dictate a shorter lamp lifetime.

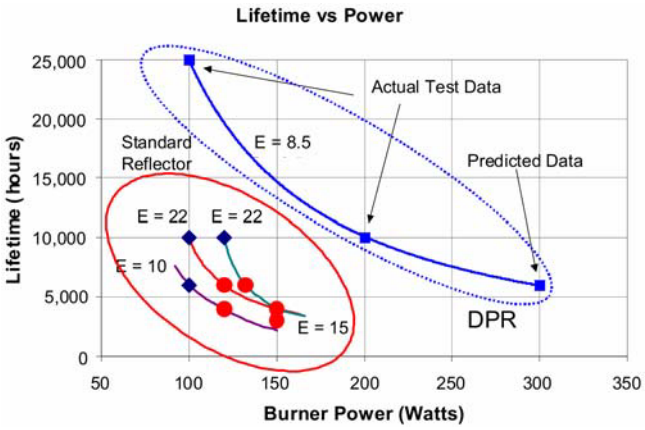

Figure 3 – Lifetime versus lamp power and etendue

For example, a typical projector uses a 200 W lamp and a 0.55 DLP imager panel with etendue value of E = 11, has a lifetime of 2,000 hours as shown in Figure 3, and this is also the typical lifetime stated in the manufacturers specifications. A higher power projector using 300 W lamps usually uses a 0.7" imager panel with etendue value of E = 22, has a lifetime of about 1,500 hours. If the same lamp is used with the DPR, the lifetime will be 10,000 hours and 6,000 hours respectively.

This increase in lifetime will reduce the number of lamp changes over the useful life of the projector, and reduces the maintenance cost and down time of the system, e.g. educational use and control rooms.

4. Competition with LED Systems

As shown in Figure 3, the lifetime of 100 W has a lifetime of 25,000 hours. This is longer than the practical lifetime of high power LEDs for projection applications. A 100 W UHP lamp based system will have an output of 1,000 lumens and potential market price of less than US$500 with a very small size. To achieve these technical and marketing parameters, the LED systems are expected to take several years, which provide a very profitable window for the UHP lamp system.

5. Multiple Lamp System

With consideration of combining efficiency and

etendue considerations, a single 200 W projection system can be replaced by a dual 132 W system, which will increase the lifetime of the system from 10,000 hours to 20,000 hours.

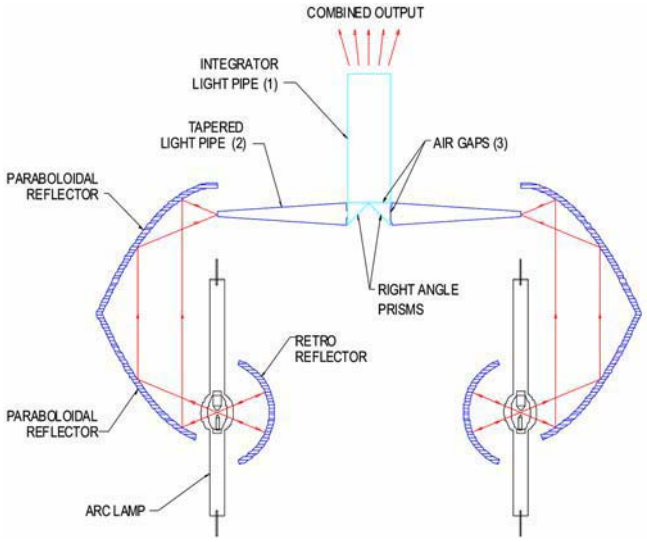

Figure 4 – Dual lamp system using DPR.

6. Summary

Based on the extended lifetime of DPR systems, the UHP lamp based projection system will provide cost effective systems for many years to come.