

frequency it is possible to obtain the results in a much shorter time. The extent to which a set of echoes resulting from a certain transmitted frequency is correlated with another set whose frequency has been shifted by Δf is described by the frequency correlation function, $\rho(\Delta f)$, which can be written as

$$\rho(\Delta f) = \left(\frac{\sin \pi \tau \Delta f}{\pi \tau \Delta f} \right)^2,$$

where τ is the pulse duration. The transmissions are assumed to be rectangular pulses occurring very closely in time with the echoes arising from a single reflecting volume containing a large number of scatterers. The experimental values of $\rho(\Delta f)$, shown in Fig. 4, agree reasonably well with theory. To obtain statistically independent samples of the backscatter from a given volume, it is evident that the transmission frequency must be shifted by at least the inverse of the pulse duration. This property allows information to be gathered rapidly by frequency shifting instead of by observing at a

single frequency for a long time. Frequency stepping may enhance the performance of some techniques, such as post-detection integration, in which numerous statistically independent clutter samples are desired.

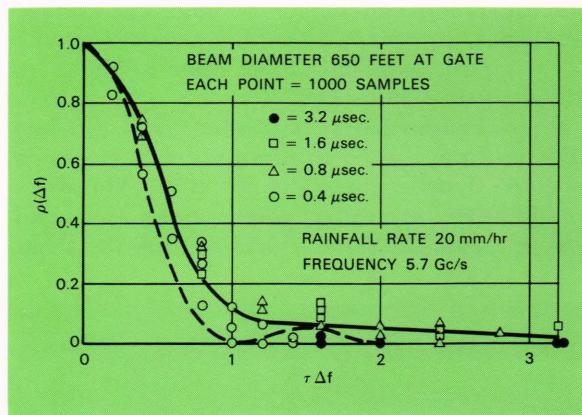


Fig. 4—Frequency correlation coefficient of rain echoes.

ADDRESSES

Principal recent addresses made by APL staff members to groups and organizations outside the Laboratory.

- A.A. Westenberg, "Applications of ESR to Gas Phase Kinetics," Chemistry Colloquia at *Harvard University*, Jan. 4, *Catholic University*, Jan. 16, and *Princeton University*, Apr. 16, 1968.
- N. Rubinstein, V.G. Sigillito, and J.T. Stadter, "Upper and Lower Bounds to Bending Frequencies of Non-Uniform Shafts and Applications to Missiles," *38th Symposium on Shock and Vibration*, St. Louis, Mo., May 1-2, 1968.
- T.G. Bugenhagen, "Using the Enemy's Cost and Effectiveness to Weight Threats," *Spring Meeting, Operations Research Society of America*, San Francisco, Calif., May 1-3, 1968.
- W.H. Avery, "Integrated Urban-Suburban Transportation System," *National Capitol and Baltimore Sections, American Institute of Aeronautics and Astronautics, Applied Physics Laboratory*, Howard County, Md., May 16, 1968.
- G.L. Dugger, "Supersonic Combustion Ramjets," *AIAA Section, Colorado State University*, Denver, Colo., May 24, 1968.
- D.M. Howard, "A Torsion Wire Damper for the DODGE Satellite," *Third Aerospace Mechanisms Symposium, Jet Propulsion Laboratory*, Pasadena, Calif., May 24, 1968.
- P.M. Bainum, W. Stuijver, and R.E. Harkness, "Stability and Deployment Analysis of a Tethered Orbiting Interferometer Satellite System," *Eighth European Space Symposium*, Venice, Italy, May 27-29, 1968.
- E.A. Bunt, "Plasma Arc Heating for Hypersonic Flight Simulation," *Mechanical Engineering Dept., University of Natal*, Durban, South Africa, May 27-June 3, 1968.
- R.E. Fischell, "Spacecraft Control Systems," *International Colloquium on Attitude Evolution and Satellite Stabilization, Centre Nationale d'Etudes Spatiales*, Paris, France, May 28-31, 1968.
- W.J. Moore, "Proposed Specification for Error Signals Resulting from Common Mode Voltage in Passive Signal Handling Equipment," *14th National Aerospace Instrumentation Symposium*, Boston, Mass., June 2-5, 1968.
- R.E. Hicks, "Substrates for Large Scale Arrays," *National Electronic Packaging Conference (NEPCON)*, New York, N.Y. June 4-6, 1968.
- D.D. Zimmerman, "Trends in Techniques for Thin Film Large Scale Hybrid Arrays," *National Electronic Packaging Conference (NEPCON)*, New York, N.Y., June 4-6, 1968.
- C.J. O'Brien, "Management Newsletters," *Workshop, International Council of Industrial Editors*, Dallas, Texas, June 10, 1968.
- C.J. O'Brien, "Employee Communications in the United States," Address to a Delegation of the *Japanese Federation of Employer Associations*, Dallas, Texas, June 12, 1968.
- K. Moorjani and C. Feldman, "Optical Constants of Amorphous Boron," *Third International Symposium on Boron*, Warsaw, Poland, June 25-29, 1968.
- R. M. Fristrom, "Molecular Beams and Chemical Problems," *Physikalische Institut, Bonn, Germany*, July 10, 1968.

ADDRESSES (continued)

- A. Brandt and L. L. Perini, "One-Dimensional Combustor Optimization," *AIAA Fourth Propulsion Joint Specialist Conference*, Cleveland, O., July 10-14, 1968.
- R. M. Fristrom, "Molecular Beams and Chemical Problems" and "Flame Chemistry and Flame Structure," *University of Gottingen*, Germany, July 11, 1968.
- R. E. Kemelhor, "Terminal Guidance for Surface Launched Missiles," *Advanced Technical Objectives Working Group for Amphibious-Close Support*, Michelson Laboratories, Naval Weapons Center, China Lake, Calif., July 11, 1968.

The following four addresses were given at the *Twelfth International Symposium on Combustion*, Poitiers, France, July 14-20, 1968:

- F. S. Billig and G. L. Dugger, "The Interaction of Shock Wave and Heat Addition in the Design of Supersonic Combustors;"
- R. M. Fristrom, "Flame Inhibition by Halogen Compounds;"
- R. M. Fristrom, "Experimental Techniques in Flame Structure Studies;"
- A. A. Westenberg, "Absolute Measurements of the $O + C_2H_4$ Rate Coefficient."
- T. Wyatt, "The Navy Navigation Satel-

lite System," *American Astronautical Society*, Denver, Colo., July 15-16, 1968.

- R. E. Fischell, "Gravity-Gradient Stabilization of Earth Satellites," *Rotary Club*, Baltimore, Md., July 23, 1968.
- C. Feldman, "Optical Constants of Amorphous Boron," *International Conference on Physics of Semiconductors*, Leningrad, USSR, July 23-29, 1968.

The following three addresses were given at the *AIAA Guidance, Control, and Flight Dynamics Conference*, Pasadena, Calif., Aug. 12-14, 1968:

- D. K. Anand, J. M. Whisnant, and M. Sturmanis, "Effect of the Near Earth Environment on the Attitude of a Slowly Spinning Multibody Satellite;"
- H. H. Hart, "Mach 8 Flow Field Effects on Small Delta Tail Surface;"
- B. E. Tossman, "Magnetic Attitude Control System for the Radio Astronomy Explorer-A Satellite."
- I. Katz, "Clear Air Turbulence," *Symposium on Clear Air Turbulence and Its Detection*, Boeing Scientific Research Laboratories, Seattle, Wash., Aug. 14-16, 1968.
- R. B. Kershner, "The U.S. Navy Navigation Satellite System," *Conference on the Exploration and Peaceful*

Uses of Outer Space, Vienna, Austria, Aug. 14-17, 1968.

- R. Turner and T. O. Poehler, "Far Infrared Lasers," *International Conference on Plasma Diagnostics*, United Kingdom Institute of Physics and Physical Society, Culham, England, Aug. 19-22, 1968.

The following four addresses were given at the *Thirteenth Weather Radar Conference*, Montreal, Canada, Aug. 20-23, 1968:

- J. J. Hicks, "Radar Observations of Gravitational Waves in a Clear Atmosphere;"
- I. Katz and D. Randall (Naval Research Laboratory), "Clear Air Radar Echoes and Corresponding Vertical Atmospheric Structure Determined by Aircraft;"
- R. A. Kropfli, I. Katz, T. G. Konrad, and E. B. Dobson, "Simultaneous Radar Reflectivity Measurements and Refractive Index Spectra in the Clear Atmosphere;"
- R. A. Kropfli and T. G. Konrad, "Convection Over the Sea as Observed by Radar."
- T. G. Konrad, "The Alignment of Clear Air Convective Cells," *International Conference on Cloud Physics*, University of Toronto, Toronto, Canada, Aug. 26-30, 1968.

PUBLICATIONS

Compilation of principal recently published books and technical articles written by APL staff members.

- R. W. Hart and R. A. Farrell, "Imaging Distribution of Radioactivity within the Human Body. I. Theoretical Considerations in Optimum Data Processing," *Investigative Radiology* **3**, No. 3, May-June 1968, 199-212.
- D. K. Anand, "Heat Pipe Application to a Gravity-Gradient Satellite (Explorer XXXVI)," *ASME, Aviation and Space Conference Proceedings*, Los Angeles, June 1968, 634-638.
- M. H. Friedman, "On Critical Hot Spot Size," *Combustion and Flame*, Butterworths, London, June 1968, Vol. 12, 281-284.
- J. M. Whisnant and D. K. Anand, "Roll

Resonance for a Gravity-Gradient Satellite," *J. Spacecraft and Rockets* **5**, No. 6, June 1968, 743-744.

- R. R. Newton, "Experimental Evidence for a Secular Decrease in the Gravitational Constant G," *J. Geophys. Research* **73**, No. 12, June 15, 1968, 3765-3771.
- V. G. Sigillito, "An Application of the Schwarz Inequality," *American Math. Monthly* **75**, No. 6, June-July 1968, 656-658.
- K. Moorjani and C. Feldman, "Optical Transitions in Amorphous Boron Films," *Solid State Commun.* **6**, No. 7, July 1968, 473-475.

- L. B. Weckesser, R. P. Suess, and R. H. Hallendorff, "Environmental Limitations of Radomes," *J. Spacecraft and Rockets* **5**, No. 7, July 1968, 762-768.
- J. R. Kuttler and V. G. Sigillito, "Lower Bounds for Stekloff and Free Membrane Eigenvalues," *SIAM, Review* **10**, No. 3, July 1968, 368-370.
- J. R. Kuttler and V. G. Sigillito, "Inequalities for Membrane and Stekloff Eigenvalues," *J. Math. Anal. Appl.* **23**, No. 7, July 1968, 148-160.
- Vernon M. Root, "Technical Publications Job Patterns and Knowledge Requirements," *Tech. Commun.* 3rd Quarter 1968, 5-12.

WITH THE AUTHORS



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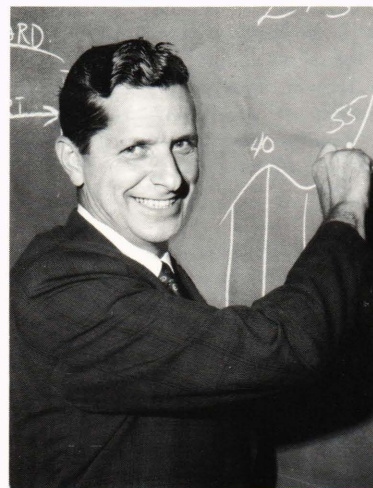
Prior to joining APL in 1945, Dr. Foner was involved in research on the Manhattan Project. A specialist in mass spectrometry, electron-spin resonance, molecular beams, free radicals, electron impact phenomena, and underwater sound, Dr. Foner's first assignment at APL was as a physicist in the Aerodynamics Group. Later, as Supervisor of the Mass Spectrometry Group in the Research Center, he was concerned with research on appearance potentials, detection of free radicals, and reaction kinetics. He has served as Science Coordinator, U. S. Science Exhibit, Seattle World's Fair, 1962, and as a member of the Committee of the National Academy of Sciences-National Research Council, Advisory to the Army Research Office. In his present position as Supervisor of the Electronic Physics Group, Dr. Foner is coordinating research in mass spectrometry, electron-spin resonance, electron impact studies, geomagnetic studies, and acoustics. Dr.

Foner is a fellow of the Washington Academy of Sciences and was recipient of its Physical Science Award in 1954. He is also a member of the Cosmos Club, the Combustion Institute, the Philosophical Society of Washington, and is a fellow of the American Association for the Advancement of Science, and the American Physical Society.



R. L. Hudson, co-author of "Mass Spectrometry of Very Fast Chemical Reactions," is an earlier contributor to the *Digest*, having co-authored with Dr. Foner "Mass Spectrometry of Free Radicals and Metastable Molecules" which was published in the March-April 1966 issue. A native of Indianapolis, Indiana, he received a B.S. degree in physics from Indiana University in 1942. A specialist in mass spectrometry, free radical research, and instrumentation, Mr. Hudson joined APL in 1943 and was involved in the proximity fuze program, carrying out test instrumentation, quality control, and fuze development engineering. As a member of the Electronic Physics Group in the Research Center, Mr. Hudson has developed specialized mass spectrometry instrumentation, has conducted research on free radicals by mass spectrometry, and has studied solid propellant instability

by acoustic techniques. Mr. Hudson is a member of the American Physical Society, the New York Academy of Sciences, and the Philosophical Society of Washington.



W. J. Wright, author of "The Engineer as an Individual," was born in Pittsburgh, Pennsylvania. He received an A. B. degree in business administration from George Washington University in 1949 and has taken graduate courses in personnel administration at the same University. Mr. Wright was employed at APL in 1952 after serving several years in the Navy. He left APL to join the Vitro Laboratories in 1954 where he prepared Weapon System Manuals for the Navy, and was involved in the supervisory development program. He returned to APL in 1958 as an Administrative Associate and has advanced to Assistant Group Supervisor in the Personnel and Education Group. He has been particularly active in professional staff recruitment, in education and training of new professional staff members, in assisting employees in their professional growth programs, and in employee counseling. Mr. Wright helped organize the Laboratory's Management Development Program and was an officer and founder of the Washington Technical Forum.