Naveen V Nair

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Michigan State University,
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RESEARCH INTERESTS

- *Computational Methods:* Novel discretization techniques, Basis function design, Time domain methods.
- *Numerical Analysis:* Numerical Integration, Iterative Solutions, Eigen analysis.
- *Integral Equations:* Approximation errors, Existence and Convergence, Non-smooth geometries, Time-domain stability and accuracy.
- *Muli-Physics and Inverse Problems:* Wave-diffusion transforms, Stability, Regularization, Inverse heat conduction, Maximum entropy techniques.
- *Nondestructive Evaluation and Sensor design*
- *Signal and Image Processing*

EMPLOYMENT

- **Visiting Research Associate** *March 2011 – present*
  Electromagnetics Laboratory, Department of Electrical and Computer Engineering,
  Michigan State University, East Lansing, MI.
- **Visiting Research Associate** *March 2011 – present*
  Electromagnetics Laboratory, Department of Electrical and Computer Engineering,
  Michigan State University, East Lansing, MI.
- **Research Assistant** *August 2007 – March 2011*
  Electromagnetics Laboratory, Department of Electrical and Computer Engineering,
  Michigan State University, East Lansing, MI.
- **Instructor:** *May 2007 – August 2007, May 2008 – August 2008*
  ECE 305 Electromagnetics, Department of Electrical and Computer Engineering,
  Michigan State University, East Lansing, MI.
- **Research Assistant** *June 2003 – May 2007, May 2008 – August 2008*
  Nondestructive Evaluation Laboratory, Department of Electrical and Computer Engineering,
  Michigan State University, East Lansing, MI.

EDUCATION

Michigan State University, East Lansing, MI 48824, USA

Doctor of Philosophy in Electrical Engineering, **2010**

- Advisors: Professor Shanker Balasubramaniam and Dean Satish S. Udpa
- Thesis Title: Development of the Generalized Method of Moments: A novel discretization scheme for integral equations.

Indian Institute of Technology Madras, Chennai, INDIA

Master of Technology in Mechanical Engineering, **2003**

Bachelor of Technology in Mechanical Engineering, **2003**

- Advisor: Professor Krishnan Balasubramaniam
- Thesis Title: A Maximum Entropy Based Solution to the Inverse Heat Conduction Problem.

REFEREED JOURNAL PAPERS

1. **N. V. Nair**, B. Shanker and L. Kempel, "Generalized Method of Moments: A novel framework for analyzing acoustic scattering from complex objects using a locally smooth surface parametrization and adaptive basis spaces," Submitted to *Journal of the Acoustical Society of America*, 2011, *preprint available: http://arxiv.org/pdf/1107.3526*

2. A. J. Pray, **N. V. Nair**, and B. Shanker, "Stability properties of the time domain electric field integral equation using a separable approximation for the convolution with the retarded potential," *to appear in IEEE transactions on Antennas and Propagation* 2012. *preprint available on request.*

3. **N. V. Nair** and B. Shanker, "Generalized Method of Moments: A Novel Discretization Technique for Integral Equations," *IEEE Transactions on Antennas and Propagation*, vol. 59(6), 2011, pp. 2280-2293.

4. **N. V. Nair** and B. Shanker, "Generalized method of moments: a framework for analyzing scattering from homogeneous dielectric bodies," *Journal of the Optical Society of America, A*, vol. 28 (3), pp. 328-340.

5. O. Tuncer, C. Lu, **N. V. Nair**, B. Shanker and L. Kempel, "Further Development of Vector Generalized Finite Element Methods and its Hybridization with Boundary Integrals," *IEEE Transactions on Antennas and Propagation*, vol. 58(3), 2010, pp. 887-899.

6. A. Tamburrino, Y. Tian, **N. V. Nair** and S. Udpa, "Interfaces Removal for Time-of-Flight Eddy Current Testing: The Planar Geometry Case," *International Journal of Applied Electromagnetics and Mechanics*, vol. 25, No. 1, 2007, pp.307-312 .

7. **N. V. Nair**, Melapudi, V.R., Jimenez, H.R., Liu, X., Deng, Y., Zeng, Z., Udpa, L., Moran, T.J., Udpa, S.S, "A GMR-Based Eddy Current System for NDE of Aircraft Structures," *IEEE Transactions on Magnetics*,vol. 42(10), 2006, pp. 3312-3314.

8. Y Tian, S S Udpa, **N. V. Nair** and S Ramakrishnan, “Modeling of Electromagnetic Heating Effects During in vivo Testing of Prosthetic Heart Valves,” *IEEE Transactions on Magnetics*, vol. 42(10), 2006, pp. 3563-3565.

9. S C Chan, R Clifford, S Majumdar, **N. V. Nair**, S Ramakrishnan, Y Li, P Ramuhalli, L Udpa, S Udpa, “Novel Methods for Detecting Fractures in Prosthetic Heart Valves,” *Insight*, vol. 47 (1), 2005, pp. 15-19.

10. **N. V. Nair**, A. J. Pray, B. Shanker, and D. R. Wilton, “A Singularity Cancellation Technique on Arbitrary Higher Order Surface Descriptions”, to be submitted to *IEEE Antennas and Propagation Letters*, 2011, *preprint available on request.*

11. **N. V. Nair**, M. Vikram, and B. Shanker, ”A flexible and adaptive integral equation framework for the solution of scattering from metallic objects using the Generalized Method of Moments and a locally smooth surface parametrization,” to be submitted to *IEEE Transactions on Antennas and Propagation*, 2011.

REFEREED CONFERENCE PROCEEDINGS

1. **N. V. Nair** and B. Shanker, “Generalized Method of Moments: A flexible discretization scheme for integral equations using locally smooth surface approximations,” to appear in *Proceedings of the IEEE International Conference on Microwaves, Communications, Antennas and Electronic Systems,* Tel Aviv, Israel, November 7-9, 2011.

2. **N. V. Nair** and B. Shanker, “ A Discretization Framework for Scalar Integral Equations Using the Generalized Method of Moments and Locally Smooth Surface Approximations,” *Proceedings of the IEEE International Antennas and Propagation Symposium*, Spokane, WA, July 3-8, 2011.

3. **N. V. Nair** and B. Shanker, “Locally Smooth Surface Meshes for Electromagnetic and Acoustic Integral Equations,” *Proceedings of the IEEE International Antennas and Propagation Symposium*, Spokane, WA, July 3-8, 2011.

4. **N. V. Nair** and B. Shanker, “ A Novel Discretization Scheme for Electromagnetic Integral Equations Using the Generalized Method of Moments and Locally Smooth Surface Approximation,” *Proceedings of the IEEE International Antennas and Propagation Symposium*, Spokane, WA, July 3-8, 2011.

5. **N. V. Nair**, B. Shanker and A. Boag, “Novel Representation of the Retarded and the Helmholz Potential, and Development of Corresponding Accelerators,” *Proceedings of the IEEE International Antennas and Propagation Symposium*, Spokane, WA, July 3-8, 2011.

6. A. J. Pray, **N. V. Nair**, M. Vikram, M. Lu, B. Shanker and E. Michielssen, “ A Parallel Implementation of the PWTD Algorithm for Time-Domain Electromagnetic Simualtions,” *Proceedings of the IEEE International Antennas and Propagation Symposium*, Spokane, WA, July 3-8, 2011.

7. C. Meierbachtol, **N. V. Nair**, T. A. Grotjohn and B. Shanker, “Multi-Physics Modeling of a Microwave Plasma-Assisted Chemical Vapor Deposition Reactor for Diamond Growth ,” *Proceedings of the IEEE International Antennas and Propagation Symposium*, Spokane, WA, July 3-8, 2011.

8. A. J. Pray, **N. V. Nair** and B. Shanker, “A Separable Approximation for Convolution with the Retarded GreenâĂŹs Function and Its Application to Time Domain Integral Equations,” *Proceedings of the IEEE International Antennas and Propagation Symposium*, Spokane, WA, July 3-8, 2011 (**Best Student Paper - Finalist)**.

9. A. Baczewski, **N. V. Nair** and B. Shanker, “Towards Integral Equation Methods for Periodic Structures with Finite Perturbations Using Accelerated Cartesian Expansions,” *Proceedings of the IEEE International Antennas and Propagation Symposium*, Spokane, WA, July 3-8, 2011.

10. C. Meierbachtol, **N. V. Nair**, T. A. Grotjohn and B. Shanker, “Modeling of convective plasma flow in high pressure microwave PACVD diamond reactors,” *IEEE international Conference on Plasma Science (ICOPS), 2011*, June 26-30, 2011.

11. O. Tuncer, **N. V. Nair** and B. Shanker, “A generalized basis function framework for integral and differential equations in electromagnetics,” *Loughborough, Antennas and Propagation Conference*, Loughborough, Nov. 8-9, 2008, pp. 9-12.

12. **N. V. Nair**, A. J. Pray and B. Shanker, “Analysis of transient scattering from PEC objects using the Generalized Method of Moments,” *Proceedings of the IEEE International Antennas and Propagation Symposium*, Toronto, CANADA, July 11-17, 2010 (**Best Student Paper - Finalist)**.

13. **N. V. Nair** and B. Shanker, “A Generalized Method of Moments based discretization of the Müller Integral Formulation,” *Proceedings of the IEEE International Antennas and Propagation Symposium*, Toronto, CANADA, July 11-17, 2010.

14. **N. V. Nair**, B. Shanker and L. C. Kempel, “ Discretization of the PMCHWT Integral Equation using the Generalized Method of Moments,” *International Review of Progress in Applied Computational Electromagnetics*, 2010.

15. **N. V. Nair**, A. J. Pray, M. Vikram and B. Shanker, “Parallel Generalized Method of Moments for Analysis of Transient Scattering from PEC Objects,” *Proceedings of the Electromagnetics Theory Symposium*, 2010.

16. **N. V. Nair** and B. Shanker, “An Accurate and Low-Frequency Stable Discretization Scheme for the Electric Field Integral Equation Using the Generalized Method of Moments,” *IEEE International Antennas and Propagation Symposium*, Charleston, SC, June 1-5, 2009 **(Best Student Paper - Honorable mention)**.

17. **N. V. Nair**, M. Vikram and B. Shanker, “ Implementation of Generalized Method of Moments,” *IEEE International Antennas and Propagation Symposium*, Charleston, SC, June 1-5, 2009.

18. **N. V. Nair**, M. Vikram and B. Shanker, " A robust generalized method of moments scheme for electromagnetic analysis," *25th Annual review of Progress in Applied Computational Electromagnetics*, March 2009 (Invited).

19. **N. V. Nair**, M. Vikram and B. Shanker, "Mathematical Analysis of the Augmented Electric Field Integral Equation Operators," *IEEE International Antennas and Propagation Symposium*, San Diego, July 5-12, 2008.

20. **N. V. Nair** and B. Shanker, "A Generalized Solution Scheme for Integral Equations," *IEEE International Antennas and Propagation Symposium*, San Diego, July 5-12, 2008.

21. O. Tuncer, **N. V. Nair** and B. Shanker, "Dispersion Analysis in Scalar Generalized Finite Element Method," *IEEE International Antennas and Propagation Symposium*, San Diego, July 5-12, 2008.

22. **N.V. Nair**, M. Vikram, B. Shanker, L. C. Kempel, "Generalized Method of Moments for Analysis of Structures with Mixed Feature Sizes," *2nd European Conference on Antennas and Propagation*, Nov. 11-16, 2007 (invited).

23. **N.V. Nair**, C. Lu and B. Shanker, "Differential and integral equation solvers based on generalized moments and partitions of unity," *International Conference on Electromagnetics and Advanced Applications*, Sept. 17-21, 2007, pp. 974-977 (invited).

24. O. Tuncer, C. Lu, **N. V. Nair**, B. Shanker, and L. C. Kempel, "Analysis of error propagation in vector generalized finite element methods," *International Conference on Electromagnetics and Advanced Applications*, Sept. 17-21, 2007, pp. 822-835 (invited).

25. M. Vikram, **N. Nair**, R. Clifford, S. S. Udpa, and L. Udpa, "Development of a Prototype âĂIJFreeScanâĂİ System for Giant Magneto-Resistive Eddy Current Inspection of Aircraft Structures," *Proceedings of 2007 International Society of Electromagnetics and Mechanics*, Sept. 2007, pp. 175-176.

26. **N. Nair**, A. Tamburrino, L. Udpa, and S. S. Udpa, "An Interface Removal Transformation: The Vector Case," *Review of Quantitative Nondestructive Evaluation*, D. O. Thompson and D. E. Chimenti, Eds., American Institute of Physics, vol. 894, Portland, OR, 2007, pp. 325-331.

27. V. R. Melapudi, **N. V. Nair**, S. S. Udpa, Lalita Udpa and William P. Winfree, "Imaging and Modeling Techniques for Terahertz Inspection of NASA SOFI," *Review of Quantitative Nondestructive Evaluation*, D. O. Thompson and D. E. Chimenti, Eds., American Institute of Physics, vol. 894, 2007, pp. 401-407.

28. **N. V. Nair**, A. Tamburrino, L. Udpa, and S. S. Udpa, "Interface Removal for Planar Geometries: The Vector Case," *Review of Quantitative Nondestructive Evaluation*, vol. 26, Ed. By D. O. Thompson and D. E. Chimenti, American Institute of Physics, 2007, pp. 325-331.

29. A Tamburrino, **N. Nair**, S S Udpa, L Udpa, “Experimental Extraction of Time-of-Flight from Eddy Current Testing Data,” *Studies in Applied Electromagnetics and Mechanics*, vol. 26, IOS press, 2006, pp. 67-74.

30. S Majumdar, S Ramakrishnan, **N. Nair**, S C Chan, R Clifford and S S Udpa, “A Modified FFT Algorithm for Efficient Computation of Narrow Band Spectrum,” *IEEE Conference on Electro-Information Technology*, East Lansing, MI May 2006, pp. 552-557

31. A Tamburrino, Y Tian, **N Nair** and S Udpa, “An Interface Removal Transformation for TOF Extraction from Eddy Current Signals : The scalar case,” *International Symposium on Electric Biomechanical and Biomedical Problems*. Bad Gastein, Austria, September, 2005, pp. 307-312.

32. **N. Nair**, V Melapudi, S Ramakrishnan, L Udpa, S S Udpa and W P Winfree, “A Wavelet Based Signal Processing Technique for Image Enhancement in Terahertz Imaging,” in *Review of Progress in Quantitative Nondestructive Evaluation*, AIP 2005, pp. 492-499.

33. S. C. Chan, M. Oka, R. Clifford, S. Majumdar, **N. Nair**, S. Ramakrishnan, Y. Li, P. Ramuhalli, L. Udpa and S. S. Udpa “In Vitro Testing of a System for the Evaluation of Prosthetic Heart Valves,” in *Studies in Applied Electromagnetics and Mechanics*, IOS press, vol 25, 2005, pp. 253-257.

34. **N. Nair**, S Ramakrishnan, R Clifford, Y Li, S Majumdar, S C Chan, P Ramuhalli, L Udpa, S S Udpa, “A Beat Frequency Electromagnetic Acoustic Transduction Technique for Detecting Strut Fractures in Prosthetic Heart Valves,” in *Studies in Applied Electromagnetics and Mechanics*, IOS press, vol 25, 2005, pp. 211-215.

35. S Ramakrishnan, **N. Nair**, R Clifford, S Majumdar, S C Chan, Y Li, P Ramuhalli, L Udpa and S S Udpa, “An Electromagnetic Acoustic Transduction Technique for Detecting Strut Fractures in Artificial Heart Valves,” *IEEE Conference on Electro Information Technology*, Lincoln, NE, May 22-25, 2005, pp. 5-11.

36. **N. Nair**, S Ramakrishnan, S T Thomas, R Ahn, and S S Udpa, “Signal Processing Techniques for Detecting Strut Fractures in Prosthetic Heart valves,” in *Studies in Applied Electromagnetics and Mechanics*, IOS press, vol 24, 2004, pp. 95-103.

37. **N Nair** and K Balasubramaniam, “A 2-D Inverse Heat Conduction Formulation for Determination of Heat Source Characteristics from Thermal Images,” in *Review of Progress In Quantitative Nondestructive Evaluation*, Boulder CO, July 2004, pp. 453-460.

38. V. Srivatsan, K Balasubramaniam, and **N. Nair**, “Artificial Neural Network Based Algorithm for Acoustic Impact Based Nondestructive Process Monitoring of Composite Products,” in *Review of Progress In Quantitative Nondestructive Evaluation*, Bellingham, WA, May 2003, pp. 1651-1656.

39. K Balasubramaniam, **N. Nair**, S. Veeraraghavan, and S. K. Das, “Modeling of Effects of Excitation Velocities on the Thermal Image Obtained for Thermosonic NDE,” *Review of Progress In Quantitative Nondestructive Evaluation*, Bellingham, WA, May 2003, pp. 525-530.

40. V. Srivatsan, **N. V. Nair** and K. Balasubramaniam, “An novel acoustic technique for detection of defects in brake-pads,” *National Seminar on Virtual Instrumentation*, Bangalore, INDIA 2002 **(Best Paper Award)**.

REFEREED CONFERENCE PRESENTATIONS

1. A. D. Baczewski, **N. V. Nair** and B. Shanker, “Integral Equation Methods for Finite Sources in Periodic Structures with Applications to Nanophotonics,” *USNC/URSI National Radio Science Meeting*, Toronto, CANADA, July 11-17, 2010.

2. A. J. Pray, **N. V. Nair** and B. Shanker, “Accurate Evaluation of Retarded Potential Integrals,” *USNC/URSI National Radio Science Meeting*, Toronto, CANADA, July 11-17, 2010.

3. **N. V. Nair** and B. Shanker, “Development of generalized method of moments,” *International Symposium on Electromagnetic Theory*, Ottawa, July 26-28, 2007.

4. **N. V. Nair** and B. Shanker, “A generalized method of moments solution to vector integral equation operators,” *USNC/URSI National Radio Science Meeting*, Ottawa, July 22-26, 2007.

5. **N. V. Nair** and B. Shanker, “Application of the generalized method of moments to augmented integral operators,” *USNC/URSI National Radio Science Meeting*, Ottawa, July 22-26, 2007.

6. S. S. Udpa, S. C. Chan, R. Clifford, S. Majumdar, **N. Nair**, S. Ramakrishnan, P. Ramuhalli, A. Surapur, L. Udpa, and A. White, “Active and Passive Methods for Detecting Strut Fractures in Prosthetic Heart Valves,” V. S. Joshi Memorial Plenary Lecture, NDE 2004, Pune, India, December 9-11, 2004. (invited)

7. V S Chakravarthy, S T Thomas and **N. Nair**, “A Model for Scheduling Motor Unit Requirement in Skeletal Muscle,” *International Conference on Theoretical Neurobiology*, Delhi, India, March 2003.

HONORS AND AWARDS

- Recipient of the MSU Postdoctoral Travel Fellowship 2011.
- Outstanding Graduate Student, College of Engineering, Michigan State University, 2010.
- Finalist in Best Student Paper Competition; IEEE Intl. Symposium on Antennas and Propagation, 2011.
- Finalist in Best Student Paper Competition; IEEE Intl. Symposium on Antennas and Propagation, 2010.
- Honorable Mention in Best Student Paper Competition; IEEE Intl. Symposium on Antennas and Propagation, 2009.
- Recipient of the Michigan State University Graduate Fellowship, 2009.
- General Electric Outstanding Scholar Award (2003).
- Best Paper Award at the National Symposium on Virtual Instrumentation, INDIA (2002).

PROFESSIONAL EXPERIENCE

Teaching:

- **Instructor,** ECE 305 : Electromagnetic Fields and Waves, Department of Electrical and Computer Engineering, Michigan State University Summer 2008
- **Instructor,** ECE 458 : Communication Systems Laboratory, Department of Electrical and Computer Engineering, Michigan State University Spring 2008
- **Instructor,** ECE 305 : Electromagnetic Fields and Waves, Department of Electrical and Computer Engineering, Michigan State University Summer 2007
- **Grader,** ECE 280, Electrical Engineering Analysis Department of Electrical and Computer Engineering, Michigan State University Spring 2008 - *Held regular weekly office hours and taught several tutorial sessions*

Research:

- Summer Research Intern: Dept. of Electrical Engineering, Michigan State University, East Lansing MI, 48823 : Summer 2002
- Summer Research Intern: Dept. of Electrical Engineering, Iowa State University, Ames IA, 50011 : Summer 2001

Research Proposal Writing:

- I have been actively involved in the writing of three NSF proposals with my PhD advisor. One of these has been funded by NSF DMS (Division of Mathematical Sciences Grant # NSF DMS: 0811197).

Affiliations and Service:

- IEEE
- SIAM
- Reviewer for the Journal of the Optical Society of America (A)
- Reviewer for IEEE Transactions on Antennas and Propagation
- Reviewer for IEEE Transactions on Microwave Theory and Techniques
- Reviewer for IEEE Transactions on Magnetics
- Reviewer for IEEE Antennas and Propagation Letters
- Reviewer for International Journal on Applied Electromagnetics and Mechanics
- Anonymous reviewer for several other international journals/conferences
- Graduate student member of the Departmental Graduate Studies Committee

PROGRAMMING

- FORTRAN, C, C++, Matlab, Linux shell scripting, Python, LaTeX 2_ε, LABVIEW, LABWindows
- Extensive working knowledge of different operating systems, office suites, visualization tools, mesh creation packages etc.
- Knowledge of scientific libraries and their implementations
- Extensive experience in numerical implementation of Neural Networks, Wavelet toolboxes, Control Systems and other Signal Processing toolkits