Validity of functional test for LED lenses illumination using an alternative LED position

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Summary

In-line optical functional tests generally suffer from the fact that the functionality is not tested precisely at the LED's designed position. In this work, we present a theoretical approach to an in-line testing strategy, with an alternative LED position, that can be used as a method to predict the designed functionality from simulated data.

Introduction

Optical quality tests are an essential tool when checking the functionality of a lens combined with optoelectronic components. Optical quality tests can be classified in three different types; a) material test, usually trough polariscopic techniques [1], b) surface test as presented in Fang et al [2], and c) functional test, this last one usually carried out when the optics are already mounted in the electronic device. Functional tests ensure that the optoelectronic component works properly and provides the final optoelectronic device with the appropriate functionality. They evaluate spectral, radiometric or photometric data and the lighting distribution in a desired plane [3]. However in-line quality control is mandatory for large production. In this situation it is necessary to find an alternative approach to do the functionality test before the lens is mounted onto the optoelectronic device.

We present the validity of an alternative functional test because in the testing process it is important to be aware that the LED may not be placed in its design position, that is, it will located in an alternative position. Therefore a functional test that does not take that fact into consideration may discard a valid component.

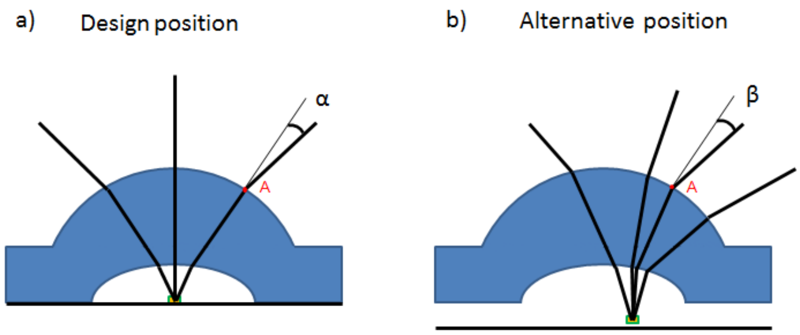

Fig.1 schematic representation of the optoelectronic component when it is working at the design position, a), and at an alternative position, b).

In this work, we present a method and a related criterion to check the validity of using an alternative positon for the source to test the functionality of the different zones of the lens surfaces. The method is based in the analysis of the local slopes over all the lens surfaces.

Discussion

We consider that we check the functionality at a given point and by extension of the whole lens if at every point the light emitted by the test source interacts with similar conditions to the design source.

Let us consider a given ray emitted by the LED when placed in its design position. This ray crosses a surface of the lens at a point A, forming an angle α with the surface normal at that point. When the LED is placed in the testing position, however, the ray that will cross the surface at this same point A will form a different angle, β, with the surface normal, as shown in Fig 1.

The testing strategy developed in this work is based on the assumption that, if in a given area of the surface, the difference between both angles is within a given range, determined by the apparent size of the source, the behavior of both LEDs are comparable in that area, and the testing results will be easy to correlate with those obtained for design conditions. Extending this procedure to the entire surface we will be able to relate the illumination distribution from both cases. In general, in order to check the functionality of the whole surface of the lens, more than one alternative LED will be necessary. The exact number will depend on the particular properties of the lens.

Conclusions

We have presented a theoretical in-line functional testing strategy for optoelectronic components, the testing strategy uses a criterion onto the incident angles when the LED is at the design and at an alternative position. Preliminary simulations from three different freeform lenses confirm that the strategy is successful for variations in the sinus of the angle lower than the 4%.

References

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