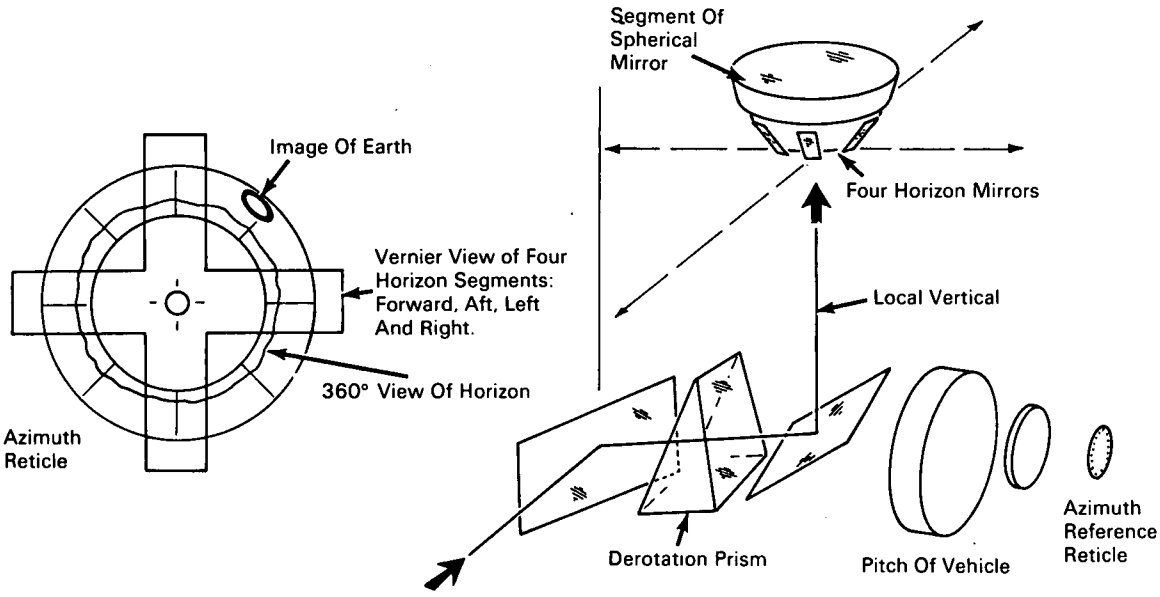
December 1966 Brief 66-10644

NASA TECH BRIEF

Three-Axis Attitude and Direction Reference Instrument Has Only One Moving Part



The problem:

Extreme weight limitations imposed on any lunar flying vehicle eliminate any but the most necessary instrumentation. Sophisticated navigational devices, radar units, and computerized coordinate systems generally require large installations and comparable power supplies. It is desirable that a very simple device provide a three-axis attitude reference and direction reference based on purely visual cues.

The solution:

A simple, single instrument combining the functions of attitude reference, direction reference, and display in a unit having only one essential moving element. The device, by use of a set of bubble levels and a calibrated dial, may be used as a sextant prior to takeoff, and as a backup navigation system during flight.

How it's done:

The lunar horizon is viewed by four mirrors set at 45° to the local vertical, oriented fore and aft, left and right. When the reference axis is vertical, the horizon will appear at the same location in each mirror. Above these four mirrors is a segment of a spherical mirror which, when the reference axis is vertical, will reflect the complete visual sphere except for occlusion by the lunar vehicle itself. Thus, it is guaranteed to pick up the moon-like image of the earth. The azimuth location of the image of the

(continued overleaf)

earth is the primary directional reference which is viewed around the circle of the horizon. An azimuth reference ring can be superimposed on the image of the horizon so that the heading of the vehicle can be read; or a command heading cursor can be included to indicate the proper heading to be maintained. This field of view must be presented to the astronaut despite the attitude of the vehicle while in motion. It is proposed that this be done by a pair of 45° mirrors or prisms, one directly in front of the astronaut and one which is rotated through the desired pitch angle by a knob graduated in degrees of pitch. This is the only necessary moving part. It is desirable to add a derotation prism which would be geared to rotate with ½ of the pitch command. For preflight survey use, the housing of the instrument would be leveled, as for example, by means of a ball swivel joint. The elevation angles to the earth and Polaris or any other pair of celestial points could be used to determine the position of the vehicle on the moon. A graphical computation or table can be used to determine the range and direction to the known position of the objective. The sight would then be rigidly attached to the frame of the vehicle, the desired pitch program angle set into the desired sight and the desired azimuth to the earth or Polaris dialed into the azimuth reference range. The astronaut would then have to fly the vehicle on the basis of visual cues until approximately in the proper direction, at which time he could transfer his attention to the attitude reference, as given by his sight.

Note:

This development is in conceptual stage only, and as of date of publication of this Tech Brief, neither a model nor prototype has been constructed.

Patent status:

No patent action is contemplated by NASA.

Source: F. B. Bossler
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under contract to
Marshall Space Flight Center

(M-FS-1819)