

PREFACE

This special issue of the journal is dedicated to *fracture and damage mechanics*. It resulted from an invitation of the journal Editor-in-Chief Professor Katica (Stevanovic) Hedrih to serve as a guest editor to an issue dealing with fracture and damage mechanics, which I accepted wholeheartedly.

The issue contains twenty one papers, which can be arranged in three sections dealing with *general problems, fatigue and damage mechanics and applications of fracture mechanics to engineering problems*.

The first section on *general problems* contains ten papers. The first paper by E.E. Gdoutos *et al* discusses the fundamental principles of fracture mechanics of rubber. The characteristics of the problem related to the large nonlinear deformations of rubber and the results of an experimental study to determine the crack growth behavior and critical tearing energy of tire rubber are presented. The second paper by K. Hedrih and Lj. Peric discusses analytical solutions for piezoelectric materials containing cracks for the three modes of crack deformation. Results are presented using MATLAB. The third paper by J.F. Kalthoff deals with various aspects of the failure behavior initiated from mode-II cracks. The fourth paper by Vukobrat uses the theory of elastic directed curves to derive a set of conservation laws with applications to fracture mechanics. The fifth paper by D. Jovanovic deals with the potential energy released during crack propagation through the lattice of the material. The sixth paper by J.M. Veljkovic and R.R. Nikolic discusses the problem of an interfacial crack between a thin film and a substrate. The seventh paper by A.R. Luxmoore discusses the stable crack growth in an aluminum alloy based on the resistance-curve method of analysis. The eighth paper by D.J. Unger and E.C. Aifantis deals with the application of a special class of solutions of the two-dimensional reduced wave equation to crack problems related to gradient elasticity. The ninth paper by H.J. Schindler introduces a new constraint parameter for a simplified analysis of the elastic-plastic stress field in the neighborhood of the crack tip. The tenth paper by Marsavina and Nurse examines the problem of the plane strain asymptotic field for the interfacial free-edge joint under small scale yielding and compares it with the corresponding problem of the interface crack.

The second section on *fatigue and damage mechanics* contains six papers. The first paper by Jelaska *et al* deals with the prediction of crack initiation and crack propagation life of structural components subjected to a combined high and low cycle fatigue loading. The second paper by Rodopoulos and de los Rios studies the effect of stress ratio on the tendency of a material to short crack growth based on the principles of the fatigue damage map. The third paper by de Freitas *et al* studies the stress-strain response, crack initiation and small crack growth behavior of notched specimens under cyclic combined bending and torsion loading. The fourth paper by Labeas *et al* presents two methodologies for the study of the three-dimensional corner crack growth problem in the case of multiple site damage by performing an equivalent two-dimensional analysis. The fifth paper by Labeas *et al* introduces a methodology based on the sub-structuring technique of the finite element method to study widespread fatigue damage problems. Finally, the sixth paper by Cacko deals with modeling of material degradation and

damage mechanics for the prediction of the service or residual life of complicated machine structures under various types of loading and environmental conditions.

The third section on *applications of fracture mechanics to engineering problems* contains five papers. The first paper by Gubeljak describes the effect of strength of heterogeneous regions of welded metals on the fracture behavior of the structure. The second paper by Tsamasphyros *et al* presents a computer program for the solution of fracture mechanics problems. The program is used for the analysis of cracked or corroded metallic aircraft structures, which are repaired by composite patches. The third paper by Nakanishi *et al* deals with the study of deformation of Aramid fibers of a fiber reinforced plastic specimen during machining. The fourth paper by Marioli-Riga *et al* deals with evaluation of the sensitivity of the eddy current method for the inspection of crack propagation under a composite patch used to repair damaged metallic aircraft structures. Finally the fifth paper by Carprineri and Locidogna describes the application of the acoustic emission technique for monitoring concrete and masonry buildings.

The editor wishes to thank the authors for their willingness to contribute to this special issue of the journal dedicated to *fracture and damage mechanics* and the referees who reviewed the quality of the submitted contributions. Finally, a special word of thanks goes to the Editor-in-Chief of the journal Facta Universitatis Professor Katica (Stevanovic) Hedrih for her kind cooperation, encouragement and support.

Emmanuel E. Gdoutos
Guest Editor

The Editor-in-chief of the Journal "Facta Universitatis, Series Mechanics, Automatic Control and Robotics" expresses her warm thanks to Professor Emmanuel E. Gdoutos of the Democritus University of Thrace, Xanthi, Greece, for his efforts to edit this special issue of the journal dedicated to "Fracture and Damage Mechanics."

Katica (Stevanović) Hedrih



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Guest Editor

Professor Emmanuel E. Gdoutos was born in the island of Lesbos in Greece in 1948. He graduated from the Department of Civil Engineering of the National University of Athens (NTUA) with the degree of Master of Science in 1971 among the first of his class. He received the degree of Doctor of Philosophy in Applied Mechanics from NTUA in 1973.

Following his graduation he served as an assistant at the Chair of Applied Mechanics of NTUA during the period 1971-1974. In 1974 he was appointed as an instructor at the above Chair and the laboratory of Applied Mechanics of NTUA. In 1977 he was elected Professor at the Chair of Applied Mechanics and director of the laboratory of Applied Mechanics of the Democritus University of Thrace (DUT) in Greece, a position that he holds up to now. He held various Visiting Professor appointments in universities in USA including Lehigh University (1981-1982), University of California at Santa Barbara (1986), University of California at Davis (1987), Michigan Technological University (1987), University of Toledo (1992) and Northwestern University (1989-1990 and 1999-2002). He served as Chairman of the department of Civil Engineering and director of the section of Design and Construction of Structures and of Mechanics of DUT.

Professor E.E. Gdoutos is member of the European Academy of Sciences and Arts, fellow of the American Society of Mechanical Engineers and the New York Academy of Sciences. He is member of the editorial board of the journals: Theoretical and Applied Fracture Mechanics, Applied Composite Materials, Advanced Composites Letters, The Archive of Mechanical Engineering of Polish Academy, Facta Universitatis of the University of Nis, and Advanced Engineering Materials. He is member of the following scientific societies: Society for Experimental Mechanics of U.S.A., Optical Society of America, Greek Society of Theoretical and Applied Mechanics, American Society of Mechanical Engineers, Sigma Xi, New York Academy of Sciences, American Society of Civil Engineer, European Structural Integrity Society (representative of Greece), Greek Association of Computational Mechanics, American Academy of Mechanics, American Society of Metals, Greek Group of Fracture.

He received two Fulbright research awards to visit Lehigh and Northwestern universities. He received the Distinguished Visiting Professorship Award of the University of Toledo of USA in 1992. He is listed in "Who's Who in the World" "International Who's Who of Intellectuals," "International Who's Who in Education"; "Five Thousand Personalities of the World," "Who's Who in Greece (1993, 1995);" "Who is Who in the World," "Longman Who's Who;" "Who's Who in Science and Engineering." He is member of the editorial board of the "International Series on Advances in Fracture Mechanics," published by WIT Press. He served

as guest editor of the special issues of: *International Journal of Fracture*, Vol. 79, No.2, pp. 97-208, 1996, *Applied Composite Materials*, Vol. 3, No. 5, pp. 265-353, 1996, *International Journal of Fracture*, Vol. 98, No 3-4, 1999. He served as member of the "Structures and Materials Panel of AGARD" (1992-1997); member of the "Research Board of Advisors and Fellow of the American Biographical Institute" and vice-chairman of the Research Committee of the Democritus University of Thrace (1994-1997). He served as a reviewer in many international journals in the area of applied mechanics in the last thirty years.

He taught at many universities in Greece and USA. He visited more than fifty universities and research establishments all over the world in which he gave invited lectures, seminars and had scientific collaboration. He participated in more than sixty international conferences in the area of applied mechanics. He participated in many Erasmus and Tempus inter-university programs for the promotion of the scientific and educational cooperation among education institutes of countries of the European Union His research interest include: experimental mechanics, fracture mechanics advanced composite materials and sandwich construction. His current research projects are concerned with sandwich constructions, tearing and fatigue of elastomers, nanotechnology, composite patch repair of metallic aircraft and design and analysis of a bridge made of composite materials. He conducted extensive research work funded by many national and international organizations. He supervised more than ten PhD. students and dozens of Master students in Greece and USA. Many of his students hold faculty positions in Greek and foreign universities.

He organized many national and international conferences including the following: "International Symposium on Mechanics and Physics of Energy Density," Xanthi, 17-20/7/1989; "Fourth Greek National Congress on Mechanics," Xanthi, 26-29/6/1996; "First Hellenic Conference on Composite Materials and Structures," Xanthi; 2-5/7/1997, "Recent Advances in Mechanics," Xanthi, 4-6/7/1998; "International Symposium on Recent Advances in Mechanics-In Honor of A.N. Kounadis," Athens, 25/11/2000; "Symposium on Recent Advances in Experimental Mechanics-In Honor of Isaac M. Daniel," Virginia Polytechnic Institute and State University, 23-28/6/2002; "Symposium on Recent Advances in Composite materials-In Honor of S. A. Paipetis," Xanthi, Greece, 12-14/6/2003. He will serve of Chairman of the 16th European Conference of Fracture that will take place in Greece in 2006.

Professor Gdoutos has published over two hundred technical papers in refereed scientific journals and conference proceedings. He has published the following books: "Theory and Applications of Photoelasticity," pp. 1-127, Athens National Technical University, 1976; "Matrix Theory of Photoelasticity," pp. i-xi and 1-352, Springer Verlag, 1979 (with P.S. Theocaris); "Mechanics of Deformable Bodies - Theory of Elasticity and Strength of Materials," pp. i-xv and 1-542, Kyriakids Bros Publishers, 1979; "Kinematics," pp. i-x and 1-106, Kyriakids Bros Publishers, 1981; "Statics - Exercises, Vol. I," pp. i-xiii and 1-558, Kyriakids Bros Publishers., Thessaloniki, 1981 (with Dr. C. Calfas); "Statics - Exercises, Vol. II," pp. i-viii and 1-769, Kyriakids Bros Publishers, 1983 with Dr. C. Calfas); "Problems of the Theory of Elasticity," pp. i-xii and 1-318, Kyriakidis Bros Publishers, 1984 (with Dr. D. Zacharopoulos); "Problems of Mixed-Mode Crack Propagation," Martinus Nijhoff Publishers, pp. i-xiv and 1-204, 1984; "Statics," pp. 1-359, Kyriakids Bros Publishers, 1984; "Principles of Mechanics of Rigid Bodies-Statics," Vol. I, pp. i-xii and 1-480, Kyriakidis Bros Publishers, 1985; "Principles of Mechanics of Rigid Bodies - Statics", Vol. II, pp. i-xii and 1-492, Kyriakidis Bros Publishers, 1986; "Fracture Mechanics Criteria and Applications," pp. i-xii and 1-314, Kluwer Academic Publishers, 1990; "Fracture Mechanics - An Introduction," pp. i-xiii and 1-307, Kluwer

Academic Publishers, 1993; "Solutions Manual: Fracture Mechanics - An Introduction," pp. i-viii and 1-196, Kyriakidis Bros Publishers, 1996; "Problems of Fracture Mechanics and Fatigue," Kluwer Academic Publishers, in press (with C.A. Rodopoulos and J.R. Yates).

He has edited the following books: "Mechanics and Physics of Energy Density," pp. I-VIII and 1-209, Kluwer Academic Publishers, 1992 (with Prof. G.C. Sih,); "Proceedings of the Fourth Greek National Congress on Mechanics," Vols. I and II, pp. i-xvi and 1-1068, Kyriakidis Bros Publishers, 1995 (with P.S. Theocaris); "Proceedings of the First Hellenic Conference on Composite Materials and Structures," Vol. I, pp. i-xiv and 1-810 and Vol. II, pp. i-xvi and 1-238, Kyriakidis Bros Publishers, 1997 (with Prof. S.A. Paipetis); "Honorary Volume for Professor D.D. Raftopoulos," pp. i-xxvi and 1-562, Athanasopoulos and Papadamis Publishers, 1998.; "Recent Advances in Mechanics-Abstracts," pp. i-viii and 1-102, Athanasopoulos and Papadamis Publishers, 1998 (with Prof. A.N. Kounadis,); "Failure Analysis of Industrial Composite Materials," pp. i-xviii and 1-555, McGraw-Hill, 2000, (with K. Pilakoutas and C.A. Rodopoulos,); "Recent Advances in Applied Mechanics - Honorary Volume for Professor A.N. Kounadis," pp. i-xix and 1-349, National Technical University of Athens, 2000 (with J.T. Katsikadellis and D.E. Beskos), "Recent Advances in Experimental Mechanics - In Honor of Isaac M. Daniel," pp. i-xlvi and 1-798, Kluwer Academic Publishers, 2002; "Recent Advances in Composite Materials - In Honor of. S. A. Paipetis," pp. i- xxviii and 1-381, Kluwer Academic Publishers, 2003 (with Z.P. Marioli-Riga).

His book "Fracture Mechanics – An Introduction" is being used by many universities worldwide as a textbook for graduate courses in fracture mechanics. Also his numerous books in Greek in the area of applied mechanics are used by many Greek universities as textbooks

Professor E.E. Gdoutos promoted the Greek-Yugoslav-Polish cooperation in the area of mechanics by organizing a Greek-Yugoslav-Polish conference in Xanthi on "Recent Advances in Mechanics" in 1998 (4-6/7/1998).