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ADVANCED ALTIMETRY

by

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The radar altimeter being developed for the Ocean Topography Experiment (TOPEX) will have an inherent instrument precision of 2-3 cm. This is smaller than or of the same order of magnitude as the effects from other sources of uncertainty in satellite altimetry, such as the ionosphere, barometric fluctuations, water vapor absorption, etc. While some minor refinements may be possible in the future, major geophysical advances could be made if altimetric measurements over a wide swath of the Earth's surface were possible. Beginning in January 1986, the NASA Headquarters Oceanic Processes Branch is supporting a 3-year investigation of the technological issues inherent in the precision measurement of topography from spaceborne platforms at angles off-nadir. Also, this RTOP, 161-1006, has as an additional goal the identification and development of a future space mission using the advanced wide swath radar altimetry under study. Much progress has been made toward this latter goal, and this is described in another activity report in this volume entitled "Eos Advanced Altimetry."

To explore the off-nadir measurement of topography, a flexible, airborne radar instrument system is being developed. Its hardware design is now complete, and it consists of the following

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subsystems. The antenna selected is a dielectric lens of .894 m diameter. At an operating frequency of 36 GHz, it has a gain of 47.5 dB and a one-way beamwidth of .6 degrees. Most importantly, it can be used to transmit and receive at angles up to 12 degrees from its axis without major beam pattern degradation from optical aberrations.

The RF subsystem uses phased-locked oscillators, FET solid-state amplifiers, and "times four" frequency multipliers to develop a transmit signal at a frequency of 36.0 GHz and a local oscillator signal at a frequency of 35.4 GHz. The transmit signal is switched on and off by a PIN diode switch at a PRF of 200 Hz and with a pulse width of 10 ns. RF amplification of the transmit pulse is achieved from a 1.5 kw Varian Extended Interaction Amplifier, and a waveguide network distributes the transmit and local oscillator signals to five circulator/feed horn/receiver assemblies. Each receiver detects the backscattered RF signal and downconverts to an intermediate frequency of 600 MHz.

Lecroy 6880 digitizers under computer control digitize the five receiver outputs. The digital subsystem consists of six single-board Heurikon processors. Each has specific responsibilities; communication with the other processors is achieved through bus interfaces. One executes UNIX and is responsible for coordinating the activities of the others, which use VRTX, a real-time operating system. With this modularized, highly flexible design, the total functioning of the radar system is under computer control. This makes the instrument, the Aircraft

Multibeam Radar Altimeter (AMRA), a unique tool for studying altimetry at angles from nadir to 12 degrees.

At this time, the instrument construction continues with final system integration planned for November 1988. The system will be installed in the Wallops P-3 research aircraft for engineering evaluation and test flights in the Spring of 1989. It is hoped that the system will be ready for use in field missions by April 1989. One experiment that the AMRA might support is the spring window of SYNOP. Also, the measurement of the backscattering cross-section of selected portions of the Earth's surface at 36 GHz is of considerable -importance to several proposed Eos investigations. AMRA should be able to make these needed measurements.

AMRA Design Performance Summary:

Antenna -	type	dielectric lens
	diameter (m)	.894
	gain (dB)	47.5
	beamwidth (deg)	.6 (one-way)
	look angles (deg)	0-12
	no. of beams	5
RF -	frequency (GHz)	36.0
	power (kw)	1.5
	bandwidth (MHz)	220
	pulse width (nsec)	10 nom.(5 goal)
	pulse rate (Hz)	200
Signal Processor -	sampling rate (GHz)	1.3
	samples/waveform	128
	tracker type	variable