

## RESUME

**NAME:** Romesh C. Batra

**U. S. CITIZEN**

Fellow - ASME, ASEE, AAM, SES

### PRESENT POSITION:

Clifton C. Garvin Professor of Engineering Science and Mechanics, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061- 0219.

Affiliate Professor of Aerospace and Ocean Engineering, Mechanical Engineering, and Materials Science

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### EDUCATION:

B.S., Mech'l Eng'g, (Gold Medalist, 1st rank in 3 states), Punjabi Univ., India, 1968.

M.A.Sc., Mech'l Eng'g, Univ. of Waterloo, Waterloo, Canada, 1969.

Ph.D., The Johns Hopkins University, Baltimore, USA, 1972.

### RESEARCH INTERESTS:

Adiabatic Shear Banding, Penetration & Impact Problems, Constitutive Relations, Smart Materials, Dynamic Fracture Mechanics, Functionally Gradient Materials, Nanotechnology/Nanoscience, Threat Mitigation, Advanced Materials

### ACADEMIC EXPERIENCE:

1994-Present, Clifton C. Garvin Prof. of Eng'g Science and Mechs., VPI&SU

1981-94, Professor; 1977 -'81, Assoc. Prof.; 1974 -'76 Assistant Prof., Univ. of Missouri - Rolla; 1976 - '77, Assistant Prof., The Univ. of Alabama, Tuscaloosa.

1973-74, Research Associate, McMaster Univ., Canada.

1972-73, Postdoctoral Associate, The Johns Hopkins Univ.

### ADMINISTRATION EXPERIENCE:

2002-Present, Director of Graduate Program

1983-Present, Director of several funded projects.

1980-Present, Organizer and Director of 4 major conferences

### VISITING APPOINTMENTS:

7/'99-1/2000, Von-Humboldt Awardee, Technical Univ. of Berlin, Germany.

May 1990, Jefferson-Smurfit Fellow, Univ. College, Ireland.

June 1987, Visiting Prof., Techn'l Univ. of Berlin, Germany.

1/'85-6/'85, Visiting Prof., Univ. of Minnesota.

9/'83-8/'84, Senior Research Fellow, Ballistic Research Lab., Aberdeen, MD.

5/'83-8/'83, Visiting Scientist, Sandia National Labs., NM.

July 1980, Visiting Professor, Univ. of Pisa, Pisa, Italy.

### TEACHING AWARDS:

Dean's list of Outstanding Teachers, Virginia Tech, almost every semester.

Outstanding Teaching Award, (\$1,000 Professional Expenses) UMR, 1988.

Letter of Commendation for Excellence in Teaching, UMR, 1991.

Exceptional Teaching Effectiveness - Letter of Commendation, UMR, 1989.

1977 Charles Henry Ratcliff Memorial Award for Excellence in Undergraduate Teaching in the Dept. of Aerospace Engr., Mech. Engr. and Engr. Mech., The Univ. of Alabama.

### HONORS & AWARDS:

2007 College of Eng'g Award for Excellence in Service

2006 D.Sc (Honoris Causa), Thapar University, India

2005 Honorary Professor, Lanzhou University of Technology, China

2005 College of Eng'g Alumni Award for Outreach Excellence

2004 Honorary Professor, Nanjing Univ. of Science & Technology, China

2004 Virginia Tech Alumni Award for Excellence in Research

2003 Frank J. Maher Outstanding Faculty Award, Dept. of Eng'g Science and Mechanics, Virginia Tech  
2003-2005 Secretary, American Academy of Mechanics  
2002-2006 Member - NRC Panel on Survivability & Lethality  
2002-2006 Member - Awards Committee, American Academy of Mechanics  
2000 Eric Reissner Medal from the Int. Soc. of Computational Eng'g. Sci. for contributions to the Mechanics of Penetration  
1996-99 Member - NRC Panel on Armor & Armaments  
1996 President of the Society of Engineering Science  
2000 Lecturer - Southwest Mechanics Series  
1998 Fellow - Society of Engineering Science, Inc. (in recognition of his many contributions in continuum mechanics and nonlinear elasticity, particularly in the dissipation phenomenon in solids.)  
1997 Virginia Tech College of Engineering Dean's Award (\$2,000) for Excellence in Research  
1993 Elected to the Johns Hopkins Society of Scholars  
1992 Recipient, Alexander von Humboldt Award for Senior Scientists  
1992 Fellow - American Society of Engineering Education  
1991 Fellow - American Academy of Mechanics (in recognition of his outstanding contributions to research and leadership in Mechanics.)  
1990 Fellow - American Society of Mechanical Engineers  
1988 Jai Krishna Award (Rupees 2500) from the Indian Soc. of Earthquake Tech. for the paper "Seismic Response of a Multistory Building Supported on Piles and a Nonlinear Soil" coauthored with a former doctoral student J. U. Khandoker.  
1993 '92, '91, '90, '89, '88, '87, Faculty Excellence Award, \$2,500, UMR  
1986 Halliburton Excellence Award, \$1,500, School of Engineering, UMR

#### **LISTING IN WHO'S WHO:**

Who's Who in America  
Who's Who in American Education  
Who's Who in Frontiers of Science and Technology  
Who's Who in the Midwest  
International Directory of Engineering Analysts, Pineridge Press, U.K.  
Who's Who in Technology Today  
International Men of Achievement  
Who's Who in Engineering  
American Men and Women in Science

#### **NSF SPONSORED PARTICIPATION IN INT. CONF.:**

Soil-Struc. Interaction, Roorkee, India, 1983  
Finite Elements in Comp. Mechs., India, 1985.  
8th Symp. on Earthquake Eng'g, Roorkee, India, 1986.  
Int. Conf. on Math. Modeling in Sci. & Tech., India, 1988.  
Int. Cong. on Theor. and Appl. Mechs., Grenoble, France, August, 21-26, 1988.

#### **SHORT COURSES TAUGHT**

Localization and Fracture Phenomenon in Inelastic Solids, Int. Center for Mechanical Sciences, Udine, Italy, (Taught 25% of one-week long course co-ordinated by P. Perzyna), October 1997.  
Adiabatic shear bands, Eglin Air Force Base, Florida, August 2001.  
Engineering and Designing Smart Structures, Virginia Tech, Roanoke, March 1998; Falls Church, Nov. 1998; Munich, Germany, March 1999; Hampton, May 1999; Dayton, Ohio, May 2000; Blacksburg, May 2001; Edinburgh, England, Nov. 2001; Cleveland, Ohio, Dec. 2001, Blacksburg, May 2002; Blacksburg, May 2003; Blacksburg, May 2004. (Organized and taught 25% of the two-day course).

#### **ORGANIZER AND CONFERENCE CHAIR/CO-CHAIR:**

23rd Meeting of the Soc. for Natural Philosophy, Univ. of Missouri-Rolla, Nov. 10-12, 1980.  
19th Annual Meeting of the Soc. of Engng Sci., Univ. of Missouri-Rolla, Oct. 27-29, 1982.  
22nd Midwestern Mechs. Conf., Univ. of Missouri-Rolla, Oct. 6-9, 1991.  
1999 ASME Mechanics & Materials Conf., Virginia Tech, June 27-30, 1999.  
2002 14th U.S. National Congress of Theoretical & Applied Mechs., Virginia Tech, June 23-28, 2002

## **GRADUATE STUDENTS' RESEARCH SUPERVISION:**

### **Doctoral:**

1. C. N. Bapat, 1983, "Plane Strain Deformations of Viscoelastic Rubber Covered Rolls."
2. J. U. Khandoker, 1984, "Seismic Response of a Multistory Building Supported on Piles and a Nonlinear Soil."
3. Pei-Rong Lin, 1988, "An Analysis of Steady State Penetration Problems by the Finite Element Method."
4. De-Shin Liu, 1989, "Dynamic Adiabatic Shear Band Development in Plane Strain Deformations of a Viscoplastic Material."
5. C. H. Kim, 1989, "Shear Strain Localization Phenomenon in Viscoplastic Materials."
6. T. Gobinath, 1990, "Finite Element Solution of Axisymmetric Penetration Problems."
7. R. Jayachandran, 1991, "Analysis of Steady State Axisymmetric Penetration Problems by the Finite Element Method Using a Mixed Formulation."
8. K.-I. Ko., 1991, "An Adaptive Mesh Refinement Technique for Two-Dimensional Problems and its Application to the Analysis of Shear Bands."
9. J. Hwang, 1992, "Analysis of Dynamic Shear Bands in Plane Strain Compression of Dipolar Thermoviscoplastic Materials by Using an Adaptively Refined Mesh."
10. X. Chen, 1993, "Finite Element Analysis of Axisymmetric Deformations of Thick Thermoviscoplastic Targets."
11. X.-T. Zhang, 1993, "Finite Element Analysis of Dynamic Shear Bands in 2-D and 3-D Deformations of Thermoviscoplastic Materials."
12. X.Q. Liang, 1997, "Dynamic Response of Linear/Nonlinear Laminated Structures Containing PZT Laminas."
13. S.S. Vel, 1998, "Analytical Solutions for the Deformation of Anisotropic Elastic and Piezothermoelastic Laminated Plates".
14. N.A. Jaber, 2000 "Finite Element Analysis of Thermoviscoplastic Deformations of an Impact Loaded Prenotched Plate".
15. T.S. Geng, 2002, "Enhancement of the Dynamic Buckling Load and Analysis of Active Constrained Layer Damping with Extension and Shear Mode Piezoceramic Actuators".
16. H.-K. Ching, 2002, "Solution of Linear Elastostatic and Elastodynamic Plane Problems by the Meshless Local Petrov-Galerkin Methods".
17. M.H. Lear, 2003, "Numerical Simulation of Adiabatic Shear Bands and Crack Propagation in Thermoviscoplastic Materials".
18. B.M. Love, 2004, "Multiscale Analysis of Failure in Heterogeneous Solids Under Dynamic Loading".
19. A. Caba, 2005, "Characterization of Carbon Mat Thermoplastic Composites: Flow and Mechanical Properties".
20. N.M. Hassan, 2005, "Damage Development in Static and Dynamic Deformations of Fiber-Reinforced Composite Plates".
21. M. Porfiri, 2006, "Analysis by Meshless Local Petrov-Galerkin Method of Material Discontinuities, Pull-in Instability in MEMS, Vibrations of Cracked Beams, and Finite Deformations of Rubberlike Materials".
22. D. Spinello, 2006, "Instabilities in Multiphysics Problems: Micro- and Nano-Electromechanical Systems, and Heat-Conducting Thermo-Elastoviscoplastic Solids".
23. A. Sears, 2006, "Carbon Nanotube Mechanics: Continuum Model Development from Molecular Mechanics Simulations".

24. W. Jiang, 2008, "Simulations of Indentation at Continuum and Atomic Levels".
25. A. G. Varghese, 2008, "Strain Localization in Tungsten Heavy Alloys and Glassy Polymers".
26. S. S. Gupta, 2009, "Elastic Constraints from Molecular Mechanics Simulations of Frequencies of Free-Free Single-Walled Carbon Nanotubes and Clamped Single-Layer Graphene Sheets".
27. A. Pacheco, 2009, "Molecular Mechanics Simulations of Instabilities in 3D Deformations of Gold Nanospecimens".
28. K. Das, 2009, "Analysis of Instabilities in Microelectromechanical Systems, and of Local Water Slamming".

**Masters:**

1. M. Hilgers, 1988, "Finite Plane Strain Thermomechanical Rolling Contact Problem for a Nonlinear Viscoelastic Cylinder."
2. A. Adam, 1991, "Effect of Viscoplastic Flow Rules and Transverse Isotropy on Steady State Penetration of Thick Targets."
3. L. D. Wang, 1993, "Analysis of Dynamic Shear Bands Under Combined Loading."
4. K. Ghosh, 1994, "Shape Control of Plates Using Piezoceramic Elements."
5. C. Adulla, 1994, "Effect of Prior Quasistatic Loading on the Initiation and Growth of Dynamic Adiabatic Shear Bands."
6. N.V. Nechitailo, 1995, "Finite Element Analysis of Failure Modes in Dynamically Loaded Pre-Cracked Steel Plates."
7. D.J. Rattazzi, 1996, "Analysis of Adiabatic Shear Banding in a Thick-Walled Steel Tube by the Finite Element Method."
8. J.B. Stevens, 1996, "Finite Element Analysis of Adiabatic Shear Bands in Impact and Penetration Problems."
9. J.G. Land, 1996, "An Axisymmetric Finite Element Solution for Elastic Wave Propagation Through Threaded Connections."
10. R. Gummalla, 1998, "Effect of Material and Geometric Parameters on Deformations of a Dynamically Loaded Prenotched Plate".
11. A. Phillip, 2001, "Finite Element Analysis of a Rotor-Shaft System".
12. L. Placidi, 2002, "Solution of St.-Venant's and Almansi-Michell's Problems".
13. W. Ballew, 2004, "Taylor Impact Test, and Penetration of Reinforced Concrete Targets by Cylindrical Reinforced Rods".
14. J.E. Thompson, 2004, "Compaction and Cure of Resin Film Infusion Prepregs".
15. S. Romano, 2005, "Three-dimensional Transient Analysis of Crack Propagation from a Void in a Thermoelastoviscoplastic Rectangular Plate", Univ. of Catania, Italy.
16. G.L. Iaccarino, 2006, "Analytical Solution of Two Traction-Value Problems in Second-Order Elasticity".

**POSTDOCTORAL RESEARCH ASSOCIATES & VISITING SCHOLARS:**

Zhu, Zhen-Guo, Ph.D.(1988) Rutgers Univ., NJ (4/89 - 6/92)  
 Kim, Chang-Ho, Ph.D.(1989) Univ. of Missouri-Rolla, (5/89 - 5/90)  
 Wang, Yiming, Ph.D.(1991) Rutgers Univ., NJ (4/91-3/92).  
 Zhang, Jianping, Ph.D.(1991) Univ. of Pittsburgh, PA (9/91-8/92)  
 Spector, A. A., Ph.D.(1991) Moscow Academy of Sciences (6/92-9/93)

Kadic-Galeb, Aida, Ph.D.(1981) Lehigh Univ., PA (4/92-3/93)  
 Wu, Li, Ph.D.(1989) Tsinghua University, China (6/92 - 3/94)  
 Ru, Chong-Qing, Ph.D.(1988) Peking University, China (11/92 - 9/94)  
 Yang, Jiashi, Ph.D.(1993) Princeton University, NJ (9/93 - 8/94)  
 Zhang, Xiang-Tong, Shanxi Mining Institute, China (5/89 - 1/90)  
 Jin, Xuesong, Southwest Jiatong Univ., China (6/92 - 9/93)  
 Huang, Yi-Nung, Ph.D. (1994) Univ. of Pittsburg (10/94-6/95)  
 Wang, J.D., Ph.D. (1992) Nagoya University, Japan (9/95-11/96)  
 Zhong, X., Ph.D. (1995) California Institute of Technology (8/95 -2/96)  
 Jin, Zhi-He, Ph.D. (1988) Tsinghua University, China (5/95-12/97)  
 Krishnaswamy, S., Ph.D. (1995) Univ. of California, Berkeley (1/96-8/97).  
 Chen, L., Ph.D. (1992) Univ. of Sci.& Tech. of China (12/96 - 9/99).  
 Oh, H.-S., Ph.D. (1996) Hanyang Univ., Korea (1/97-1/98).  
 Cheng, Zhen-Qiang, Ph.D. (1991) Univ. of Sci & Tech. of China (05/98-4/99).  
 Vidoli, S., Univ. of Roma, Italy (9/98-12/98; 2/00-7/00)  
 Yu, Jang-Horng, Ph.D. (1996) Univ. of Minnesota (1/99-8/99)  
 Vel, S.S., Ph.D. (1998) Virginia Tech (1/99-8/00)  
 Jiang, B., Ph.D. (1998) Tsinghua Univ. (12/99-5/01).  
 Marur, P.R., Ph.D. (1998) Auburn Univ. (2/02-1/03).  
 Wei, Z., Ph.D. (2001) Univ. of Sci. & Tech. of China (4/02-8/05).  
 Qian, L.F., Nanjing Univ. (4/02-4/03).  
 Jin, J., Nanjing Univ. (2/03-2/04).  
 Zhang, G.M., Univ. of Sci. & Tech. of China (6/03-3/07)  
 Li, S.R., Ph.D. (2003) Lanzhou University (2/04-1/05).  
 Yan, L.H., Ph.D. (2003) NUDT, China (5/04-11/04).  
 Wang, Z.C., (2004) Virginia Tech. (6/04-2/05).  
 Yoo, Y.M., Ph.D. (2004) Univ. of Seoul, Korea (12/04-11/05).  
 Love, B.M., Ph.D. (2004) Virginia Tech. (1/05-6/05).  
 Pohit, G., Ph.D. (2000) Jadvarpur Univ. (9/05-10/05).  
 Ray, M.C., Ph.D. ( ) IIT Kharagpur (5/06-6/06; 5/07-7/07).  
 Qin, Z. M., Ph.D. (2002) Virginia Tech (5/07-1/08).  
 Hasanyan, D., Ph.D. (1990) (5/07-8/07).  
 Jiang, W., Ph.D. (2008) Virginia Tech (7/08-6/09).  
 Varghese, A., Ph.D. (2008) Virginia Tech (10/08-9/09).  
 Nie, Guojun, Ph.D. (2002) Tongi Univ. (9/08-9/09).  
 Fang, H.W., Nanjing Univ. (9/08-9/09).  
 Zhang, M., Beijing Inst. Technology (9/08-9/09).

#### **TEXT BOOK**

R.C. Batra, *Elements of Continuum Mechanics*, AIAA Publishers, August 2005.

#### **BOOKS EDITED**

1. R. C. Batra, *Contemporary Research in Engineering Science*, Springer-Verlag, Berlin, Heidelberg, New York, etc., pp. 685, 1995.
2. R. C. Batra, A. K. Mal and G. P. MacSithigh, *Impact, Waves and Fracture*, ASME Press, pp. 481, 1995.
3. A. M. Rajendran and R. C. Batra, *Constitutive Laws: Theory and Applications*, CIMNE, Barcelona, pp. 301, 1995.
4. R. C. Batra and H. M. Zbib, *Material Instabilities: Theory and Applications*, ASME Press, 1994.
5. R. C. Batra and G. P. MacSithigh, *Recent Developments in Elasticity*, AMD-Vol. 124, ASME Press, pp. 107, 1991.
6. H. M. Zbib, T. G. Shawki and R. C. Batra, *Material Instabilities*, Applied Mechs. Reviews, Vol. 45, No. 3(2), pp. 173, March 1992.

7. R. Armstrong, R. C. Batra, M. Meyers and T. W. Wright, *Shear Instabilities and Viscoplasticity Theories*, A Special Vol. of the Mechanics of Materials J., Vol. 17, (Nos. 2, 3), pp. 83-328, March 1994.
8. R. C. Batra and T. W. Wright, *Finite Deformation Viscoplasticity*, ASME Press, MD-Vol. 69-1, 1995.
9. R. C. Batra and M. F. Beatty, *Contemporary Research in the Mechanics and Mathematics of Materials*, CIMNE, Barcelona, Spain, pp. 500, 1996.
10. R. C. Batra, Y. D. S. Rajapakse and A. Rosakis, Failure Mode Transition Under Dynamic Loading, a special issue of the *Int. J. Fracture* **101**, 1-180, 2000.

#### **BOOKS OF ABSTRACTS EDITED:**

1. R. C. Batra and R. L. Davis, *ABSTRACTS - Proc. 19th Annual Meeting of the Society of Engng Sci.*, Univ. of Missouri-Rolla, Rolla, Oct. 1982, pp. 210.
2. R. C. Batra and B. F. Armary, *Recent Developments in Mechs.*, Vol. 16, *Proc. 22nd Midwestern Mechs. Conf.*, Univ. of Missouri-Rolla, Rolla, Oct. 1991, pp. 635.
3. R. C. Batra and E. G. Henneke, *ABSTRACTS - Proc. 1999 ASME Mechanics and Materials Conf.*, June 1999, pp. 480.
4. R. C. Batra and E. G. Henneke, *Contemporary Research in Theoretical and Applied Mechanics, 14th U.S. National Congress of Theoretical and Applied Mechanics*, June 2002, pp. 649.

#### **CLASS-NOTES PUBLISHED:**

1. R. C. Batra, *Finite Element Approximation*, pp. 123, 1994, 2000, 2005.

#### **CHAPTERS IN BOOKS:**

R. C. Batra, M. Porfiri and D. Spinello, Pull-in Instability in Electrostatically Actuated MEMS, in *Advances in Multiphysics Simulation of MEMS and NEMS* (Eds.: Aluru N., Cercignani C., Frangi A., Mukherjee S.) World Scientific, pp. 329-374, 2008.

R. C. Batra, Numerical Solution of Initial-Boundary-Value Problems with Shear Strain Localization in *Localization and Fracture Phenomenon in Inelastic Solids* (P. Perzyna, ed.), pp. 301-389, Springer-Verlag, Wien, New York, 1998

#### **PROFESSIONAL ACTIVITIES:**

Co-Editor-in-Chief, *Int. J. Computational Methods*, 1/04- )  
 Editor - *Mathematics and Mechanics of Solids* (1/95 - )  
 Member - Editorial Advisory Board, *Int. J. Plasticity* (1/90 - 12/03)  
 Member - Editorial Advisory Board, *Computational Mechanics* (4/94 - )  
 Member - Editorial Advisory Board, *Polish J. Theoretical and Applied Mechanics* (1/2000- )  
 Member - Editorial Board, *Continuum Mechanics & Thermodynamics* (6/92 - 12/04)  
 Member - Editorial Board, *Computer Modeling in Engineering & Sciences* (1/2003 - )  
 Associate Technical Editor - *ASME J. Eng'g Mat'l & Tech.*, (1/96 - 12/00)  
 Member - Editorial Board, *Mathematical Modelling & Scientific Computing* (10/96- )  
 Chairman - *ASME Elasticity Committee* (1995 - 2000)  
 Member - Editorial Committee, *SECTAM* 1996.  
 Member - NSF Review Panel for Proposals.  
 Director - *Society of Engineering Science, Inc.* (1/91 - 12/96)  
 Director - *Midwestern Mechanics Conference Board*, 1987-1993; Chairman 1989-91.

**Referee for** *ASME J. of Applied Mechanics*, *Int. J. Num. Meth. Engng.*, *Canadian J. of Civil Engineering*, *AIAA J. of Thermophysics and Heat Transfer*, *Experimental Mechs.*, *Int. J. Solids and Structures*, *Int. J. Plasticity*, *Int. J. Nonlinear Mechs.*, *J. of Elasticity*, *J. Mechs. Physics Solids*, *Int. J. Engng Sci.*, *J. Mathematical & Physical Sci.*, *Mechs. Research Communications*, *Acta Mechanica*, *Computational Mechs.*, *Computer Methods in Appl. Mechs. & Eng'g.*, *Int. J. Impact Eng'g.*, *ASME J. Eng'g Materials & Tech.*, *ASCE J. Eng'g Mechs.*, *J. Nonlinear Vibrations*, *J. Vibrations & Control*, *Smart Materials and Structures*, *AIAA J.*, *Mechs. of Composite Materials & Structures*, *Indian J. Pure & Appl. Math.*, *J. Sound & Vibration*.

**Reviewer for** *Applied Mechs. Reviews* (1973-78), *Shock and Vibration Digest* (1972-74)