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STAT

June 15, 1970

ACTIVITY SUMMARY

To: John C.

STAT From:

Subject: Contract Visit to Customer Facility

STAT 9, 10 June 1970
- 10, 11, 12 June 1970

STAT (5500-6076) 70R

STAT Reference: /2201201-AS-8

The objective of this week was to complete data-taking for purposes of the briefing scheduled the week of 6 July 1970. During the days of 9, 10 and 11 of June we continued the applied effort to fabricate filters and reconstruct images degraded by image motion. To this end images were blurred for use in the experiment, and several series of exposures were taken on the interferometer to fabricate filters. Those that were fabricated were evaluated, and it was found that they did not supersede the filters fabricated on May 27, 1970 by STAT An evaluation of the filter technology was performed to demonstrate the status of the program results as a function of the technology being applied.

At this time filters are being constructed by a unique method such that they act as high pass, matched filters. That is they operate on the high frequencies of the spectrum of which they are the complex conjugate. The fiber is fabricated on the interferometer, and expressed as

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$$T_A(W) = \left\{ \left| Ke^{ix} + F(w) \right|^2 \right\}^{-\gamma/2} \qquad (1)$$

where F(w) is the spectrum of the target we want to detect. The film is processed to $\gamma = +2$ yielding, for a low contrast signal F(w), a matched filter (the complex conjugate of F(w)). This filter is well suited to target recognition under low-noise conditions. To demonstrate the applicability of this technology to image processing we applied this filter to compensate for image blur. The results demonstrated the expected output of image motion compensation by matched filtering. The compensated frequency response is a sinc squared function with large amplitude variations that yield strong side-orders in the corrected point spread function. An inverse filter will be a more optimum filter for image blur removal. We plan to construct the inverse filter in the coming weeks.

A tutorial session was given to the co-op students from 9:30 to 11:30am on Friday, June 12. This session was given to aid their understanding of their contributions and their part in the planned program. In support of their activity for the next two weeks a program plan was generated. A copy of the plan is attached to this activity summary.

The next trip is scheduled for July 1,2, 1970, at which time we will review the data prepared for presentation the following week.

PSC/c
Attachments

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Memorandum

To: John C.

STAT From: [redacted]

Subject: Laboratory Program Plan for the two week period, 15-26 June.

Date: 12 June, 1970

STAT Ref. no. [redacted] 2201201-AS-8

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Laboratory Program Plan
June 15 & 26, 1970

The following program outline and schedule is provided as a basis for continuing STAT development activity in the [redacted], STAT [redacted] The effort will include, in general, four primary objectives:-

1. Processing and sensitometry of film.
2. Fabrication of inverse hologram filters.
3. Maintenance of optical benches + facility
4. Alignment and test of coherent bench.

This document covers objectives 1, 2 + 4. The third will be handled by [redacted] STAT

1. Repeatable processing of Micro-file film to $\gamma = -2 \pm 0.2$ is required for fabricating inverse hologram filters on the interferometer. The process to $\gamma = +2 \pm 0.2$ has been accomplished during the past [illegible] use the

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same methods of measurement (sensitometer step wedge exposures measured with MacBeth Quanta-log densitometer) for setting-up this process. The process is:-

Reversal Processing of Microfile to $\gamma = -2$

1) Develop DK-50, 1 part to 2 H_2O
   5 min, 68°F, normal agitation
   (Normal agitation is continuous first 30 seconds, 5 sec. each 30 seconds thereafter.)
2) Rinse in water, 30 seconds.
3) Kodak Direct Positive Bleach
   3 min, normal agitation
4) Water rinse, 1 min.
5) Kodak Direct Positive Clear Bath
   30 sec. constant agitation
6) Water rinse, 30 sec.

Open can — expose all film to a high intensity lamp uniformly and thoroughly. Replace on reel and into can.

7) Repeat no. 1
8) Repeat no. 2
9) Rapid fix, 2 min., constant agitation or normal fix for 5 min.
10) Rinse in water, 1 min.
11) Hypo neutralizer, 1 min.
12) Water rinse, 1 min.
13) Photo-flo & dry.

Record data in note book. If γ too high, decrease time of development in #1 above; if too low increase time of development

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2. Fabrication of inverse hologram filters.
Record two outputs on the interferometer.

a) Block out the reference wave and record the spectrum of the slit on micro-file film. Record a full range of exposures so that the spectrum is recorded from low to high exposure, in about 5 steps. Low exposure is that when the first side lobe becomes evident. Use exposure steps that increase by a factor of 3 in exposure. Process the film to $\gamma = +2$ (direct processing). Try a test run at first to determine expected exposure times.

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b) Record the spectrum <u>with the reference wave</u>, using Recordak Micro-file film. Process this by reversal processing to $\gamma = -2$. Several samples of the balance of the signal beam and reference beam can de obtained by using N.D. filters 1, 1.3, 1.6 in the reference beam. Best exposure is known when the recorded holographic spectrum has interference fringes (straight lines visible when the reference beam is illuminating the spectrum) starting at the first order side lobes and continuing out several lobes. Use the N.D. filters as

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performed in recording the filters on 6/10/70. This changes the amount of light from the reference beam. An exposure series for each N.D. filter is required, with about 5 exposure samples above minimum, a factor of three in exposure between samples.

4. Alignment and test of optical bench. The optical bench will be cleaned, based upon the maintenance procedure taken. The components must be set-u and aligned. We will support you in this activity by demonstrating the technique (not schedule). Alignment is essential to the optical system operation. The techique

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we use is Boy's point alignment, the method required for alignment of components of a complex lens. The test for this alignment is to note presence of Boy's points in front of, and behind each lens, centered on the shadow of the cross-hair shadow defining the optical axis. This set-up and alignment will also require critical focusing techniques, based upon auto-collimation and normal focusing. These will be demonstrated. The techniques can then be repeated and tested.

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Schedule

Item no.	Date 15	16	17	18	19	22	23	24	25	26
1. Sensitometry	x	x	x	x	x	x	x	x	x	x
2. Fabricating filters						x	x	x	x	x
3. _____										
4. Alignment + test+									x	x

+ The alignment and testing of alignment demonstration is scheduled for 23, 24 June. The technique can be repeated on 25, 26 June. Questions concerning items #1 & #2 can be brought up on 23, 24 of June, or earlier, if necessary, by phone.

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