NASA TECH BRIEF

Marshall Space Flight Center

Design and Fabrication of an Experimental Image Forming Light Modulator

Information processing by means of optical Fourier transforms has a long history of successes in microscopy, photography, character recognition, and holography, to name a few. In many of these techniques, the input information is an optical transparency on photographic film. Although the photographic film offers high resolution and a wide range of exposure and spectral response characteristics, it is not suitable for real time processing because of the time required to develop the film. The extension of coherent optical processing to real time applications has resulted in a class of imaging devices which generate time-varying optical transparencies. In general, these devices transform an incoherent image into a coherent one by means of a modulation medium.

Based on this operation, an image forming light modulator (IFLM) was designed to transform an electrical signal representation of a two dimensional image into an optical transparency. The electrical image representation conforms to the standard EIA composite TV video signal. The operating mode includes image formation with complete erasure at a 30-Hz rate and storage of the optical transparency for at least 1 minute. The image quality is comparable to that of a commercial TV display with a minimum resolution of 300 lines/inch (12 lines/mm) over an image plane of 2 by 2 inches (5 by 5 cm).

Each point on the image is developed sequentially from an electron beam which scans an electro-optic crystal situated in the modulator plane. A charge pattern proportional to the image intensity is deposited on the crystal surface, and a light beam passing through the crystal is modulated by the longitudinal electro-optic effect. The crystal is attached to a demountable assembly which can be conveniently adapted to other modulation media, and whose temperature can be controlled over the range -50° to 27° C.

The modulator may be envisioned as a two-dimensional array of Pockel's cells which completely cover the image plane. This electro-optic effect employed in an optical transmission mode utilizes an electron-beam-addressed KD*P (deuterated potassium dihydrogen phosphate) modulation medium. A maximum resolution of 320 lines/inch (13 lines/mm) was measured with a contrast of about 95 for linear conversion of the TV video signal. Image retention for several minutes is provided by cooling the KD*P crystal to a temperature near its Curie point.

All major assemblies, including the modulator, are easily demounted for convenience in adapting the IFLM to other operating modes with different modulation-media. A high-speed vacuum pump is also incorporated into the modulator housing to help reach the required operating pressure.

Note:

Requests for further information may be directed to:

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NASA has decided not to apply for a patent.

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