R.J. Marks II, ``Space-variant processing using temporal holography'',
Journal of the Optical Society of America, vol. 69, p.1467A (1979).

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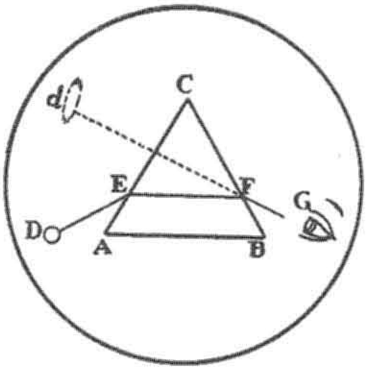

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tensifier was used to describe the signal-to-noise ratio (SNR) at each stage. By using statistical communication theory, the optimum spread function of the imaging system will also be discussed. It was found that the external noise component did contribute a significant part to the overall system design. (13 min.)

ThO9. Space-Variant Processing Using Temporal Holography.* ROBERT J. MARKS II, *Dept. of Electrical Engineering, University of Washington, FT-10, Seattle, WA 98195.*—A number of generalized two-dimensional space-variant coherent processors are presented. Each makes use of the temporal field amplitude summation/integration capabilities of the conventional transmission hologram[1] and some recently developed methods of space-variant system characterization.[2] Each processor also requires a mask with real-time transmittance changing capability (either mechanically or electrically) as well as a means of sequential data input. The processors presented are not meant to be representative of all possible cases, but rather illustrative of a basic methodology. (13 min.)

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* Research generously supported by University of Washington Graduate Research Fund (Project PSE-517)

[1] M. O. Hagler, E. L. Kral, J. F. Walkup, and R. J. Marks, II, "Linear coherent processing using an input scanning technique," Proc. International Optical Computing Conference, London, England (1978).

[2] R. J. Marks, II, J. F. Walkup, and M. O. Hagler "Methods of linear system characterization through response cataloging," Appl. Opt. **18**, 655 (1979).

ThO10. Technique for Coherent Optical Extrapolation of Two-Dimensional Bandlimited Signals.* ROBERT J. MARKS II, AND DAVID K. SMITH, *Dept. of Electrical Engineering, University of Washington, FT-10, Seattle, WA 98195.*—An iterative algorithm for extrapolation of bandlimited signals, recently proposed by Papoulis,[1] is, in principle, capable of being implemented in two dimensions with a coherent optical processor. Involved in Papoulis's algorithm is an infinite sequence of the linear operations of low-pass filtering and truncation. These operations are sequentially performed using conventional techniques in a coherent processor with simple feedback. Some fundamental limitations of the processor will be discussed and some preliminary results presented. (13 min.)

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* This research generously supported by National Science Foundation Grant ENG7908009.

[1] A. Papoulis, "A New Algorithm in Spectral Analysis and Bandlimited Signal Extrapolation," IEEE Trans Circuits Systems **CAS-22**, 735 (1975).

THURSDAY, 11 OCTOBER 1979 STUART ROOM (AR), 3:00 P.M.

EMIL WOLF, *Presider*

Photon Statistics and Wave-Front Estimation

Contributed Papers

ThP1. Photon Emission in Resonance Fluorescence: An Example of Sub-Poissonian Statistics.* L. MANDEL, *Dept. of Physics and Astronomy, and Institute of Optics, University of Rochester, Rochester, NY 14627.*—The probability $p(n)$ is calculated that n photons are emitted spontaneously in a given time when a two-level atom is placed in a resonant, coherent exciting field. The variance $\langle(\Delta n)^2\rangle$ is found to be smaller than the variance $\langle n\rangle$ for random emissions, and the ratio $[\langle n\rangle - \langle(\Delta n)^2\rangle]/\langle n\rangle$ can be as large as 3/4. Some curves are presented to illustrate the photon statistics. The possibility of observing the sub-Poissonian distribution in a photon counting experiment is discussed briefly. (13 min.)

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* This work was supported by the National Science Foundation.

ThP2. Resonance Fluorescence in Two-Level Atoms Driven by Intense Chaotic Light. C. R. WILLIS AND R. H. PICARD,* *Physics Dept., Boston University, Boston, MA 02215.*—The recent intense activity in strong-field resonance fluorescence excited by lasers of finite bandwidth has been concerned almost exclusively with the effect of laser phase noise and leads to only small quantitative changes in the familiar three-peaked spectrum obtained for monochromatic laser excitation. We calculate, both analytically in closed form and numerically, the resonance fluorescence spectrum for an atom driven by an intense chaotic light field characterizied by Gaussian statistics, for example, multimode laser light, and find marked differences from the phase-noise case. The coherence time τ_c of the laser light enters the model as a distinct new parameter playing a role analogous to that of the pulse duration in coherent transient effects. When the natural linewidth is sufficiently small, one obtains the characteristic three-peaked spectrum, but the sidebands are much broader and less intense than in the monochromatic case, having widths comparable to their displacements from the central peak. The widths of the sidebands are determined by τ_c and the rms Rabi frequency f. The features of the fluorescence spectrum are discussed in two important limiting cases: the slow-modulation and fast-modulation (motional narrowing) limits. (13 min.)

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* Solid State Sciences Division, Rome Air Development Center, Hanscom AFB, MA 01731.

ThP3. Stable Iterative Approach to Phase Retrieval from Point-Spread Function Data. RICHARD BARAKAT, *Dept of Applied Sciences, Harvard University, Cambridge, MA 02138.*—A numerically stable iterative algorithm is proposed for determining the unknown wave front of an optical system in terms of measured values of the point-spread function. The linearized iterative procedure employs a filtered version of singular value decomposition which controls the ill-posed nature of the problem. Representative numerical calculations for a wavefront having spherical aberration and coma are illustrated and discussed. (13 min.)

ThP4. Wigner Distribution in Optics. H. O. BARTELT, K. H. BRENNER, AND A. W. LOHMANN, *Physikalisches Institut, Universität Erlangen-Nürnberg, 1 Erwin-Rommel-Str., Erlangen, D-8520 W. Germany.*—The Wigner distribution (WD) was introduced by E. Wigner[1] in 1932 as a probability function for quantum mechanics. The WD helped to reconcile wave/particle duality conflicts. De Bruijn in 1967 showed that the WD is a legalization of the musical score, which presents simultaneously the time coordinate and the log frequency. Bastiaans[2] demonstrated the usefulness of the WD for the description of optical wavefields. We will review the fundamentals and then present some optical experiments. The input is an acoustical amplitude signal and the output the optical display of the associated WD. This two-dimensional WD could serve as input for an optical processor that recognizes spoken words or identifies the speaker. (13 min.)

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[1] E. Wigner, Phys. Rev. **40**, 749 (1932).

[2] M. J. Bastiaans, Opt. Commun. **25**, 26 (1978).

ThP5. Diffusion and Scattering of a Picosecond Pulse in a Dense Scattering Medium. KOICHI SHIMIZU, AKIRA ISHIMARU, AND ADAM P. BRUCKNER,* *Dept. of Electrical Engineering, University of Washington, Seattle, WA 98195.*—A theoretical study of the diffusion of a short pulse in a random distribution of particles has been reported previously.[1] An experimental system for picosecond time-resolved backscattering measurements has also been reported.[2] This paper presents comparisons between the theoretical calculations