

April 1971

CORRECTED COPY

Brief 71-10072

# NASA TECH BRIEF

## *Marshall Space Flight Center*



NASA Tech Briefs announce new technology derived from the U.S. space program. They are issued to encourage commercial application. Tech Briefs are available on a subscription basis from the National Technical Information Service, Springfield, Virginia 22151. Requests for individual copies or questions relating to the Tech Brief program may be directed to the Technology Utilization Office, NASA, Code KT, Washington, D.C. 20546.

### Systems for Dead-Reckoning Navigation and for Simulation of Instrumental Error: Concepts

A dead reckoning navigational system, conceived for manned lunar vehicles, and a relatively simple test system for simulated instrumental error, devised in conjunction with the navigational concept, may have application in such diverse fields as oceanography and air-traffic control.

The navigational system is intended for travel totalling 30 km within 5 km of a home base, and the total distance traveled must be indicated with  $\pm 2\%$  accuracy. At five kilometers radially from the home base, the heading toward the base must always be known within  $\pi/60$  radians (3 deg). The system must always be able to return the vehicle to within 500 m of the base, and to effect a return visit to an established site. (Unless aided by visual cues, natural or artificial landmarks, such a return would need greater accuracy than within 500 m.) The vehicle and system must be capable of 3-hr trips over a 3-day period.

Hardware required by the navigational system includes two two-degrees-of-freedom gyros solidly mounted on the vehicle frame, odometers, and tachometers. For the system to be self-contained, some type of signal-processing equipment would also be required.

A particular lunar trajectory was selected for evaluating the accuracy of the system. The time-varying sequential angles were used as inputs for a digital simulation study of the gyro drift rates and vehicle misalignments. The results of this simulation study indicate that the navigational system can meet the requirements. If the accuracy requirement

is to be met, the gyro drift rates should be in the range of  $\pi/180$  rad/hr (1 deg/hr). Ability to revisit any point, with  $\pm 300$  m accuracy, requires a vehicle realignment accuracy of  $\pi/36$  rad. (5 deg).

Other navigational systems that should be analyzed include a directional and vertical gyro system, a sun-aspect sensor and vertical-gyro system, and a directional gyro and inclinometer system. Simulation studies could determine the accuracies of the systems.

#### Notes:

1. This innovation is in the conceptual stage only and at the time of this publication no model or prototype exists.
2. The following documentation may be obtained from:

National Technical Information Service  
Springfield, Virginia 22151  
Single document price \$3.00  
(or microfiche \$0.95)

#### Reference:

NASA-TM-X-53953 (N70-20655), A Simplified Dead Reckoning Navigation System for the Manned Lunar Roving Vehicle

#### Patent status:

No patent action is contemplated by NASA.

Source: W. L. Green  
Marshall Space Flight Center  
(MFS-20860)

Category 07