May 1971

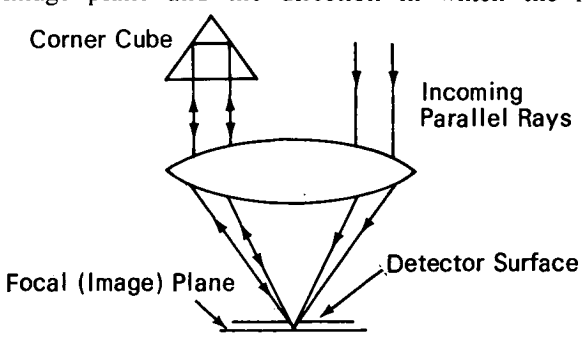
Brief 71-10112

NASA TECH BRIEF

Ames Research Center

Radiant Energy Absorption Enhancement in Optical Imaging Systems

A reimaging system makes more efficient use of incident light, overcoming problems encountered by previous imaging detectors which were unable to absorb all the light incident upon them. In a simple optical system that images parallel light, there is a one-to-one correspondence between points in the image plane and the direction in which the light



enters the system. A parallel beam of light entering the system anywhere in the entrance aperture will be focused to a point whose position is dependent only on the direction from which the light came. Similarly, light leaving a point on the focal plane and traveling through the aperture will leave the system in a direction that depends only on its point of origin, regardless of where it strikes the aperture.

Using this principle, an optical system was designed to collect light that was reflected from or transmitted through the focal plane, and to redirect this light so that it again impinges on the focal plane in register with the original image. Reimaging the unabsorbed light increases the probability that this light will be absorbed and used by the detector.

A simple reimaging optical system is shown in the figure. Parallel light rays from a distant object are focused to an image at the detector. Any reflected light incident on the detector is recollimated by the lens and leaves in a direction antiparallel to that of the incoming rays. This light is then reversed by a corner cube; it reenters the lens and is focused to the original focal point. The corner cube generally shifts the light rays laterally as well as reversing their direction. This is not a problem, however, since the imaging will take place in register as long as the light again enters the aperture of the focusing system. Additional corner cubes could be used to make a multipass system.

Mirrors, or combinations of lenses or mirrors, may be used in place of the simple lens system shown in the figure, and any appropriate retroreflective device which returns light antiparallel to its original direction may be used in place of the corner cube. By using two lens systems, one behind and one in front of the image plane, with corner cubes properly positioned, both the transmitted light and the light reflected from the image plane can be redirected to form the subsequent images.

Reference:

Gunter, W. D., Jr.; Erickson, E. F.; and Grant, G. R.: Enhancement of Photomultiplier Sensitivity by Total Reflection. Appl. Opt., 4, 512, 1965.

Note:

No other documentation is available. Specific questions, however, may be directed to:

Technology Utilization Officer
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(continued overleaf)

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to:

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