NASA TECH BRIEF
Goddard Space Flight Center

LEAPS
(Laser Electro-optical Alignment Pole for Surveying)

The problem:

Surveyors must often determine the angular azimuth between two points that are obscured from each other by intervening hills, woods, or other obstacles in the line of sight. These measurements require the extra time and labor of establishing intermediate points with which the line of sight may be maintained.

The solution:

An azimuthal bearing between two obscured points can be measured by placing a laser beam at one of the points. The beam is directed vertically, straight up into the air, so that some part of it may be detected from any position a reasonable distance away.

How it's done:

Figure 1 is an illustration of the beam and receiver arrangement. At one of the points, a high-power pulsed ruby laser is permanently mounted on a platform which has a leveling device to precisely align the beam with local vertical. After the beam (which is at a wavelength outside the visible spectrum e.g., 6943 Å) is vertically aligned, it is rotated until the beam energy polarization

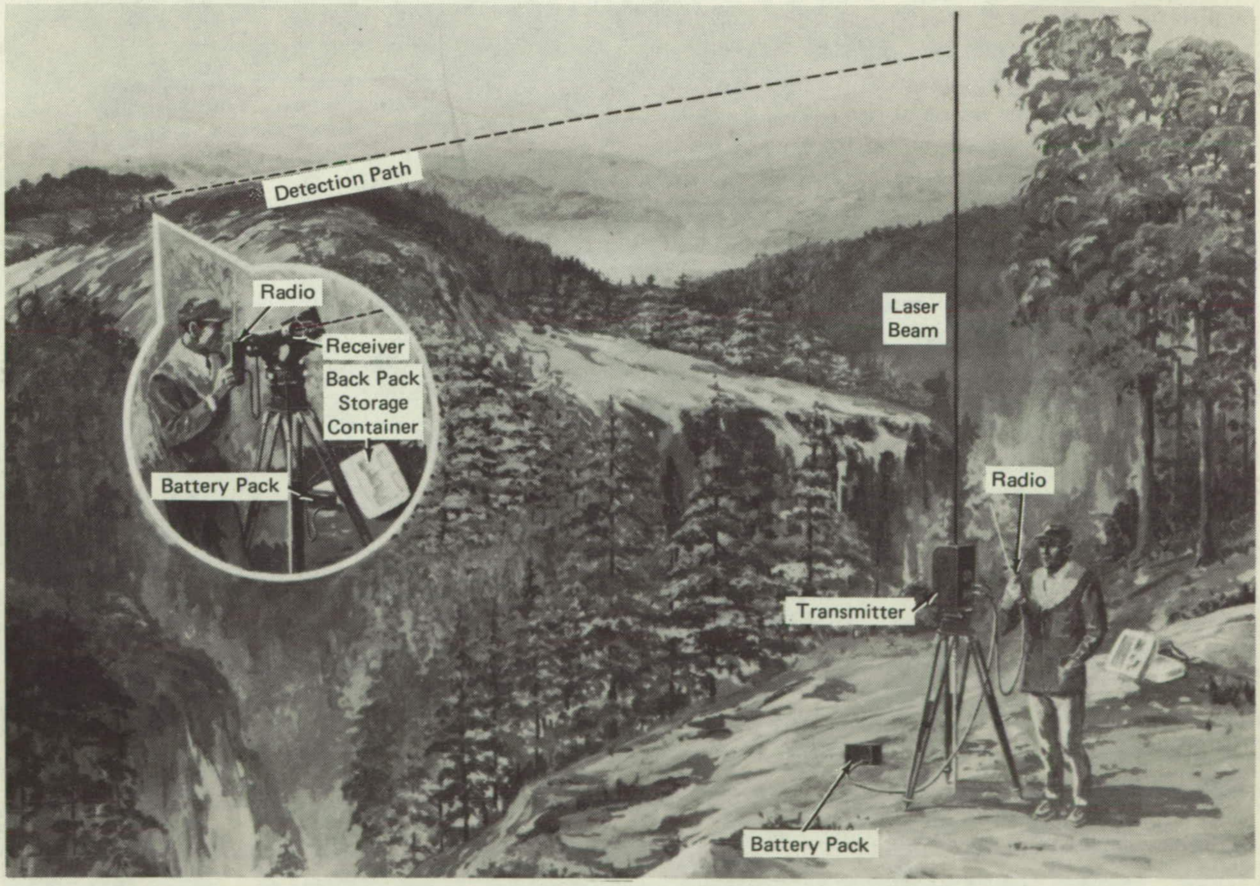

Figure 1

(continued overleaf)

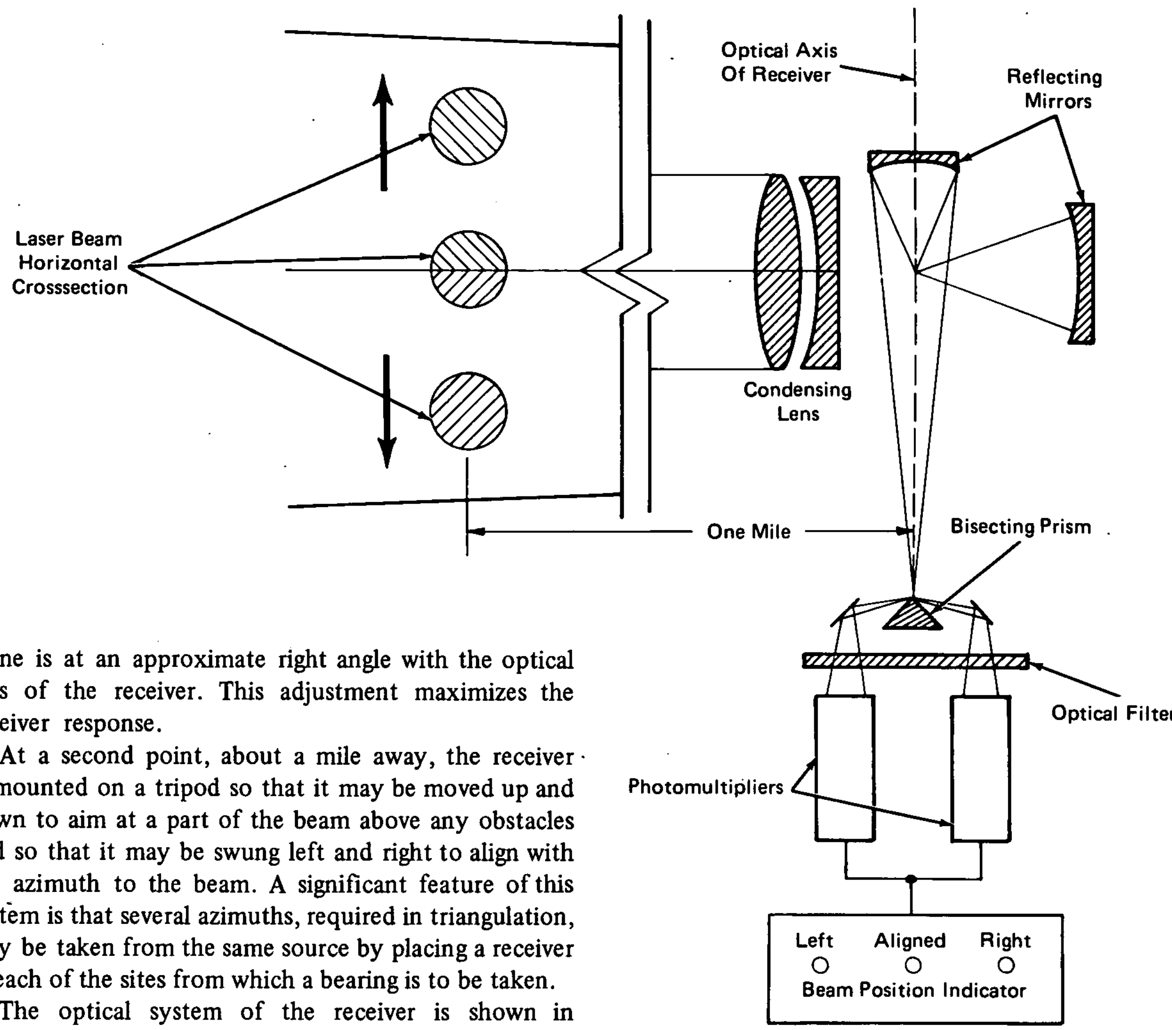

Figure 2. Long Range Laser Traversing System Optical Schematic

plane is at an approximate right angle with the optical axis of the receiver. This adjustment maximizes the receiver response.

At a second point, about a mile away, the receiver is mounted on a tripod so that it may be moved up and down to aim at a part of the beam above any obstacles and so that it may be swung left and right to align with the azimuth to the beam. A significant feature of this system is that several azimuths, required in triangulation, may be taken from the same source by placing a receiver at each of the sites from which a bearing is to be taken.

The optical system of the receiver is shown in Figure 2. A condensing lens and a concave mirror focus scattered energy from the collimated laser beam at a point on the optical axis of the receiver. The laser beam is focused on the apex of a prism placed in the focal plane of the receiver optical system. If the incident radiation from the laser is exactly centered on the condensing lens, it will impinge on the apex of the prism and be split evenly to both sides of the prism. If, however, the center of the incident beam is off to the left or right of the condensing lens, the focused beam will go more to one side or the other of the prism. Two photo-multiplier cells which detect the radiation from each side of the prism are provided with an indicator system that shows whether the receiver is aligned or off to one side of the laser beam.

To make a measurement, the surveyor at the receiver uses a communication link to pulse the laser. The indicator shows him which way to adjust the receiver. After the adjustments, the surveyor again pulses the laser and makes a finer adjustment. He continues this procedure until the indicator shows that the receiver is exactly aligned.

Note:

Requests for further information may be directed to:

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Reference: TSP73-10122

Patent status:

This invention is owned by NASA, and a patent application has been filed. Inquiries concerning nonexclusive or exclusive license for its commercial development should be directed to:

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Category 02, 03