Surveyor Informs LEM

➤ INFORMATION from Surveyor's lunar landing and from the Gemini space flights is being fed as soon as it is available to a series of computers on Long Island that are helping with practice for the manned landing on the moon.

The Lunar Excursion Module, which will carry astronauts to the moon around the end of this decade, is already being flown by computer simulation at the Bethpage, L.I., laboratories of the Grumman Aircraft Engineering Corporation.

The simulation technique, using a team of digital and analog computers, gives scientists accurate information about the LEM's future performance on or near the moon's surface. In this way, errors of design and other problems can be spotted and solved under conditions that represent no danger to the astronauts or to costly equipment.

A report on the LEM simulation was given by Robert W. Kress and Gerald D. Fogel of Grumman at a scientific computing symposium in Yorktown Heights, N.Y., sponsored by International Business Machines Corporation.

Mr. Kress is director of guidance navigation and control-test—LEM. Mr. Fogel is chief of computing sciences.

Using a large array of computing hardware, including four analog consoles and an IBM 7094 digital computer linked into a single "hybrid" system, Grumman scientists are developing information about such crucial factors as fuel needs, docking and rendezvous procedures, and the function of the vehicle guidance and control systems.

New information from current space flights is continually added to the system's store of data so as to make the simulated flights as close to reality as possible. For example, the Surveyor vehicle, which landed on the moon June 2, has been providing valuable information on lunar surface conditions that will help verify the LEM landing gear design.

The system includes a cockpit similar to the one being built for the actual LEM vehicle. Through windows in the cockpit, an astronaut sees displays representing the moon's surface or other scenes that he will see in actual operation.

As the astronaut maneuvers the simulated vehicle, the system computes the results of his maneuvers, and changes in his apparent rate of descent, flight attitude and other factors in response to his control commands. Factors such as the vehicle's mass and the thrust of its engines must also be taken into account.

The computations take place in "real time," that is, the results of the astronaut's actions happen as rapidly as they will in actual flight.

• *Science News, 90:38 July 16, 1966*

TECHNOLOGY

$1.5 Million VLF Radio Station to Be Built

➤ CONSTRUCTION of a $1.5 million VLF (very low frequency) radio station will soon begin north of the Arctic Circle in the county of Salten in Norway. Contract for its construction for the North Atlantic Treaty Organization (NATO) has been awarded Continental Electronics Systems, Inc., Dallas-based subsidiary of LTV Electrosystems, Inc.

VLF stations require extremely large antenna installations and in Norway the typical rugged terrain will be utilized, J. V. Weldon, president of Continental Electronics said.

The antenna structures will be suspended between two steep mountain ridges instead of large steel masts, as is usually required.

"However," Mr. Weldon said, "the footings and anchors at the mountain tops will involve extremely difficult construction work. The challenge of this system will be the conditions of climate and terrain in which it will be performed, coupled with the tight schedule for completion.

The facility is scheduled for operation in 1968.

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GEOPHYSICS

Meandering Rivers Take Easiest Route to the Sea

See Front Cover

➤ THIRTY-FIVE YEARS after Hoagy Carmichael wrote the song beginning "Up the lazy river," two scientists at the U.S. Geological Survey in Washington, D.C., used a mathematical model on a computer to show that rivers actually are "lazy." They take the easiest path down to the sea, even though it takes more time than a straight course would.

The wandering path taken by each rivulet, stream or river flowing under the influence of gravitation is called meandering. These meanderings can be explained on the principles of chance, the scientists found.

They compared the meanderings of hundreds of rivers to a "random walk," which is the mathematical way of describing the route of a staggering drunkard who takes each step aimlessly but who will, nevertheless, end up at his destination given sufficient time.

The Survey hydrologists found that the distance over which any river follows a straight path does not exceed 10 times its width at that place. Their explanation is that a stream is moving with constant velocity and may change its direction at random at any point.

This is a model of chance, and the assumption is that a river will follow the most probable among all possible random paths in flowing from one point to another.

The random-walk mathematical model offers evidence that the most probable path is that which minimizes what is called the "variance of the changes in direction." This means the river's path is a lazy curve that takes the easiest available turnings.

Such meanders are illustrated by the Colorado River, shown on the front cover, flowing toward the bottom of the picture.

Drs. Luna B. Leopold and Walter Langbein, research hydrologists at the Geological Survey, reported results of their mathematical analysis of rivers in Scientific American, June 1966.

(Cover photograph by U.S. Geological Survey.)

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