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Fourier optics technology for viewing angle measurements: past, present and future

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Abstract

The proposed paper will explain the technical bases of the Fourier Optics Technology (OFT) for viewing angle measurement of displays and the evolution of the ELDIM systems over the years. There multiple capacities to obtain luminance, color, spectral, polarization or reflection data will be explained and illustrated by various application examples. New OFT systems dedicated to the characterization of NIR light sources will be also presented.

1. Introduction

Viewing angle properties are certainly among the most common characteristics measured on LCDs since the beginning of this technology in the eighties. Historically, the goniometer was the first equipment used to perform angular measurements [1]. In this case, various mechanical movements allow the scanning of the complete display-viewing field with a directional detector. Main drawback of those systems is the "one after each other" nature of the measurements which results in very long acquisition times if more than a few directions are required.

ELDIM was founded in 1991 to promote an innovative display measurement method based on Fourier optics. A specific optic was designed in order to convert angular field map into a planar one allowing very rapid measurements of the full viewing cone with high angular resolution. This fast viewing angle measurement system was first publicly introduced at Eurodisplay'1993 in Strasbourg [2].

The first generation of systems measured luminance in a cone of ±60° with an angular resolution around 1° and a maximum spot size of 1mm. Our systems have been improved throughout years to reach extremely high performances at every level and also new measurement capacities.

2. Paper content

In the proposed paper the principle of the Fourier optics will be presented. We will explain how a practical instrument can be designed with special focus on different aspects of the system. First, the collection efficiency and the accuracy which are related to the optical setup will be examined. The challenge to make large spot sizes for large TVs will be explained [3]. Technical details with some examples of application will be given concerning the polarization measurements [4] and the multispectral measurements [5] introduced in 2007 and 2008 respectively. Very high angular resolution systems have been developed in 2009 for specific applications like 3D autostereoscopic displays [6]. The integration of a sample illumination across the OFT optics makes also possible measurements of the reflective properties of surface [7] which leads to various application in the field of displays and outside it. Recent developments for the characterization of NIR light sources for 3D imaging [8], will be also discussed and future systems with extended capacities for advanced characterization of light sources will be discussed.

3. References

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