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NASA TECH BRIEF

New Microwave Spectrometer/Imager Has Possible Applications for Pollution Monitoring

The multifrequency microwave radiometer is a device responsive to microwave energy at several frequencies, corresponding to different temperature gradients. The use of thermally produced multifrequency microwaves for image production of temperature profiles is new, and could be useful in water pollution monitoring, agriculture, and forestry survey applications. Also, designers and manufacturers of environmental monitoring systems should be interested in this innovation.

The original research conducted in this study involved the recording of a thermal-emissivity image, through covering clouds, of the solid sphere of the planet Venus. The microwave spectrometer/imager, first specified as a base-line experiment, was a combination of narrow-band radiometers mechanically scanning about 4°/sec; the long-wavelength antenna was 3-ft square; the other operating wavelengths were assumed to be 3.4 and 8 mm. However, from an altitude of 1000 km, an imaging instrument must scan at about 12°/sec and have instantaneous playback to form a complete image of the surface. Thus an instrument that scans at 4°/sec in both directions, normal to the scan line, records data along a ground track that is an open zigzag rather than a complete image.

The mechanical motion of the antenna presents a problem in control of attitude. The only solution to the attitude-control problem is counterbalancing the mechanically sweeping unit to balance the change in angular momentum of the antenna. This technique would require the addition of various moving parts, which could decrease the reliability of the system.

A newly recommended experiment eliminates part of the problem by electronic scanning with the 3-cm antenna during mechanical scanning with the conventional 3.4- and 8-mm radiometers which look at the atmosphere. This combined instrument provides an image of the planet's surface and a crude image of its atmosphere. The instrument consists of three subsystems: a large, fixed, scanning, phased-array antenna and a receiver for 3-cm operation; an 8-mm Cassegrainian antenna and a receiver; and a 3.4-mm Cassegrainian antenna and a receiver. The imager is a 3-cm adaptation of a 1.58-cm unit already constructed. It is believed that a 3-cm imager could be an improvement on the existing unit.

The microwave imager primarily forms a thermal-emissivity image of the solid portion of the planet, and also provides useful atmospheric data when looking tangentially through the atmosphere. Therefore the experiment should: (1) view a portion of the atmosphere tangentially; (2) view as much of the solid portion as possible; (3) obtain as detailed a view of the surface as possible; and (4) obtain maximum resolution near the terminator for determination of possible significant changes in temperature. If the experiment is restricted to one direction of viewing, the requirements for coverage of great area and for fine detail are contradictory; however, if multiple directions of viewing are possible, the detail can be observed near the planet and broad coverage can be obtained from a greater distance.

Note:

Requests for further information may be directed to:

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(continued overleaf)

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No patent action is contemplated by NASA.

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