

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
- 1997 Gold Medal, Technical University of Crete, Chania, Greece
- 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 14th 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 M. M. Frocht Award, Society for Experimental Mechanics
- 2006 Plenary speaker at 16th European Conference on Fracture, Alexandroupolis, Greece.
- 2006 Elected Associate Fellow of the American Institute of Aeronautics and Astronautics (AIAA)
- 2007 P. S. Theocaris Award, Society for Experimental Mechanics
- 2007 Elected Honorary Member of the Society for Experimental Mechanics
- 2007 Elected Fellow of the American Society for Composites
- 2008 Best paper award, Society for Experimental Mechanics
- 2009 Elected Member of the European Academy of Sciences (EAS)
- 2009 Elected Member of the European Academy of Sciences and Arts (EASA)

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
- 1996-2009 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
Experimental Solid Mechanics
Special Topics in Nano-Engineering

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, blast, fatigue)
- Stress and failure analysis (stress concentrations, joints, warpage)
- Development and verification of new failure theory
- Damage mechanics (damage characterization, damage evolution, damage accumulation, accelerated testing, life prediction)

Nondestructive Evaluation

- Ultrasonics
- Acoustic emission
- Acoustography

Acousto-ultrasonics
X-radiography
Experimental Mechanics
Photoelasticity, birefringent coatings
Moiré methods
Strain gages
Interferometry
Digital Image Correlation
Elasticity, Plasticity, Viscoelasticity, Wave propagation, Fracture
Nanotechnology
Nanocomposites, Multiscale Hybrid Nano-Microcomposites (processing, characterization, modeling)
Wind Energy applications (materials, processing, design)

FOREIGN LANGUAGES

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

SOCIETIES AND COMMITTEES

American Society of Mechanical Engineers (Fellow)
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 (Honorary Member; Fellow; Chairman, Technical Editor, 1975-77; Executive Board, 1978-80; Fracture Committee; Composites Committee; Monographs Committee; Committee on Fellows; International Advisory Board, current)
American Society of Nondestructive Testing
Society for the Advancement of Material and Process Engineering (SAMPE)
American Society for Composites (Fellow)
American Institute for Aeronautics and Astronautics (AIAA, Assoc. Fellow)
American Society for Engineering Education (ASEE)
Society of Engineering Science (SES)

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* (current).

Member of the Editorial Board of the *Journal of Composite Materials* (1999-2009).

Member of the Editorial Board of *Strain* (current).

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, Composites B, Composites Science and Technology, International Journal of Fracture, International Journal of Solids and Structures, Journal of Nondestructive Evaluation, Journal of Sandwich Structures and Materials, American Institute of Aeronautics and Astronautics, Polymer Engineering and Science, Journal of Materials Science, National Science Foundation, ONR, ARO, National Research Council.

Has attended numerous professional meetings (SEM, ASTM, ASME, ASC, SAMPE, ICF, ECF, ICM, ICCM, ICCE, AGARD, SPI, SES, 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 and plenary 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
Goodrich

Government

Air Force Wright Aeronautical Laboratories
NASA-Glenn 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
National Institute of Standards and Technology
Office of Naval Research
Air Force Office of Scientific Research
Federal Aviation Administration

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.

“Gas Flow Method for Detection of Preform Defects Based on Transient Pressure Measurement,” with S. K. Kim, US patent number 7,305,308, December 4, 2007.

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, 2006.

Major Accomplishments in Composite Materials and Sandwich Structures—An Anthology of ONR Sponsored Research, I. M. Daniel, E. E. Gdoutos and Y. D. S. Rajapakse (eds.), Springer, 2009.

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.

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

"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.

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

I. M. Daniel and E. E. Gdoutos, "Failure Modes in Composite Sandwich Beams," Chapter 9, in I. M. Daniel, E. E. Gdoutos and Y. D. S. Rajapakse (eds.), *Major Accomplishments in Composite Materials and Sandwich Structures-An Anthology of ONR Sponsored Research*, Springer, 2009, pp. 197-227.

I. M. Daniel, "Impact Response and Damage Tolerance of Composite Sandwich Structures," in A. Shukla, G. Ravichandran, and Y. D. S. Rajapakse (eds.), *Dynamic Failure of Materials and Structures*, Springer, 2010, pp. 191-233.

I. M. Daniel and J-M. Cho, "Multiscale Hybrid Nano/Microcomposites- Processing, Characterization, and Analysis," Chapter 12, in R. Gilat and L. Banks-Sills (eds.), *Advances in Mathematical Modeling and Experimental Methods for Materials and Structures*, in honor of Jacob Aboudi, Solid Mechanics and Its Applications 168, Springer, 2010, pp. 161-172.

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. N. A. Weil and I. M. Daniel, "Analysis of the Fracture Probabilities in Nonuniformly Stressed Brittle Materials," *Journal of the American Ceramic Society*, Vol. 47, No. 6, June 1964, pp. 268-274.

11. I. M. Daniel and W. F. Riley, "Stress Distribution on the Boundary of a Circular Hole in a Large Plate Due to an Air Shock Wave Traveling Along an Edge of the Plate," *Journal of Applied Mechanics*, Vol. 31, Series E, No. 3, September 1964, pp. 402-408.
12. Isaac M. Daniel, "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. Isaac M. Daniel, "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. Isaac M. Daniel, "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. R. E. Rowlands, C. E. Taylor and I. M. Daniel, "A Multiple-Pulse Ruby Laser System for Dynamic Photomechanics. Applications to Transmitted and Scattered-Light Photoelasticity," *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. Isaac M. Daniel, "Photoelastic Study of Crack Propagation in Composite Models," *Journal of Composite Materials*, Vol. 4, April 1970, pp. 178-190.
23. I. M. Daniel, "Photoelastic Analysis of Stresses Around Oblique Holes," *Experimental Mechanics*, Vol. 10, No. 11, November 1970, pp. 467-473.
24. I. M. Daniel and R. E. Rowlands, "Determination of Strain Concentration in Composites by Moiré Techniques," *Journal of Composite Materials*, Vol. 5, April 1971, pp. 250-254.
25. R. B. Pipes and I. M. Daniel, "Moiré Analysis of the Interlaminar Shear Edge Effect in Laminated Composites," *Journal of Composite Materials*, Vol. 5, April 1971, pp. 255-259.

26. I. M. Daniel and R. L. Marino, "Wave Propagation in Layered Model Due to Point Source Loading in Low-Impedance Medium," *Experimental Mechanics*, Vol. 11, No. 5, May 1971, pp. 210-216.
27. I. M. Daniel and R. L. Marino, "Wave Propagation in Layered Model Due to Point Source Loading in High-Impedance Medium," *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. I. M. Daniel and R. E. Rowlands, "Deformation and Fracture Around Lined and Unlined Cylindrical Cavities in Rock," *Experimental Mechanics*, Vol. 11, No. 10, October 1971, pp. 473-480.
30. I. M. Daniel, "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. R. E. Rowlands and I. M. Daniel, "Application of Holography to Heterogeneous Anisotropic Composite Plates," *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. I. M. Daniel and R. E. Rowlands, "Experimental Stress Analysis of Composite Materials," *Mechanical Engineering*, Vol. 94, No. 7, (ASME Paper No. 72-DE-6), 1972, pp. 58-66.
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. R. E. Rowlands, I. M. Daniel and J. B. Whiteside "Stress and Failure Analysis of Glass/Epoxy Composite Plate with Circular Hole," *Experimental Mechanics*, Vol. 13, No. 1, January 1973, pp. 31-37.
37. R. E. Rowlands, T. Liber, I. M. Daniel and P. G. Rose "Higher-Order Numerical Differentiation of Experimental Information," *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. I. M. Daniel, R. E. Rowlands and D. Post, "Strain Analysis of Composites by Moiré Methods," *Experimental Mechanics*, Vol. 13, No. 6, June 1973, pp. 246-252.
41. R. E. Rowlands, T. Liber, I. M. Daniel and P. G. Rose, "Stress Analysis of Anisotropic Laminated Plates" *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. I. M. Daniel, R. E. Rowlands and J. B. Whiteside, "Effects of Material and Stacking Sequence on Behavior of Composite Plates with Holes," *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. R. E. Rowlands, I. M. Daniel and R. Prabhakaran, "Wave Motion in Anisotropic Media by Dynamic Photomechanics," *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. Y. Y. Hung, R. E. Rowlands and I. M. Daniel, "Speckle-Shearing Interferometric Technique: A Full-Field Strain Gage," *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. I. M. Daniel and R. E. Rowlands, "On Wave and Fracture Propagation in Rock Media," *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. I. M. Daniel and T. Liber, "Effect of Laminate Construction on Residual Stresses in Composites," *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. T. Liber, I. M. Daniel and C. C. Chamis, "Static Behavior and the Effects of Thermal Cycling in Hybrid Laminates," *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. Y. Y. Hung, R. E. Rowlands and I. M. Daniel, "Full-Field Optical Strain Measurement Having Postrecording Sensitivity and Direction Selectivity," *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. I. M. Daniel, "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. I. M. Daniel, T. Liber and R. LaBedz, "Wave Propagation in Transversely Impacted Composite Laminates," *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.
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