

**VENKATARAM VANAJA**  
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## **EDUCATION**

Ph.D. in Mathematics  
University of Maryland, College Park, Maryland, 1988  
Dissertation: *Iterative Solution of Backward-Forward Heat Equation.*

M.A. in Mathematics  
University of Maryland, College Park, Maryland, 1984.

## **RESEARCH ACTIVITIES**

**1. Reviewer for Mathematical Reviews, 2004 - present**

Reviewed articles on “Numerical Methods to solve Partial Differential Equations”.

**2. Partial Differential Equations**

We use symbolic methods to construct exact solutions to non-linear partial differential equations arising in physical situations.

**3. Finite element method to solve Two-way Diffusion Equations**

We analyze a numerical method to solve differential equations arising in three sources: 1. Electron Scattering Theory, 2. A Counter-Current Separator, and 3. Dynamics of Runaway Electrons in Tokamaks. These equations tend to be forward-parabolic in a part of the domain and backward-parabolic in the remaining part of the domain under consideration. We present a Galerkin method to obtain numerical solution of such problems and determine convergence rates and error estimates for the method.

**4. Generalized Burgers Equations**

We study partial differential equations arising out of physical situations. We analyze “Self-similar and Travelling Wave Solutions of Generalized Burgers Equations” and asymptotic stability of solutions to initial or boundary- value problems in suitable domains.

## 5. **Florida Aquifer Recharge**

Using the basic storage equation of hydrology, we derive a mathematical model to approximate the amount of water accessible in the South Florida Surficial Aquifer system (Biscayne and Surficial aquifers) in any given year, and determine the year in which the aquifer water storage will reach a maximum and the year in which “depletion” may occur.

6. **Article Referee for the Journals:** 1) Numerical Methods for Partial Differential Equations, and 2) Physica Scripta.

## **PUBLICATIONS**

### **a) Journal Articles**

1. *Exact solutions of a nonlinear diffusion-convection equation*, by V. Vanaja- Physica Scripta, Vol. 80, 045402 (7pp), 2009.
2. *Asymptotic Solutions of a Generalized Burgers Equation*, by V. Vanaja and P. L. Sachdev - Quarterly of Applied Mathematics, Vol. 50, No. 4, pp. 627- 640, Dec.1992.
3. *Numerical Solution of a simple Fokker-Planck Equation*, by V. Vanaja- Applied Numerical Mathematics 9, pp. 533-540, 1992.
4. *Iterative Methods for a Forward-Backward Heat Equation*, by V. Vanaja and R. B. Kellogg - SIAM journal on Numerical Analysis, Vol. 27, No.3, pp. 622- 635, June 1990.
5. *An Approximation to South Florida Surficial Aquifer Storage*, by R. Douglas Hyman, and V. Vanaja; unpublished.
6. *An Integrative Mathematical Physics Problem for College Students*, by R. Douglas Hyman, and V. Vanaja; unpublished.
7. *A Finite Element Method to solve a Two-way Diffusion Equation*, by V. Vanaja; work in progress.
8. *An Estimate of Convergence of Iterative Technique to Solve a Simple Fokker- Planck Equation*, by V. Vanaja; work in progress.
9. *Self Similar Solutions of the non-Planar Burgers Equation*, by V. Vanaja; In preparation.

**b) Reviews**

10. A computational finite difference treatment for PDE's including the mixed derivative term with high accuracy on curved domains (by Khamis, S. M.; Youssef, I. K.; EL- Dewik, M. H; and Bayoumi, B. I.)- J. Egyptian Math. Soc. 17 (2009), no. 1, 15, 33; reviewed by V. Vanaja, Mathematical Reviews.
11. A posteriori error estimates for finite volume approximations (by Cochez-Dhondt, S.; Nicaise, S.; and Repin, S.) Math. Model. Nat. Phenom. 4 (2009), no 1, 106-122; reviewed by V. Vanaja, Mathematical Reviews.
12. Numerical results on alternating direction shooting method for nonlinear Differential equation (by Kim, Do Hyun) – J. Korea Soc. Math. Educ. Ser. B Pure Appl. Math. 15 (2008), no. 1, 57-72; reviewed by V. Vanaja, Mathematical Reviews.
13. Comparison of Finite Volume and Finite Difference Methods and Application (by Faure, S.; Pham, D.; Temam, R.) - Anal. Appl. (Singap.) 4 (2006), no. 2, 163–208; reviewed by V. Vanaja, Mathematical Reviews.
14. On the Convergence of Finite Difference Scheme for Elliptic Equation with Coefficients Containing Dirac Distribution, (by Jovanović; Boško, S.; Vulkov, Lubin G.)- Mat Vesnik 56 (2004), no. 3-4, 115-123; reviewed by V. Vanaja, Mathematical Reviews.
15. Finite Difference Schemes for Partial Differential Equations with Weak Solutions and Irregular Coefficients, (by Jovanović; Boško, S.)- Comput. Methods Appl. Math. 4 (2004), no.1, 48–65; reviewed by V. Vanaja, Mathematical Reviews.
16. Analysis and Optimization of Inner Products for Mimetic Finite Difference Methods on a Triangular Grid, (by Liska, R.; Shashkov, M.; Gangha, V.)- Math. Comput. Simulation 67 (2004), no.1-2, 55-66; reviewed by V. Vanaja, Mathematical Reviews.
17. An Improved Piecewise Uniform Mesh for a Singularly Perturbed Elliptic Reaction- Diffusion Equation, (by Shishkin, G. I.)- Proc. Steklov Inst. Math. 2003, Fluid Dynamics, Suppl. 2, S138-S147; reviewed by V. Vanaja, Mathematical Reviews.

## CONFERENCES AND PAPER PRESENTATIONS

1. **Invited presentation-** Conference on “**Mathematics and its Applications to Physical Problems**”, University of Maryland, College Park; May 5-7, 1995.
2. “**Hydraulic Analysis of the Miami River**”, presented by R. Douglas Hyman and V. Vanaja - “*The Dade Public Education Fund*”, Miami, Florida, July 1999.
3. “**Joint Mathematics Meetings of the AMS, MAA, and AWM**” – New Orleans, Louisiana; January 10-13, 2001.
4. “**Joint Mathematics Meetings of the AMS, MAA, and AWM**”- San Diego, California; January 6- 9, 2002.
5. “**Joint Mathematics Meetings of the AMS, MAA, and AWM**”- Baltimore, Maryland; January 15-18, 2003.
6. “**Finite Element Circus**”, a meeting of Numerical Analysts; Presented “Preliminary Results” on current research, 88-93.
7. “**Seventh International Conference on Differential Equations and Dynamical Systems**”, Organizing committee member, University of South Florida, Tampa, Florida, Dec 2010.

## MATHEMATICAL COLLABORATIONS

1. Collaborated with Prof. R. B. Kellogg (Institute for Physical Science and Technology, University of Maryland, College Park, Maryland; Doctoral dissertation advisor), 1985–1996. Project title: **Numerical Methods to solve Forward–Backward Equations.**
2. Collaborated with P. L. Sachdev (Professor of Mathematics, Indian Institute of Science, Bangalore), 1989–1997. Project title: **Asymptotic Solutions of Generalized Burgers Equations.**
3. Collaborated with R. Douglas Hyman (Engineer, Florida Department of Environmental Protection), 1998-2004. Project titles:
  - a) ***Florida Aquifer Recharge.***
  - b) ***Hydraulic Analysis of the Miami River.***

4. Current collaboration on “Partial Differential Equations” with Prof. Ma, Department of Mathematics, University of South Florida, Tampa, 2006-present.

## **TEACHING AND RESEARCH EXPERIENCE**

1. **Department of Mathematics, University of South Florida, Tampa, Florida 33620, 2005–present.**

Courses taught: Engineering Calculus I, II, III, Calculus II, III, and Life Sciences Calculus 1.

2. **Reviewer for Mathematical Reviews, 2004–present.**

Reviewed articles on “Numerical Methods to solve Partial Differential Equations”.

3. **Collaboration with R. Douglas Hyman, P. E., (Florida Department Of Environmental Protection, W. Palm Beach), 1998-2004.**

Worked on the project, “South Florida Surficial Aquifer System”.

4. **Visiting Professor of Mathematics, Florida Atlantic University, Boca Raton, Florida, 1996-97.**

Taught undergraduate courses in Discrete Mathematics, Calculus II and Calculus III and carried out independent research. Used **Maple** while teaching Calculus II and III.

5. **Assistant Professor in Mathematics, Virginia Union University, Richmond, Virginia, 1993-96.**

Supervised undergraduate students in research by directing **Senior Theses**, taught undergraduate courses in Differential Equations, Discrete Mathematics, Linear Algebra, Numerical Analysis, Calculus I, II, III, Business Mathematics, and Statistics for Non-Mathematics majors.

6. **Assistant Professor in Mathematics, New Jersey Institute of Technology, Newark, New Jersey, 1988-1992.**

Taught a graduate course in Numerical Analysis and undergraduate courses in Numerical Analysis, Linear Algebra, Discrete Mathematics,

Differential Equations, Calculus I, II, and III. Used **Mathcad** to teach Calculus I, II, and III. Supervised Masters research projects.

7. **Visiting Research Scientist, Department of Mathematics, Indian Institute of Science, Bangalore, India, Summer 1991.**

Collaborated with Dr. P. I. Sachdev, Professor of Mathematics, IISc, Bangalore.

8. **Research Assistant for Dr. M. Coplan, Institute for Physical Science and Technology, University of Maryland, College Park, Maryland, 1987-88.**

Worked on a NASA project "Solar Wind"- In brief, the solar wind ion composition experiment aboard the ISEE-C spacecraft measures the flux of ions in the solar wind over a given mass per unit charge and specified velocity. From these measurements, we obtain ion abundances, densities, coronal temperatures, and solar wind kinetic temperatures; these serving as a basis for models of the sun and solar wind formation.

9. **Teaching Assistant, Mathematics Department, University of Maryland, College Park, Maryland, 1981-87.**

Teaching Assistant for undergraduate Mathematics courses.

10. **Assistant Professor in Mathematics, Sri Sarada College, Salem, Tamil Nadu, before 1981.**

Taught various graduate and undergraduate Mathematics courses.

## **COMPUTER SKILLS**

1. Expert in the **Computer Algebra System *Maple***: 1) Coordinator of the Maple assignments for Calculus II and III at Florida Atlantic University, Boca Raton, Florida (1996-97), and 2) Currently using Maple for research.
2. Expertise in the **Computer Algebra System *Mathcad***, which was used for teaching Calculus I, II and III at New Jersey Institute of Technology, Newark, New Jersey (1988-1992).
3. Doing computations for my research - good knowledge of Fortran, worked on Apollo, Sparc stations, Micro Vax 11, Univac, and Cray.

## **Voluntary Work**

1. Judge; Palm Beach County Science and Engineering Fair, 2004.
2. Judge; Belvedere Elementary; Science and Mathematics Fair, 1999-2000.
3. Member; Association for Supervision and curriculum development, New Jersey division, 1989.

## **PROPOSALS**

1. During 1989 – 90, submitted proposals to New Jersey Institute of Technology, successfully obtained funds, received summer support for research and got research release time and purchased a Sparc work station for high speed computing.
2. Submitted a proposal to National Science Foundation in January 1991, to obtain research planning grant of \$ 18,000; title of the project *Generalized Burgers Equations and Euler - Painleve Transcendents*; one reviewer reported it to be 'very good', and another reported it be 'good'.
3. Submitted a proposal to U.N.C.F. in March 95, to obtain Henry C. McBay Research fellowship of \$10,000 to obtain Sun workstation and summer salary.

## **SENIOR THESES/ MASTERS RESEARCH PROJECTS DIRECTED**

1. **Finite Element Solution of an Equation of Mixed Type from Electron Scattering Theory**, by P. Vora- Masters research project- guided by V. Vanaja- New Jersey Institute of Technology, 1989-90.
2. **Analysis of Techniques to Solve  $n$  Equations in  $n$  Unknowns, where  $n$  is any Positive Integer**, by Marci Jenkins - Senior Thesis- guided by V. Vanaja - Virginia Union University, Spring 1994.
3. **Analysis of Techniques to Solve a Non-linear Equation in one Variable**, by Aaron Anderson- Senior Thesis- guided by V. Vanaja- Virginia Union University, Fall 1995.

## **LANGUAGES**

**French:** Reading knowledge

**German:** Reading ability.

## **AWARDS**

1. Received a cash merit award of five hundred dollars from New Jersey Institute of Technology, in recognition of the good work done during the academic year 1989-90.
2. Secured the first place in the University final examinations in Graduate, Undergraduate and School final programs of The University of Madras.

**MEMBERSHIP:** American Mathematical Society.