

July 20, 2009

Subject: My encounter with Moon research

Dear Colleagues:

1. My research on understanding Moon started with research under Dr. J. W. R. Griffiths at Calcutta University in 1964. Dr. Griffiths was a Visiting Professor from University of Birmingham, England. I worked on the project, "Moon Relay Communication System," which was aimed at using Moon as a passive reflector to communicate between two locations on earth. We developed a rotating model of Moon from Plexiglas and used high frequency ultrasound waves in the laboratory while developing an x-band microwave communication system.
2. I designed an x-band microwave radar system and Moon targets to study the depolarization of microwaves as a researcher at Kansas State University. This research was started in January 1965 under Dr. W. W. Koepsel of Kansas State University (KSU) and Dr. R. K. Moore of University of Kansas (UK).
3. I was conducting experiments on the roof of Seaton Hall at KSU during 1965. In early 1966, I developed a laboratory at KSU. I studied the properties of Moon using laboratory data and the data published by Evans and Pettengill. Their x-band data was gathered by bouncing x-band microwaves from Moon using the Goldstone facility in California.

Cross-polarization measurements and their relation to target surface properties, Krishen, K. Koepsel, W. Durrani, S., Kansas State Univ., Manhattan, KS, USA; Antennas and Propagation, IEEE Transactions on, Sep 1966, Volume: 14, Issue: 5.

4. I concluded this work in June, 1969. I applied this learning to observing Earth from satellites. I still have interest in this subject.

Thanks,

Kumar Krishen, Ph. D., Assoc. Fellow, AIAA, Fellow, SDPS.

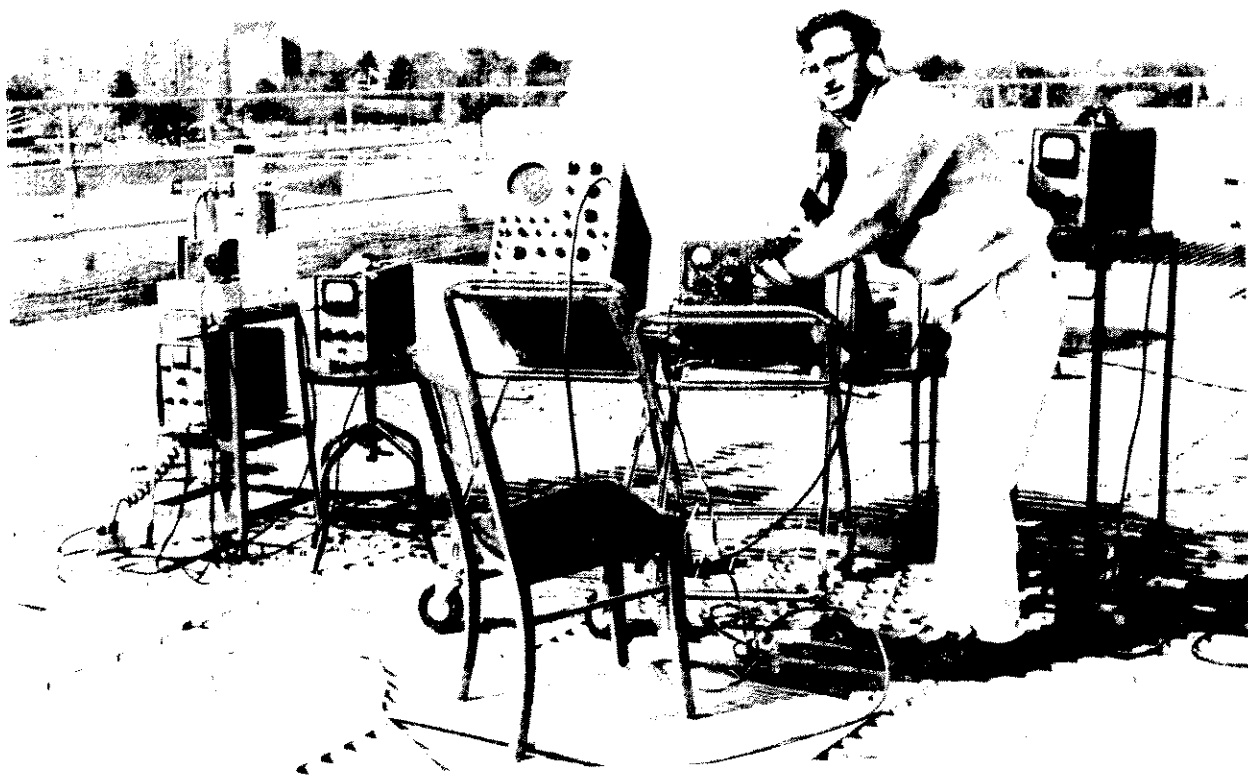
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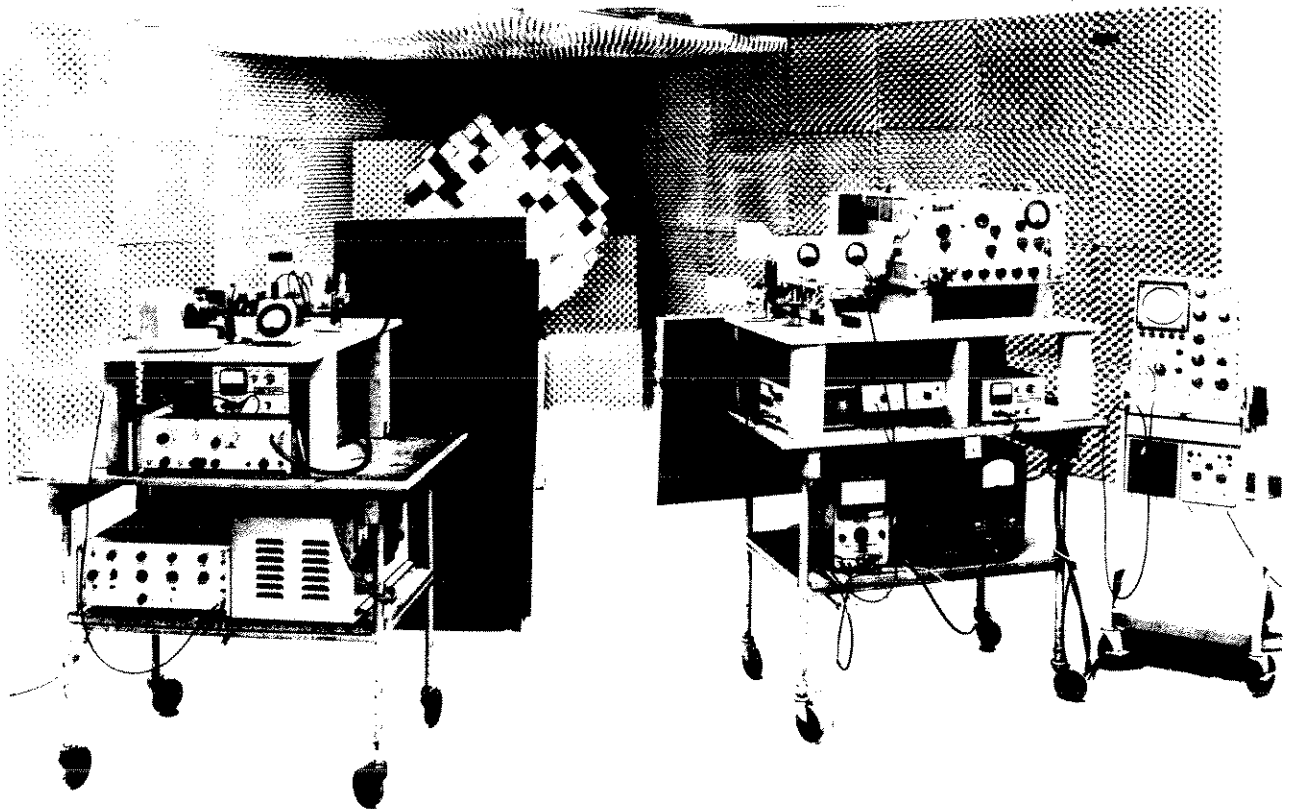
Page 1: Top: Publicity in Kansas Newspapers
 Bottom: Working on the roof of Seaton Hall at KSU

Page 2: Top: Laboratory Setup
 Bottom: More Publicity



MOON BUMPS—Discussing the characteristics of their styrofoam target, used to simulate the moon's surface during experiments, are (left to right) Dr. S. H. Durrani, W. W. Koepsel, and K. Krishen. The round irregular target is used in honoring radar impulses from a "space camera" that will determine the composition of the moon's surface as well as its contour. The three Kansas State University electrical engineers are presenting the results of their research to date at this year's IEEE Convention in New York City Tuesday.





Oct. 29, 1968

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Astronaut, Diver Benefit From K-State Research

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By NARIMAN KARANJIA

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Astronauts and deep sea divers will no longer be surprised by what they find on the moon or at the bottom of the sea.

"It is possible to predict the composition and surface characteristics of far away and hard-to-reach objects," Kumar Krishen, assistant professor of electrical engineering, said.

Research done by the K-State electrical engineering department and funded by the National Aeronautics and Space Administration has made this possible.

The research is being done to establish a relationship between the degree of polarization of an electromagnetic wave reflected from an object and the object's surface characteristics.

Krishen explained the project. "In radar, electromagnetic waves are sent out by a transmitter."

These waves travel till they hit an obstruction and are reflected. These obstructions are called targets, and the electromagnetic waves reflected from the target are called reflected signals.

When a wave hits a target and is reflected, it undergoes changes. One of

these changes is depolarization. There is a relationship between the degree of depolarization and the surface characteristics of the target.

Industrial concerns have been trying to do this for a long time.

"They flew around in planes or helicopters and sent out electromagnetic waves and recorded the reflected signals," Krishen said. "They were unable, however, to control the variables in their experiments.

"For instance they found that signals bounced off the surface of the bottom of the sea underwent a certain amount of depolarization. However, they did not know the nature of the surface from which these signals

reflected. They could not therefore establish a relationship between the two."

At K-State the waves are bounced off artificial targets whose composition and surface can be varied. Some of the targets are made of wood, others of styrofoam. The reflected waves are analyzed by an analog computer.

Wellington Koepsel, head of the department of electrical engineering, worked with Krishen on the project. Koepsel believes the facilities in this area of research are far above average.

The applications of the results of these studies are numerous, Krishen said. Radio communication with a minimum of distortion may be one of the benefits.

**ALL HONOR STUDENTS
MEETING IN VAN ZILE
THURSDAY 7 P.M.**