Abhishek Kumar

Contact Information

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Research Interests

Computational Material Science, Computational Solid Mechanics, Finite Element Method, Additive Manufacturing, Energy Storage

Education

University of Michigan, Ann Arbor, Michigan USA

Ph.D., Aerospace Engineering, January 20111 - August 2014

- GPA 4.0/4.0
- Dissertation Topic: "Multiscale modeling and design of magnetoelastic microstructures"
- Advisor: Prof. Veera Sundararaghavan

University of South Florida, Tampa, Florida USA

M.S., Engineering Mechanics, January 2006 - August 2007

- GPA 4.0/4.0
- Dissertation Topic: "RKEM implementation for strain gradient theory in multiple dimensions"
- Advisor: Prof. Daniel Simkins

Indian Institute of Technology (I. I. T. B.H.U), Varanasi, India

B. Tech., Mechanical Engineering, July 2000 - June 2004

- GPA 8.4/10.0

Honors and Awards

- NSF Travel support to attend the McMat2015 conference, 2015
- Young Investigator Fellowship,11th World Congress on Computational Mechanics to be held in Barcelona, Spain, Travel Grant, 2014
- Distinguished Academic Achievement Award, College of Engineering, University of Michigan, 2014
- Ivor K. McIvor Award for outstanding research and scholarship in Applied Mechanics, College of Engineering, University of Michigan. 2014
- Young Investigator Fellowship,12th US National Congress on Computational Mechanics, Travel Grant, 2013
- National Science Foundation Fellowship to the attend Summer Institute Course on Material Genome Initiative, 2013
- Nominated for Richard and Eleanor Towner Prize for Outstanding Ph.D. Research, Aerospace Department, University of Michigan, 2013
- Nominated for the Outstanding Graduate Student Instructor(GSI) College of Engineering, University of Michigan, 2012 ,2013 and 2014
- Fellowship given by IUTAM to attend summer school on Biomechanics held at Purdue University, 2012
- Best student presentation award 5th Ablation Workshop held at Lexington, KY, 2012
- Young Investigator Fellowship, 11th US National Congress on Computational Mechanics, Travel Grant, 2011
- Member of Engineering Honor Society TAU BETA PI and PHI KAPPA PHI
- Civil Engineering Graduate Fellowship, University of South Florida, 2006

- First Prize in National Level Design Contest held at IT BHU, Varanasi, India, 2002, 2004

Research Experience

- **Post-doc Researcher, Oak Ridge National Laboratory**, Aug 2014 - Present
  - Multi-physics Modeling for Lithium ion batteries for crash safety
    - Developed mechanical model to study short circuit in the cell under impact loading.
    - Worked on VIBE a multi-physics coupling and time integration simulation environment for batteries to study new chemistries and configuration for Lithium-ion batteries.
- **Research Assistant, University of Michigan**, Jan 2011 - Aug 2014.
  - Multi-scale Modeling of Magnetostrictive Alloys (Thesis Topic)
    - Developed multiscale computational methodologies to optimize microstructures of the magnetostrictive iron-gallium alloy Galfenol.
    - Worked to develop a finite element homogenization technique to calculate microstructuresensitive response under coupled magnetic and stress fields.
    - Design deformation processes that can lead to high magnetostriction and strength in the final product
  - Atomistic Modeling of Polymer Composites
    - Studied Mechanical and Thermal Behavior of epoxy composites using Molecular Dynamics (MD) approach
    - Compared the result obtained from MD with experimental results available in literature and theoretical models
    - Developed a new model to predict failure in polymer material using phonon-dispersion curve
  - Probabilistic Modeling of Microstructures
    - Worked to create a probabilistic FEM scheme to simulate evolution of polycrystalline microstructures during deformation.
    - Worked on a new model known as Conditional Orientation Correlation Function(COCF) similar to Orientation Distribution function (ODF)
    - Compared the texture and strain obtained by COCF with that obtained by ODF

Academic Experience

- **Center for Research Learning and Teaching,University of Michigan, Engineering Teaching Consultant, Ann Arbor, Sept 2013 - May 2014**.
  - Consulted Graduate Student Instructor (GSIs) and Instructional Aids (IAs) on methods for implementing educational techniques to engage students in various educational settings including classrooms, labs and office hours
  - Performed observations and obtain midterm student feedback for GSIs and IAs to help instructors improve the student learning environment.
- **University of Michigan Graduate Student Instructor (GSI)Ann Arbor, MI, Aug 2011-Dec 2012**
  - Conducted problem solving and tutorial sessions on the basic Solid and Structure course for sophomore/junior aerospace engineering students.
  - Worked as GSI for AEROSP 315,Aircraft and Spacecraft Structures under Prof. Carlos Cesnik in Fall 2012

Publications

1. John Turner, Srikanth Allu, Mark Berrill, Wael Elwasif, Sergiy Kalnaus, Abhishek Kumar, Damien Lebrun-Grandie, Sreekanth Pannala, Srdjan Simunovic Safer Batteries through Coupled Multiscale Modeling Procedia Computer Science (2015) 1168-1177
2. V Sundararaghavan, A Kumar, S Sun Crystal plasticity simulations using nearest neighbor orientation correlation function *Acta Materialia (2015) 12-23*
3. Ruoqian Liu, Abhishek Kumar, Zhengzhang Chen, Ankit Agrawal, Veera Sundararaghavan, Alok Choudhary, A predictive machine learning approach for microstructure optimization and materials design *Scientific reports, Nature Publishing Group (2015)*
4. Abhishek Kumar, Veera Sundararaghavan and A.R.Browning Thermal Conductivity of polymers using Molecular Dynamics Simulation *Modeling and Simulations in Material Science and Engineering (2014) 22 (2), 025013*,
5. S. Ghosh, A. Kumar, V. Sundararaghavan, A.M. Waas, Non-local Linear Elastic Modeling of Epoxy using atomistic kernel, *International Journal of Solids and Structures*, 50(2013) pp. 2837-2845
6. Veera Sundararaghavan and Abhishek Kumar, Molecular Dynamics Simulations of Compressive Yielding in Cross-linked Epoxies in the Context of Argon Theory, *International Journal of Plasticity*, 47(2013) pp. 111-125
7. Veera Sundararaghavan and Abhishek Kumar, Probabilistic modeling of microstructure evolution using finite element representation of statistical correlation functions, *International Journal of Plasticity*, 30-31(2012) pp. 62-80
8. Daniel C. Simkins, Abhishek Kumar, Nathan Collier and Lisa B. Whitenack, Geometry Representation, Modification and Iterative Design Using RKEM *Computer Methods in Applied Mechanics and Engineering*, 196(2007) pp. 4304-4320.
9. Kalyanmoy Deb, Abhishek Kumar Interactive evolutionary multi-objective optimization and decision-making using reference direction method *Proceedings of the 9th annual conference on Genetic and evolutionary computation 2007/7/7 pp. 781-788*

Conference Presentations

1. A reduced-order model of Titanium alloy for the control of microstructure-sensitive material properties, 12th US National Congress on Computational Mechanics, Rayleigh, North Carolina, July 2013.
2. Computational Approaches for Multi-scale Design of Magnetostrictive Alloys Galfenol, PACAM 2013, Houston, Texas, May 2013.
3. Mechanical Behavior of DGEBA-DAPSONE Epoxy Networks from Molecular Dynamics Simulations, TMS 2012, Orlando, Florida, Feb 2012.
4. (Invited) Study of Mechanical and Thermal Behavior of Polymeric Ablator using Molecular Dynamics, Proceedings of the 5th Ablation Workshop,Lexington, Kentucky, February 28 March 1, 2012.
5. 1st Order Statistical approach for Microstructure design to Fiber Reinforced Composite Materials , US National Congress on Computational Mechanics, Minneapolis, Minnesota, July 2011.
6. RKEM Implementation for Strain Gradient Theory in Multiple Dimensions, 11th US National Congress on Computational Mechanics, San Francisco,, California, July. 2007.

Professional Experience

- **Coop,Frontier Research Department(FRD),Toyota Technical Center, Ann Arbor, MI**
  Sept 2013 - May 2014
  Worked in FRD department for Multiphase material modeling for optimum material properties using commercial software such as Abaqus, Digimat, Alphastar and LsDyna, also involved in investigation of additive manufacturing techniques which can be aid in concept of 'material by design'
- **EDI Consultant,Soho Square Solutions, NYC, NY**
  Aug 2007 - Dec 2010
  Worked as a Counsltant on various EDI software Gentran, IBM WTX, See Burger etc. for configuration of supply chain across various divisions of companies such as inventory, procurement and sales for clients such as HP, Sherwin Williams, Inovis and Crayola. Trained other consultant on these technology to expand the business.
- **Research Engineer, Gas Turbine Research Establishment GTRE), Bangalore, India**
  Aug. 2004 - Dec. 2005
  Worked on Mechanical Design and Testing of Gearbox to be used in fighter aircraft engine.

Computer Skills

- Languages: C, C++, Operating Systems: Windows 2000/ XP, LINUX
- Finite Element Analysis: Extensive experience in the development of user codes for multi-scale finite element analysis,large strain homogenization, design optimization, statistical learning and reduced-order modeling.
- Parallel computing: MPI (Message Passing Interface), OPENMP (for multi-threading)
- Experienced in a variety of commercial/educational packages: ABAQUS, MATLAB, PETSc, LaTeX, TecPlot, Digimat,DiffPack, LAMMPS, and GULP.

Coursework

- Structures : Solid Mechanics, Non-linear Solid Mechanics, Structural Analysis, Finite Element Methods, Advanced Finite Element Methods, Elastic Stability, Structural Dynamics, Mechanics of composites, Theory of Plasticity,Multifunctional Materials and Structures
- Material Science: Atomistic Modeling of Materials, Advanced Mechanical Behavior
- Math: Numerical Methods in Scientific Computing, Analytical Methods in Mechanics