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QUARTERLY REPORT
For
Contract No: NAS5-11542

(1 April, 1971 - 30 June, 1971)

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FACILITY FORM 602

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SUMMARY

This report on contract NAS5-11542 covers the period 1 April - 30 June, 1971. Major reporting areas include:

1. Time domain data extraction.
2. Radio Altimeter.
3. Application of ATS data.

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I. INTRODUCTION AND DISCUSSION

A. Time Domain Data Extraction

A break through was made during the last quarter toward developing an operational prototype system for measuring wind field data sets from cloud motion in ATS pictures and we have finally met the GARP wind requirements.

Two important advances were implemented in computer programs. The first was the use of a sequence of ATS pictures to pin accurately down the phase of the satellite orbital and axis motion in time. We are now able to relatively align successive ATS pictures to better than 1 mile, eliminating both the time consuming and costly step of computer mapping images and the inaccurate displacements caused by an insufficiently precise satellite ephemeris. The second advance was to combine the new navigation technique with the computerized cloud auto-correlation technique developed in the previous quarter to determine actual wind fields from measured cloud displacement.

In April, a quantitative test using digitized Bomex data from Day 207 was very successful. A sequence of picture pairs yielded wind data sets consistent with each other over several hours to better than 5 knots rms, about half of this error is due to residual navigation errors. However by use of a series of three pictures, which allows a comparison of three picture pairs 1-2, 2-3 and 1-3, even the systematic error can be reduced. The remaining error of 2 1/2 knots is the pure random error. A random error is of virtually no concern when applied to use in the numerical model. The model itself gives the best fit and actually reduces the error for the 1st day. Comparison to cloud motions measured from a movie loop showed similar agreement. Refinements of the programs in May and June reduced cost per wind vector from 90¢ to 40¢ - a lower limit imposed by computer I/O limitations. A fully

documented wind determination package now exists in our computer library for use by experimenters. Several other days are being analyzed prior to submission of the results for publication. Future efforts will be extended towards improving accuracy through judicious selection of proper cloud patterns and use of filtering and smoothing techniques during processing.

An important remaining obstacle to operational use of this system is the slow and tedious selection of cloud tracer data points by hand. We are presently measuring coordinates from hard copy pictures. It isn't necessary to make the selection this slow way. A better method would utilize an automatic system with a light pen and TV screen. The meteorologist could then select points as fast as the computer could process them.

We have considered numerous approaches to the problem of retaining adequate image geometry for the computer and achieving fast display and point selection. At present, a combination of videotape and silicon storage tubes appears best. Hardware development studies will continue in the next quarter and could provide the basis for an operational wind field measurement system of high accuracy, suitable for real time use with SMS and future GARP experiments. In order to proceed in this work expeditiously, we need new hardware and more money. When our feasibility study is completed we will present a proposal for this procurement.

B. Radio Altimetry

Research on the radio altimeter progressed toward completion of a final model for experimentation and flight testing.

Tests both on recent GHOST balloon flights and in the laboratory indicate RF interference problems and these are being investigated. One source

of interference has been identified as the fast rise times in the quench pulse generator and this has been remedied. The urgency of these problems has delayed some of the other work suggested in the last quarterly report.

An effort was made to lower power supply requirements from ± 12 volts to ± 6 volts. With some modification, all circuits except the RF stage now can operate over this voltage range. The RF stage will require extensive changes to develop the required one watt of RF power on the lower supply voltages. Since average power requirements are low for this stage, it probably is easier to use a voltage doubler for the RF stage.

A major effort has been made toward measuring and adjusting the dynamic response of the phase-lock-loop. A problem which became evident is that the loop gain varied with the nominal time delay used. A new VCO design which is linear in time delay instead of linear in frequency has solved this problem. Measurements indicate that loop gains of 20-40 are best with poor tracking and excessive noise setting these limits respectively.

Good yagi antennas are being constructed from thin phosphor bronze sheeting, cut in strips and formed with a slight curvature. Plans are to test these improved altimeter versions in the next quarter.

C. Application of ATS Data

A M.S. thesis entitled "Cloud photographs from satellites as a hydrological tool in remote tropical regions" has been completed. Thesis abstract follows:

"The use of cloud pictures obtained from satellites to determine rainfall parameters would be beneficial in many fields. This study attempted to relate satellite measurements of cloud brightness to rainfall rate and stream discharge with fair success.

In addition, a demonstration of a simple method for intercontinental dissemination of graphical meteorological data was made using

office equipment (Xerox telecopiers) and amateur radio apparatus. This enables populations in remote regions observed by the satellite to be aware of impending hydrological problems".

Complete information will appear in the final report.

II. PROGRAM FOR NEXT REPORTING PERIOD

Meteorological studies using cloud motion vector from the ATS time lapse sequence will be completed in the next quarter. Also, the final results on the determination of surface layer wind stress from ATS sun glitter information should be available. A report on the feasibility studies on Data Retrieval, Processing and Storage, partly prepared in the quarter, will be completed by the end of next quarter when more data will be available.