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SUBJECT: Monthly Report for October 1976
VLA Optical Processor
Contract: VLA-215

1.0 SUMMARY

Work during October consisted of Task 2 efforts with particular emphasis in phase error analysis, compensation and calibration techniques, system modeling, and continuation of experimental breadboard processor assembly and checkout.

Phase error analysis [1,2,3] of two types have been performed: (1) those caused by non-paraxial optical Fourier transform operation, and (2) input (u,v data) plane phase errors. Results are encouraging in that (1) non-paraxial operation in the optical Fourier transform operation appears feasible to the extent needed with the use of a compensation for linear and quadratic error effects, and (2) input phase errors of $\frac{\lambda}{15}$ peak-to-peak for first and third order errors (and greater for higher orders) is acceptable while maintaining one-percent accuracy of the system point spread function (dirty beam). Phase error contributions of a film, plus liquid gate have been analyzed experimentally [4], and the results suggest negligible error with proper liquid and film choices.

System modeling [5] was updated. Work on the model is continuing toward including amplitude and phase error sources.

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A method for controlling the affect of the zero order beam in the sky map plane has been conceived. Related discussion of recording bias level selection is given in Ref. 6.

The experimental breadboard system work is continuing with emphasis on initial checkout of the detection array electronics. Detector electronics, and a mechanical scanning stage have been built up to allow incorporation of readout of the processor output plane into the ERIM digital storage and TV display facilities. The following types of experimental data will be obtained when the breadboard is completed:

- (i) A scanning microdensitometer will be used to scan the point spaced function of the system with and without the liquid gate and film. When the gate and film are used, both a clear aperture and CRT recorded data will be used.
- (ii) Data similar to that of (i) will then be scanned with the detector array. This will be accomplished for cases where the reference wave phase is changed by a specified amount (0, π , etc.).
- (iii) Results from (i) and (ii) will be analyzed to assess the experimental performance which is available with the breadboard demonstration system.

REFERENCES

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2. L. Somers, F. Schwab, and C. Aleksoff, "Spherical Wave Defects for a Particular Optical Fourier Transform Configuration", ERIM Memorandum, 25 October 1976.
3. L. Somers, F. Schwab, J. Garalund, "Errors in an Optical Fourier Transform Processor Due to Certain Phase Error Effects", ERIM Memorandum, 11 November 1976.
4. C. Dwyer, "Film Coherent Optical Quality Considerations", ERIM Memorandum, 26 October 1976.
5. I. Cindrich, "Optical Processor System Model", ERIM Memorandum, 5 November 1976.
6. J. Fienup, "Arbitrary Bias in Non-Track Areas", ERIM Memorandum, 10 November 1976.
7. J. Fienup, "Method for Imaging Both Halves of u-v Plane on Film Simultaneously", ERIM Memorandum, 11 November 1976.