December 1966

Brief 66-10596

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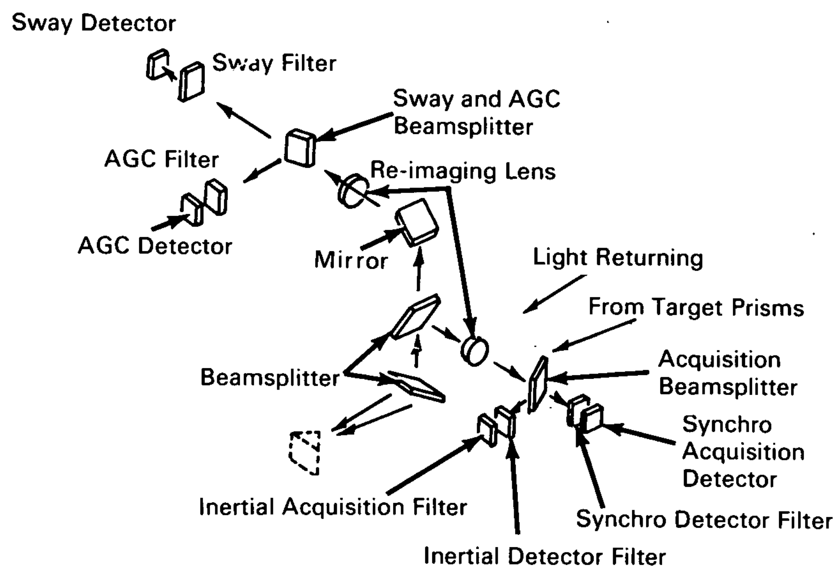
NASA TECH BRIEF

Optical Automatic Gain Channel



The problem:

Theodolites sighting over land have their performance degraded due to optical gain changes in the atmosphere and to shimmer. This effect has been compensated for in previous instruments by manually adjusting gain pots in the electronic error channel.

The solution:

An automatic gain control (AGC) channel that automatically compensates for gain changes in the azimuth error channel due to time varying optical sight degrading effects.

How it's done:

The complete device is an automatic azimuth laying theodolite capable of determining simultaneously, but separately, the azimuth orientation of two porro prisms mounted within an inertial guidance system some 1,000 feet distant. The instrument performs this function automatically while tracking the swaying target.

By placing a trihedral with the two target prisms, so that an autocollimated signal from it could be sensed in the theodolite by appropriately located detectors, it is possible to provide a signal for sensing deleterious signal effects in the optical path. Porro prisms are azimuth orientation sensitive to on-coming collimated light. Trihedrals can return this light upon itself. The optical signal from a porro prism not at null thus contains azimuth information attenuated by atmospheric effects.

The light from the trihedral, however, always returning on itself, can provide, under the best viewing conditions, a reference base from which to sense degradation of the optical signal.

(continued overleaf)

The optimum optical signal from the trihedral is used to set the bias voltage in the AGC circuit. This bias voltage is then introduced into the azimuth error signal computer amplifier and automatically sets the gain of this channel so that signal output is solely a function of azimuth error—independent of atmospheric transmission variables. Consequently, at any subsequent moment, degrading effects in the optical path will cause appropriate gain increases in the error channels.

The trihedral supplying the AGC signal is dichroically coated to return energy to the theodolite in the 1.8 to 2.6 micron range. This optical signal is thus discrete from the azimuth error signals which occupy the 0.7 to 1.8 micron range. By placing appropriately coated filters within the theodolite, the return beam is differentiated into various optical channels within the instrument.

The figure illustrates how this may be accomplished. Besides transmitting light to the error detectors, the clear beamsplitter reflects light returning to the autocollimator from the vehicle prisms to the second beamsplitter located directly above the clear beamsplitter, the bandwidth transmitted by the second beamsplitter being approximately 1.8 to 2.6 microns. After reflection by the mirror, light is reimaged by the lens onto the third beamsplitter that transmits light to the sway detector and filter and reflects light to the AGC detector and filter. Both filters transmit only the 1.8 to 2.6 micron bandwidth. Since the filters absorb the 0.7 to 1.8 bandwidth, the sway and AGC channels are not affected by the inertial and synchro prism error and acquisition channels.

Notes:

1. This system should be useful in remote television monitors, automatic navigation systems, and surveying and mapping instrumentation.
2. Inquiries concerning this invention may be directed to:

   Technology Utilization Officer
   Marshall Space Flight Center
   Huntsville, Alabama 35812
   Reference: B66-10596

Patent status:

Inquiries about obtaining rights for the commercial use of this invention may be made to NASA, Code GP, Washington, D.C. 20546.

Source: George Mrus and Walter Zukowsky
of Perkin-Elmer Corporation
under contract to
Marshall Space Flight Center
(M-FS-1550)