

## Isaac M. Daniel



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### EDUCATION

1952-1954	Attended the National Technical University, Athens, Greece
1957	B.S. in Civil Engineering, Illinois Institute of Technology
1959	M.S. in Civil Engineering, Illinois Institute of Technology
1964	Ph.D. in Civil Engineering, Illinois Institute of Technology

### HONORS AND AWARDS

1957	Graduation with distinction from Illinois Institute of Technology (First in Class of Engineering Division)
1957	Award of American Society of Civil Engineers
1957-1959	Chicago Bridge and Iron Company Fellow, IIT
1970	Listed in American Men and Women in Science
1970	M. Hetényi Best Paper Award, Society for Experimental Stress Analysis
1975	Best Paper Award, Society of the Plastics Industry
1976	M. Hetényi Best Paper Award, Society for Experimental Stress Analysis
1976	NASA Certificate of Recognition
1977	Listed in Who is Who in Engineering
1981	Elected Fellow of the Society for Experimental Stress Analysis
1982	Keynote Speaker at 7th International Conference on Experimental Stress Analysis, Haifa, Israel
1983	NASA Certificate of Recognition
1984	B. J. Lazan Award from the Society for Experimental Mechanics for Distinguished Contributions in Experimental Mechanics
1994	Elected Fellow of American Academy of Mechanics

1995	Keynote Speaker at 2nd International Conference on Composites Engineering,
1996	Distinguished Research Award from American Society for Composites
1998	William M. Murray Medal and Lecture, Society for Experimental Mechanics
1999	Fellow, American Society of Mechanical Engineers
1999	Professional Achievement Award, Illinois Institute of Technology
2002	Symposium on "Recent Advances in Experimental Mechanics" in honor of Isaac M. Daniel, held in conjunction with 14 <sup>th</sup> U.S. National Congress of Theoretical and Applied Mechanics, Blacksburg, VA
2002	Best paper award, American Society for Composites
2004	Best paper award, American Society for Composites
2006	Plenary speaker at 16 <sup>th</sup> European Conference on Fracture, Alexandroupolis, Greece.

## PROFESSIONAL EXPERIENCE

1957-1958	Research Assistant, Chicago Bridge and Iron Company
1959-1965	Assistant Research Engineer to Senior Research Engineer, Armour Research Foundation
1965-1980	Manager of Experimental Stress Analysis Section, IIT Research Institute
1975-1982	Science Advisor, Materials and Manufacturing Technology Division, IIT Research Institute
1982-1986	Professor and Director, Experimental Stress Analysis and Mechanics of Materials Laboratory, Illinois Institute of Technology
1984(summer)	Visiting Professor at University of Poitiers, France
1986-Date	Professor of Theoretical and Applied Mechanics, Departments of Civil and Environmental Engineering and Mechanical Engineering, Northwestern University
1996-Date	Chair, Theoretical and Applied Mechanics Council, Northwestern University
1997-Date	Director, Center for Intelligent Processing of Composites
1998-Date	Walter P. Murphy Professor

## TEACHING EXPERIENCE

1976-Date	Various short courses on Composite Materials and Nondestructive Evaluation George Washington University University of Delaware Society of Plastics Engineers U.S. Army Polytechnic of Central London Society for Experimental Mechanics Illinois Institute of Technology IBM Corporation American Society for Composites Sandia National Laboratories Northwestern University
1982-1986	Introduced and/or taught courses at Illinois Institute of Technology Mechanics of Solids

Mechanics of Solids Laboratory  
Experimental Stress Analysis  
Mechanics of Composite Materials

1986-Date     Introduced and/or taught courses at Northwestern University  
                  Mechanics of Materials  
                  Experimental Stress Analysis  
                  Mechanics of Composite Materials I  
                  Mechanics of Composite Materials II

## **AREAS OF RESEARCH EXPERIENCE**

### **Composite Materials**

Processing  
Development of test methods  
Micromechanics  
Material characterization  
Special testing (torsion, impact, creep/relaxation, fracture toughness, hygrothermal effects, high rate testing, multi-axial testing, fatigue)  
Stress and failure analysis (stress concentrations, joints, warpage)  
Damage mechanics (damage characterization, damage evolution, damage accumulation, accelerated testing, life prediction)

### **Nondestructive Evaluation**

Ultrasonics  
Acoustic emission  
Acoustography  
Acousto-ultrasonics  
X-radiography

### **Experimental Stress Analysis**

Photoelasticity, birefringent coatings  
Moiré methods  
Strain gages  
Interferometry

Elasticity, Plasticity, Viscoelasticity, Wave propagation, Fracture

Nanocomposites (processing, characterization, modeling)

## **LANGUAGES**

Knowledge of and translating capability in Greek, Spanish, French, Italian, Hebrew, and German.

## **SOCIETIES AND COMMITTEES**

American Society of Mechanical Engineers

American Society for Testing and Materials (Committee D-30 on High Modulus Fibers and their Composites)

American Academy of Mechanics (Fellow)

Chi Epsilon

Tau Beta Pi

Sigma Xi

Society for Experimental Mechanics (Fellow; Chairman, Papers Review Committee, 1975-77; Editorial Committee, 1975-77; Executive Committee, 1978-80; Fracture Committee; Composites Committee; Monographs Committee; Committee on Fellows; International Advisory Committee)

American Society of Nondestructive Testing

Society for the Advancement of Material and Process Engineering

American Society for Composites

American Institute for Aeronautics and Astronautics (AIAA)

American Society for Engineering Education (ASEE)

American Association of University Professors (AAUP)

## **PROFESSIONAL ACTIVITIES**

Committee on "Characterization of Organic Matrix Composites" of the National Materials Advisory Board of the National Research Council, 1978-1980.

Associate Editor of *Journal of Applied Mechanics* (1993-1999).

Member of the Editorial Board of *Composites A* (Elsevier).

Member of the Editorial Board of the *Journal of Composite Materials*.

Member of the Editorial Board of *Strain*.

Reviewer of papers and proposals for journals and agencies, including *Experimental Mechanics*, *ASTM publications*, *Journal of Applied Mechanics*, *Journal of Composite Materials*, *Composites Engineering*, *Composites A*, *Journal of Nondestructive Evaluation*, *American Society for Testing and Materials*, *American Institute of Aeronautics and Astronautics*, *Polymer Engineering and Science*, *Journal of Materials Science*, *National Science Foundation*, *National Research Council*.

Has attended numerous professional meetings (SEM, ASTM, ASME, ASC, ICM, ICCM, ICCE, AGARD, SPI, SES, ICF, Gordon Conferences, etc.) at home and abroad.

Has chaired and co-chaired many sessions at various meetings (SEM, SPI, ASTM, ICF, ASC, ASME, Gordon Conferences, etc.)

Organized and chaired the Sixth ASTM Conference on Composite Materials in Phoenix, AZ, May 1981 and edited the Proceedings.

Organized Symposium on Mechanics of Composites for the McNU Conference at Northwestern University, July 1997.

Gave numerous invited lectures, including keynote lectures, at home and abroad.

## **GRANTS AND CONTRACTS**

**Industrial**

RAJ Technology, Inc.  
Continental Can Co.  
Miller Fluid Power  
American Standard  
A. Finkl and Sons  
Hercules, Inc.  
Gleason Works  
Schick, Inc.  
Baxter-Travenol  
IBM Corp.  
Amoco  
Bandag  
Northrop

**Government**

Air Force Wright Aeronautical Laboratories  
NASA Lewis Research Center  
NASA-Langley Research Center  
Army Materials Technology Laboratory  
David W. Taylor Naval Ship R & D Center  
National Science Foundation  
Air Force Weapons Laboratory  
Rock Island Arsenal  
Office of Naval Research  
Air Force Office of Scientific Research

**Consulting**

RAJ Technology, Inc.  
Perkin Elmer  
Raytheon  
Army Materials Technology Laboratory  
IBM Corp.  
International Jensen  
Danly Machine Corp.  
International Paper Co.  
Northrop Corp.  
Sandia National Laboratories  
MITRE Corp.  
ALCOA  
CBI Industries, Inc.  
Schwinn Bicycle Co.  
Deublin Co.  
Allied Corp.  
Packaging Corporation of America

Hercules, Inc.  
Fel-Pro  
Illinois Tool Works  
Motorola  
Aerospace Corporation

## **PATENTS**

“Composite Femoral Implant Having Increased Neck Strength,” with D. S. Cairns, J. M. Moran, G. E. Meyer, R. O’Flynn O’Brien, R. A. Salzstein and B. J. Swetlin, Hercules, Inc., Patent No. 5,522,904, June 4, 1996.

“Gas Flow Method for Detection of Local Preform Defects Based on Statistical Analysis,” with S. K. Kim and J. G. Opperer, US patent number 6,853,925 B2, February 2005.

“Out-of-Mold Inspection of Fibrous Preform,” with S. K. Kim, US patent number 6,907,357, June 2005.

## **PUBLICATIONS**

### **A. Books**

*Experimental Mechanics of Fiber Reinforced Composite Materials*, with James M. Whitney and R. Byron Pipes, Society for Experimental Mechanics, Monograph No. 4, SEM, Bethel, CT, 1982; Second Edition, 1985.

*Composite Materials: Testing and Design* (Sixth Conference), ASTM STP 787, I. M. Daniel, ed., American Society for Testing and Materials, 1982.

*Engineering Mechanics of Composite Materials*, with Ori Ishai, Oxford University Press, New York, 1994.

*Engineering Mechanics of Composite Materials*, with Ori Ishai, Oxford University Press, New York, Second Edition, 2005.

### **B. Contributions to Books**

"Theoretical Stress Analysis," in *Testing of Polymers*, Vol. 4, ed. by W. E. Brown, Interscience Publishers, New York, 1969, pp. 297-378.

"Photoelastic Investigation of Composites," in *Composite Materials*, Vol. 2, "Mechanics of Composite Materials," (Vol. ed. G. P. Sendeckyj, Series Eds. L. J. Broutman and R. H. Krock), Academic Press, 1974.

"Photoelastic Studies of Mechanics of Composites," in *Progress in Experimental Mechanics*, Durelli Anniversary Volume, Catholic University of America, 1975.

"Methods of Testing Composite Materials," Chapter in *Fracture Mechanics and Methods of Testing*, Vol. ed. by G. C. Sih and A. M. Skudra in Series *Handbook of Fibrous Composites*, ed. by A. Kelly and Y. N. Rabotnov, North Holland Publishing Co., Amsterdam, 1985.

"Dynamic Photoelasticity," in *Photoelasticity in Engineering Practice*, ed. by S. A. Paipetis and G. S. Hollister, Elsevier Applied Sci. Publishers, London and New York, 1985.

"Composites-Testing," in *Encyclopedia of Polymer Science and Engineering*, John Wiley and Sons, 1985.

"Composite Materials," in *Handbook on Experimental Mechanics*, 2nd ed., VCH Publishers, New York, 1993.

"Nondestructive Evaluation of Composite Materials," *Flight-Vehicle Materials, Structures and Dynamics*, Vol. 4, pp. 313-342, *Tribological Materials and NDE*, ed. by R. L. Fusaro and J. D. Achenbach, Series eds., A. K. Noor and S. L. Venneri, The Amer. Soc. of Mech. Eng., New York, 1992.

"Testing, Mechanical Characterization," *Encyclopedia of Composites*, Vol. 5, S. M. Lee, ed, VCH Publishers, New York, 1991.

### **C. Articles in Journals and Proceedings**

1. "Stress Analysis of a Cylindrical Shell Ring Stiffener," ASME Paper No. 60-PET-26, September 1960.
2. "Structural Model Analysis by Means of Moiré Fringes," with A. J. Durelli, Proceedings of ASCE, *Journal of Structural Division*, ST 12, Vol. 86, No. 2693, December 1960, pp. 93-102.
3. "Photoelastic Investigation of Residual Stresses in Glass-Plastic Composites," with A. J. Durelli, *Proceedings of 16th Conference of Reinforced Plastics Division*, Society of Plastics Industry, Section 19-A, February 1961.
4. "Photothermoelastic Analysis of Bonded Propellant Grains," with A. J. Durelli, *Experimental Mechanics*, Vol. 1, No. 3, March 1961, pp. 97-104.
5. "A Non-Destructive Three-Dimensional Strain Analysis Method," with A. J. Durelli, *Journal of Applied Mechanics*, Vol. 28, Series E., No. 1, March 1961, pp. 83-86.
6. "Stress Distribution Around a Circular Hole in a Semi-Infinite Plate Under Impact at Different Points on the Edge," with A. J. Durelli, *Developments in Mechanics*, Vol. 1, Plenum Press, New York, 1961, pp. 268-285.
7. "Shrinkage Stresses Around Rigid Inclusions," with A. J. Durelli, *Experimental Mechanics*, Vol 2, No. 8, August 1962, pp. 240-244.
8. "A Short Bibliography of Recent British Work in Photoelasticity," with J. W. Dally and W. F. Riley, *Proceedings of the International Symposium on Photoelasticity*, Pergamon Press, New York, 1963.
9. "The Influence of Stress Gradient Upon Fracture of Brittle Materials," with N. A. Weil, ASME Paper No. 63-WA-228, November 1963.

10. "Analysis of the Fracture Probabilities in Nonuniformly Stressed Brittle Materials," with N. A. Weil, *Journal of the American Ceramic Society*, Vol. 47, No. 6, June 1964, pp. 268-274.
11. "Stress Distribution on the Boundary of a Circular Hole in a Large Plate Due to an Air Stock Wave Traveling Along an Edge of the Plate," with W. F. Riley, *Journal of Applied Mechanics*, Vol. 31, Series E, No. 3, September 1964, pp. 402-408.
12. "Quasi-Static Properties of a Photoviscoelastic Material," *Experimental Mechanics*, Vol. 5, No. 3, March 1965, pp. 83-89.
13. "Experimental Methods for Dynamic Stress Analysis in Viscoelastic Materials," *Journal of Applied Mechanics*, Vol. 32, Series 3, No. 3, Sept. 1965, pp. 598-606.
14. "Dynamic Properties of a Photoviscoelastic Material," *Proceedings of the Second International Congress on Experimental Mechanics*, September 28-October 1, 1965, Washington, DC; also, *Experimental Mechanics*, Vol. 6, No. 5, May 1966, pp. 225-234.
15. "Stresses Around a Circular Hole in a Viscoelastic Plate Subjected to Point Impact on One Edge," *Developments in Mechanics*, ed. by T. C. Huang and M. W. Johnson, Jr., Vol. 3, Part I, John Wiley and Sons, New York, 1966, pp. 491-547.
16. "Mechanical and Optical Characterization of Plasticized Polyvinyl Chloride," *Transactions of the Society of Rheology*, Vol. 10, Part 1, 1966, pp. 25-49.
17. "Viscoelastic Wave Interaction with Cylindrical Cavity," *Journal of the Engineering Mechanics Division*, ASCE, Vol. 92, No. EM6, Proceedings Paper 4999, December 1966, pp. 25-42.
18. "Ultrahigh-Speed Framing Photography Employing a Multiple-Pulsed Ruby Laser and a 'Smear Type' Camera: Application to Dynamic Photoelasticity," with R. E. Rowlands and C. E. Taylor, in *High-Speed Photography*, ed. by N.R. Nilsson and L. Hogberg, John Wiley and Sons, New York, 1968, pp. 275-280.
19. "Three-Dimensional Photoelastic Analysis of a Fiber-Reinforced Composite Model," with R. H. Marloff, *Experimental Mechanics*, Vol. 9, No. 4, April 1969, pp. 156-162.
20. "A Multiple-Pulse Ruby Laser System for Dynamic Photomechanics. Applications to Transmitted and Scattered-Light Photoelasticity," with R. E. Rowlands and C. E. Taylor, *Experimental Mechanics*, Vol. 9, No. 9, September 1969, pp. 385-393.
21. "Photoelastic Studies of Wave Propagation in Layered Media," *Proceedings of Instrumentation for Nuclear Weapons Effects Simulation Symposium*, Air Force Special Weapons Center, Kirtland Air Force Base, NM, AFSWC-TR-5, Vol. IV, March 1970, pp. 277-309.
22. "Photoelastic Study of Crack Propagation in Composite Models," *Journal of Composite Materials*, Vol. 4, April 1970, pp. 178-190.
23. "Photoelastic Analysis of Stresses Around Oblique Holes," *Experimental Mechanics*, Vol. 10, No. 11, November 1970, pp. 467-473.
24. "Determination of Strain Concentration in Composites by Moiré Techniques," with R. E. Rowlands, *Journal of Composite Materials*, Vol. 5, April 1971, pp. 250-254.
25. "Moiré Analysis of the Interlaminar Shear Edge Effect in Laminated Composites," with R. B. Pipes, *Journal of Composite Materials*, Vol. 5, April 1971, pp. 255-259.



26. "Wave Propagation in Layered Model Due to Point Source Loading in Low-Impedance Medium," with R. L. Marino, *Experimental Mechanics*, Vol. 11, No. 5, May 1971, pp. 210-216.
27. "Wave Propagation in Layered Model Due to Point Source Loading in High-Impedance Medium," with R. L. Marino, *Geophysics*, Vol. 36, No. 3, June 1971, pp. 517-532.
28. "Study of Lined and Unlined Cavities in Biaxially Loaded Rocks," with R. E. Rowlands, *Dynamic Rock Properties*, ed. by G. B. Clark, American Institute of Mining, Metallurgical and Petroleum Engineers, New York, 1971, pp. 877-902.
29. "Deformation and Fracture Around Lined and Unlined Cylindrical Cavities in Rock," *Experimental Mechanics*, Vol. 11, No. 10, October 1971, pp. 473-480.
30. "Three-Dimensional Photoelastic Analysis of Hypoid Gears," *Journal of Engineering for Industry*, Trans. of ASME, Vol. 93, Series B, No. 4, November 1971, pp. 1275-1279.
31. "Study of Lined and Unlined Cavities in Uniaxially Loaded Rock," with R. E. Rowlands, *Proceedings of the Second Annual Meeting of the Nuclear Survivability Working Group*, San Bernardino, CA, 1971.
32. "Application of Holography to Heterogeneous Anisotropic Composite Plates," with R. E. Rowlands, *Experimental Mechanics*, Vol. 12, No. 2, February 1972, pp. 75-82.
33. "The Embedded Strain Gage Technique for Testing Boron/Epoxy Composites," with J. L. Mullineaux, F. J. Ahimaz and T. Liber, *Composite Materials: Testing and Design*, ASTM STP 497, American Society for Testing and Materials, 1972, pp. 257-272.
34. "Experimental Stress Analysis of Composite Materials," with R. E. Rowlands, ASME Paper No. 72-DE-6, May 1972.
35. "Stress Concentration and Strength Reduction in Composite Plates with Cutouts," with R. E. Rowlands and J. B. Whiteside, *Proceedings of Conference on Fibrous Composites in Flight Vehicle Design*, AFFDL-TR-72-130, September 1972.
36. "Stress and Failure Analysis of Glass/Epoxy Composite Plate with Circular Hole," with R. E. Rowlands and J. B. Whiteside, *Experimental Mechanics*, Vol. 13, No. 1, January 1973, pp. 31-37.
37. "Higher-Order Numerical Differentiation of Experimental Information," with R. E. Rowlands, T. Liber and P. G. Rose, *Experimental Mechanics*, Vol. 13, No. 3, March 1973, pp. 105-112.
38. "Deformation and Failure of Boron/Epoxy Plates with Circular Hole," with R. E. Rowlands and J. B. Whiteside, *Analysis of the Test Methods for High Modulus Fibers and Composites*, ASTM STP 521, American Society for Testing and Materials, 1973, pp. 143-164.
39. "Mechanical Behavior of a Graphite/Epoxy Laminate Containing a Hole," with R. E. Rowlands and J. B. Whiteside, *Proceedings of the Sixth St. Louis Symposium on Composite Materials*, 1973.
40. "Strain Analysis of Composites by Moiré Methods," with R. E. Rowlands and D. Post, *Experimental Mechanics*, Vol. 13, No. 6, June 1973, pp. 246-252.
41. "Stress Analysis of Anisotropic Laminated Plates" with R. E. Rowlands, T. Liber and P. G. Rose, *Proceedings of Thirteenth International Congress of Theoretical and Applied*

- Mechanics*, Moscow, USSR, August 1972; also, *AIAA Journal*, Vol. 12, July 1974, pp. 903-908.
42. "Effects of Material and Stacking Sequence on Behavior of Composite Plates with Holes," with R. E. Rowlands and J. B. Whiteside, *Proceedings of Third International Congress on Experimental Mechanics*, 1974; also *Experimental Mechanics*, Vol. 14, No. 1, January 1974, pp. 1-9.
  43. "Geometric and Loading Effects on Strength of Composite Plates with Cutouts," with R. E. Rowlands and J. B. Whiteside, *Composite Materials: Testing and Design* (Third Conference), ASTM STP 546, American Society for Testing and Materials, 1974, pp. 361-375.
  44. "Photoelastic Study of Water Jet Impact," with R. E. Rowlands and T. J. Labus, *Proceedings of Second International Symposium on Jet Cutting Technology*, Paper A1, April 2-4, 1974, Cambridge, England.
  45. "Wave Motion in Anisotropic Media by Dynamic Photomechanics," with R. E. Rowlands and R. Prabhakaran, *Experimental Mechanics*, Vol. 14, No. 11, November 1974, pp. 433-439.
  46. "Optical Methods for Testing Composite Materials," *Proceedings*, 39th Meeting of the Structures and Materials Panel on "Failure Modes of Composite Materials with Organic Matrices and Their Consequences on Design," AGARD-NATO, Munich, West Germany, October 6-12, 1974; AGARD-CP-163, 1975.
  47. "The Effects of Thermal Cycling on Advanced Composite Angle-Ply Laminates," with T. Liber and C. C. Chamis, *Proceedings of 30th SPI Reinforced Plastics/Composites Institute*, Section 18-B, Washington, DC, February 4-7, 1975.
  48. "Speckle-Shearing Interferometric Technique: A Full-Field Strain Gage," with Y. Y. Hung and R. E. Rowlands, *Applied Optics*, Vol. 14, March 1975, pp. 618-622.
  49. "Measurement of Residual Strains in Boron/Epoxy and Glass/Epoxy Laminates," with T. Liber and C. C. Chamis, *Composite Reliability*, ASTM STP 580, American Society for Testing and Materials, 1975, pp. 340-351.
  50. "Residual Stresses in Angle-Ply Polymer Matrix Composites," *Proceedings of Workshop in Nondestructive Evaluation of Residual Stresses*, San Antonio, TX, August 13, 14, 1975, NTIAC-76-2, pp. 111-124.
  51. "Experimental Studies of Water Jet Impact," *Workshop on Application of High Pressure Water Jet Cutting Technology*, University of Missouri at Rolla, Rolla, MO, November 10-11, 1975.
  52. "On Wave and Fracture Propagation in Rock Media," with R. E. Rowlands, *Experimental Mechanics*, Vol. 15, No. 12, December 1975, pp. 449-457.
  53. "Effects of Tensile Load Cycling on Advanced Composite Angle-Ply Laminates," with T. Liber, *Proceedings of 31st SPI Reinforced Plastics/Composites Institute*, Section 21-E, Washington, DC, February 3-6, 1976.
  54. "Experimental Studies of Water Jet Impact on Rock and Rock-Like Materials," *Proceedings of Third International Symposium on Jet Cutting Technology*, Paper B3, Chicago, IL May 11-13, 1976.

55. "Measurement of Lamination Residual Strains in Graphite Fiber Laminates," with T. Liber, *Proceedings of Second International Conference on Mechanical Behavior of Materials*, ICM-II, Boston, MA, August 16-20, 1976.
56. "Relaxation of Residual Stresses in Angle-Ply Composite Laminates," with T. Liber, *Proceedings of Army Symposium on Solid Mechanics*, 1976; Composite Materials; The Influence of Mechanics of Failure on Design, South Yarmouth, MA, September 14-16, 1976.
57. "Effect of Laminate Construction on Residual Stresses in Composites," with T. Liber, *Experimental Mechanics*, Vol. 17, No. 1, January 1977, pp. 21-25.
58. "Lamination Residual Strains and Stresses in Hybrid Laminates," with T. Liber, *Composite Materials: Testing and Design (Fourth Conference)*, ASTM STP 617, American Society for Testing and Materials, 1977, pp. 331-343.
59. "Failure Mechanisms in Fiber Reinforced Composites," *Proceedings of ARPA/AFML Review of Progress in Quantitative NDE*, Cornell University, Ithaca, NY, June 14-17, 1977, AFML-TR-78-55.
60. "Effects of Mechanical and Thermal Cycling on Composite and Hybrid Laminates with Residual Stresses," *Proceedings of 14th Annual Meeting of Society of Engineering Science*, Lehigh University, Bethlehem, PA, November 14-16, 1977, pp. 237-246.
61. "Static Behavior and the Effects of Thermal Cycling in Hybrid Laminates," with T. Liber, and C. C. Chamis, *Proceedings of 32nd SPI Reinforced Plastics/Composites Institute*, Section 15-D, Washington, DC, February 8-11, 1977; also *Polymer Engineering and Science*, Vol. 18, No. 2, February 1978, pp. 157-166.
62. "Thermal Deformations and Residual Stresses in Fiber Composites," *Proceedings of 1977 International Symposium on Thermal Expansion of Solids*, Hecla Island, Manitoba, Canada, August 29-31, 1977; *Thermal Expansion 6*, ed. by Ian D. Peggs, Plenum Publishing Corp., New York, 1978, pp. 203-221.
63. "Full-Field Optical Strain Measurement Having Postrecording Sensitivity and Direction Selectivity," with Y. Y. Hung and R. E. Rowlands, *Experimental Mechanics*, Vol. 18, No. 2, February 1978, pp. 56-60.
64. "Edgeless Composite Laminate Specimen for Static and Fatigue Testing," with T. Liber, *Proceedings of 33rd SPI Reinforced Plastics/Composites Institute*, Section 12-B, Washington, DC, February 1978.
65. "Testing of Fiber Composites at High Strain Rates," with T. Liber, *Proceedings of Second International Conference on Composite Materials*, ICCM/2, Toronto, Canada, April 16-20, 1978, pp. 1003-1018.
66. "Behavior of Uniaxially Loaded Graphite/Epoxy Plates with Holes," *Proceedings of Second International Conference on Composite Materials*, ICCM/2, Toronto, Canada, April 16-20, 1978, pp. 1019-1034.
67. "Strain and Failure Analysis in Graphite/Epoxy Plates with Cracks," *Experimental Mechanics*, Vol. 18, No. 7, July 1978, pp. 246-252.
68. "Deformation and Failure of Composite Laminates with Cracks in Biaxial Stress Fields," *Proceedings of Sixth International Conference on Experimental Stress Analysis*, VDI-Berichte Nr. 313, Munich, West Germany, September 18 - 22, 1978, pp. 705-710.

69. "Nondestructive Evaluation of Composite Materials," with T. Liber, *Proceedings of Fourth International Conference on Automated Inspection and Product Control*, Chicago, IL, November 7-9, 1978, pp. 263-292.
70. "Ultrasonic Techniques for Inspecting Flat and Cylindrical Composite Specimens," with T. Liber and S.W. Schramm, *Nondestructive Evaluation and Flaw Criticality for Composite Materials*, ASTM STP 696, American Society for Testing and Materials, 1979, pp. 5-25.
71. "Wave Propagation in Transversely Impacted Composite Laminates," with T. Liber, and R. LaBedz, *Experimental Mechanics*, Vol. 19, No. 1, January 1979, pp. 9-16.
72. "Effects of Material, Geometric and Loading Parameters on Behavior of Composites," *Proceedings of 34th SPI Reinforced Plastics/Composites Institute*, Section 20-B, New Orleans, LA, January 19-February 2, 1979.
73. "Fabrication and Testing of Composite Ring Specimens," with T. Liber, R. LaBedz and T. Niiro, *Proceedings of 34th SPI Reinforced Plastics/Composites Institute*, Section 22-B, New Orleans, LA, January 29-February 2, 1979.
74. "Nondestructive Evaluation Techniques for Composite Materials," with T. Liber, *Proceedings of 12th Symposium on Nondestructive Evaluation*, San Antonio, TX, April 24-26, 1979.
75. "Nondestructive Monitoring of Flaw Growth in Graphite/Epoxy Laminates Under Spectrum Fatigue Loading," with S. W. Schramm and T. Liber, *Proceedings of ARPA/AF Review of Progress in Quantitative NDE*, La Jolla, CA, July 8-13, 1979; AFWAL-TR-80-4078.
76. "Load Introduction with Tubular Composite Structural Members," with R. Vanderby, G.M. Koller and T. Liber, *Proceedings of Third International Conference on Vehicle Structural Mechanics*, Troy, MI, October 10-12, 1979.
77. "Load Introduction Problems with Tubular Composite Structural Members," with R. Vanderby, G.M. Koller and T. Liber, *Proceedings of First International Automotive Fuel Economy Research Conference*, Department of Transportation, National Highway Traffic Safety Administration, Washington, DC, October 31-November 2, 1979.
78. "Ultrasonic Monitoring of Flaw Growth in Graphite/Epoxy Laminates Under Fatigue Loading," with S. W. Schramm and T. Liber, *Proceedings of Conference on Advanced Composites-Special Topics*, El Segundo, CA, December 4-6, 1979.
79. Behavior of Graphite/Epoxy Plates with Holes Under Biaxial Loading," *Experimental Mechanics*, Vol. 20, No. 1, January 1980, pp. 1-8.
80. "Nondestructive Characterization of Flaw Growth in Graphite/Epoxy Composites," with S. W. Schramm and W. G. Hamilton, *Proceedings of 35th Annual Conference of SPI Reinforced Plastics/Composites Institute*, Section 12-E, New Orleans, LA, Feb. 4-8, 1980.
81. "Holographically Determined Isopachics and Isochromatics in the Neighborhood of a Crack in a Glass-Composite," with R. E. Rowlands, T. D. Dudderar and R. Prabhakaran, *Experimental Mechanics*, Vol. 20, No. 2, February 1980, pp. 53-56.
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