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# United States Patent [19]

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Hagerman

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[54] **METHOD AND APPARATUS FOR MEASURING ILLUMINATION UNIFORMITY OF A LIQUID CRYSTAL LIGHT VALVE PROJECTOR**

[75] Inventor: **James G. Hagerman**, San Diego, Calif.

[73] Assignee: **Hughes-JVC Technology Corporation**, Carlsbad, Calif.

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### Related U.S. Application Data

[63] Continuation-in-part of Ser. No. 481,768, Jun. 7, 1995, abandoned.

[51] Int. Cl.<sup>6</sup> ..... **H04N 5/73**

[52] U.S. Cl. .... **348/658; 345/147**

[58] Field of Search ..... **345/87-89, 904, 345/50, 132, 147; 348/658, 687; 349/5-8**

### References Cited

#### U.S. PATENT DOCUMENTS

4,700,218 10/1987 Thomsen et al. .... 348/658  
4,962,418 10/1990 Kamaga ..... 348/658

5,181,103 1/1993 Tatsuya ..... 348/658  
5,231,481 7/1993 Fouzan et al. .... 348/658  
5,315,378 5/1994 Satou et al. .... 348/675  
5,416,385 5/1995 Hau ..... 315/758  
5,530,489 6/1996 Henderson et al. .... 348/757  
5,537,145 7/1996 Miseli ..... 345/904

Primary Examiner—Mark R. Powell  
Attorney, Agent, or Firm—Harness, Dickey & Pierce, P.L.C.

### [57] ABSTRACT

A system for measuring the illumination uniformity of a liquid light valve (LCLV) for a LCLV projector includes a projection device including a first LCLV. The projection device reflects light from the first LCLV to form an image on a screen. An image sensing device senses illumination values for a plurality portions of said image. A processor is coupled to the image sensing device and the projection device. The processor determines an optimum voltage bias which provides a maximum illumination for the plurality of image pixels. The illumination uniformity measuring system can independently measure the illumination non-uniformity of the LCLV and illumination non-uniformity resulting from other sources such as projection lens roll-off, screen gain, and other illumination non-uniformities. Using the measured illumination non-uniformity, a correction system can improve the quality of the displayed image.

**24 Claims, 5 Drawing Sheets**

