Clarence O. E. Burg

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Education

Mississippi State University, Mississippi State, MS
Ph. D., Computational Engineering, August, 1999

Duke University, Durham, NC
A.M., Mathematics, May, 1995

Rice University, Houston, TX
B.A., Mathematics/ Non-Western Studies, 1990

Employment History

Assistant Professor, University of Central Arkansas
Department of Mathematics, August, 2006 – Current

Visiting Assistant Professor, University of Central Arkansas
Department of Mathematics, August, 2005 - May, 2006

Assistant Research Professor, Mississippi State University
Computational Simulation and Design Center, July, 2001 – March, 2005

Research Engineer I, Mississippi State University
Computational Simulation and Design Center, May, 2000 – June, 2001

Post-Doctoral Research Assistant, Mississippi State University
Computational Fluid Dynamics Laboratory, July, 1999 – April, 2000

Graduate Research Assistant, Mississippi State University
Engineering Research Center, June, 1996 – July, 1999

Instructor, Heritage Academy, Columbus, MS
High School Mathematics, August, 1995 – May, 1996

Graduate Teaching Assistant, Duke University
Lab and Classroom Instructor, August, 1993 – May 1995

Courses Taught

University of Central Arkansas

MA 1191 – Mathematical Software (Mathematica section, Spring 2006, Spring 2008, Fall 2008, Spring 2009, Fall 2009)
MA 1360 – Mathematics in Society (Fall 2008)
MA 1390 – College Algebra (Summer 2006)
MA 1395 – Business Calculus (Fall 2005, Spring 2006, Spring 2007)
MA 1580 – Algebra and Trigonometry (Fall 2006)
MA 1591 – Calculus I (Spring 2006, Summer 2008, Fall 2009)
MA 1592 – Calculus II (Fall 2005)
MA 2371 – Calculus III (Fall 2007 (2), Spring 2008, Fall 2008 (2), Spring 2009)
MA 3320 – Linear Algebra (Fall 2005)
MA 3331 – Differential Equations (Summer 2009, Fall 2009)
MA 4340 – Numerical Methods (Spring 2006, 2007, 2008, 2009)
MA 6350 – Numerical PDEs in Two Dimensions (Spring 2008)
MA 6348 – Numerical Analysis (Fall 2006, Fall 2007, Fall 2008)
MA 6358 – Numerical Differential Equations (Spring 2007)
MA 6375 – Integral Calculus (Summer 2007)
MA 6382 – Scientific Computing on Vector Architectures (Spring 2009)

University of Central Arkansas Upward Bound Program
Geometry and Algebra II Preparation Courses – Summer 2008

Mississippi State University
MA 4313/6313 – *Numerical Analysis I*
Summer 2003
CME 6999 - *Fundamentals of Computational Analysis*
Fall 2001, Fall 2002
Developed course
ASE 8423 - *Computational Fluid Dynamics II*
Spring 2001, Spring 2002, Spring 2003
Taught 5 week segment on numerical design optimization
CS 2413 – *Discrete Structures*
Spring 1993, Summer 1993

Mississippi University for Women
Summer Developmental Program, Math Instructor
Summers 1996, 1997

Duke University
Multivariable Calculus with Computer Lab
Spring 1995

Teaching Interests

All levels of Calculus, Linear Algebra, Differential Equations, Partial Differential Equations, Numerical Analysis, Numerical ODE's, Numerical PDE's and Numerical Linear Algebra.

Students Advised

Major Professor:

Vasanth Kumar Murali, "Code Verification using the Method of Manufactured Solutions", Master of Science in Computational Engineering, Mississippi State University, December 2002.

Sunil Nandihalli, "A B-Spline Geometric Modeling Methodology for Free Surface Simulations", Master of Science in Computational Engineering, Mississippi State University, May 2004.

David Watts, "Analysis of Numerical Methods for the Wvae Equation using the Modified Equation", Master of Science in Applied Mathematics, University of Central Arkansas, August 2008.

Sam Green, "FPGA Coprocessing for Computational Mathematics", Master of Science in Applied Mathematics, University of Central Arkansas, May 2009.

Taylor Erwin, "Richardson Extrapolation applied to Numerical Solution of Compressible Euler Equations", Master of Science in Applied Mathematics, University of Central Arkansas, August 2009.

Ethan Hereth, "Numerical Simulation of Subaqueous Debris Flow in One Dimension", Master of Science in Applied Mathematics, University of Central Arkansas, August 2009.

Eric Sellers, thesis track, Master of Science in Applied Mathematics, University of Central Arkansas, expected August 2011.

Master's Committee: 10 Graduated
Ph.D.'s Committee: 6 Graduated while at Mississippi State University

Undergraduate Research

Fall 2006 and Spring 2007 – Jonathan Johnson and Taylor Erwin worked on Richardson Extrapolation project.

Summer 2007 – Taylor Erwin worked on Richardson extrapolation in 2D, Matthew Brozak worked on space-time finite volume method in 1D, and Shane McNew worked on a 1D system of partial differential equations modeling calcium in yeast cells.

Spring 2008 – Ben Perea worked on the application of the complex Taylor's series expansion method to numerical integration

Summer 2008 – Nick Nelson worked on wave generation and cancellation within the shallow water equations

Fall 2009 – Mark VanDerLugt worked on numerical simulations to create a supersonic wing with no shock sent towards the ground.

Research Interests

Algorithm and code development for flow simulations on unstructured grids, including the following areas:

1. General algorithms for unstructured grids, including gradient estimation via least-squares method, calculation of connectivity arrays and grid metrics, determination of Jacobian matrices and solution of nonlinear systems of equations
2. Increased spatial accuracy via higher order unstructured methods
3. Increased temporal accuracy via the space-time finite volume methodology
4. Moving mesh simulations, using the torsional springs method
5. Free surface flow simulations, using the surface tracking method where the grid moves to match the free surface and the single-phase surface capturing method where the grid is fixed and the free surface is solved using an auxiliary equation
6. Code verification, using the method of manufactured solutions.
7. Adjoint and direct formulations for gradient-estimation for numerical design optimization, including the use of the complex Taylor's series expansion method.

Grants and Contracts

The Callisto Cluster – UCA's First Research Computer Cluster, funded by the UCA University Research Council, PI, $25,670, 2010-2012.

Interactive Computational Sciences Website – Prototype Development, funded by UCA University Research Council, PI, 4,300, Summer 2008.

Assisting NASA's Education Mandate Via Interactive Computational Sciences Website, funded by the Arkansas Space Grant Consortium, PI, $6,129, Summer 2008.

Using Tablet PC Technology to Enhance Learning in Upper Division Mathematics Courses, funded by HP Technology for Teaching Program, $74,000, Fall 2007-Spring 2009.

Space-Time Finite Volume Methods for Computational Simulation Involving Moving Surfaces, funded by UCA University Research Council, PI, $3840, Summer 2007.

Improving the predictive ability of NASA Langley's computational simulation package FUN3D, funded by the Arkansas Space Grant Consortium, PI, $7478, Summer 2007.

Rudder Manufacturing Tolerance Study, contract through Northrop-Grumman Ship Systems, April-October, $75,000, 2004.

Design Methodology for Stern Flaps, contract with Univ. of Michigan and Office of Naval Research, April, 2001- April, $220,000, 2004.

Program for Computational Engineering Research: Supporting the Analysis and Design of Marine and Aerospace Vehicles, contract through the Office of Naval Research, November, 2000 – November 2002.

Proposals Submitted and Unfunded

ACCP: Arkansas Computing Community of Practice, submitted to National Science Foundation CPATH II program, Spring, 2009.

Launch of Interactive Computational Sciences Education Website, submitted to Motorola Innovation Generation Grant program, Spring, 2009.

Using the Sony Playstation 3 for Interactive Computational Sciences Simulations, white paper submitted to Sony Electronics, Summer, 2008.

A Study of the Effectiveness of Tablet PC and Pen-based technology in Upper Division Mathematic, submitted to the Microsoft Tablet PC Technology RFP, 2007.

Application of Richardson Extrapolation to the Numerical Solution of Partial Differential Equations, one-page proposal submitted to the Arkansas Space Grant Consortium for 2006-2007, PI.

Code Verification Methodologies for Current Weather Prediction Codes, White Paper submitted to the Army Research Office, Fall, 2005.

Methodology for Uncertainty Propagation and Error Estimation in Computational Hydrodynamics, Office of Naval Research, Submitted Fall 2003.

Innovative Computational Framework for High-Performance Simulation-Based Design and Analysis, National Science Foundation – Information Technology Research for National Priorities, Submitted Feb. 2004.

High Performance Computational Tools for Engineering Optimization of Ship Systems, Office of Naval Research – Research Tools Design Consortia, Submitted Nov. 2004, in conjunction with Jackson State University.

Architectural Concepts & Hydrodynamics Technologies for High Speed Sealift to Austere Ports, Office of Naval Research – BAA #05-007, Submitted March, 2005.

Numerical Simulations of Submarine Debris Flow, Institute for Creation Research, Submitted, Sept. 2006.

Professional Activities

Member of AIAA

Reviewed articles for the following journals:

Journal of Ship Research,
ASCE Journal of Hydraulic Engineering,
Communications in Numerical Methods in Engineering,
International Journal for Numerical Methods in Fluids,
International Journal of Numerical Methods
Advances in Water Resources
Numerical Methods for Partial Differential Equations

Reviewed a proposal for the US Army Research Office

University Service

Chair, Technology Committee, Department of Mathematics, University of Central Arkansas, Fall 2006- current

Chair, Recruitment and Retention Committee, Department of Mathematics, University of Central Arkansas, Fall 2008- current

At-large representative to research committee for College of Natural Sciences and Mathematics, University of Central Arkansas, Fall 2006 – Spring 2009.

Representative for Engineering Research Center to Engineering College Faculty Council, Mississippi State University, January 2002 – December 2004

Member of Numerical Analysis Committee within Department of Mathematics, Mississippi State University, July 2002 – March 2005

Refereed Journal Publications

1. Burg, C. O. E., "Derivative-Based Closed Newton-Cotes Numerical Quadrature", submitted to journal Applied Mathematics and Computation, Dec, 2009.
2. Burg, C. O. E., and Erwin, T., "Application of Richardson Extrapolation to the Numerical Solution of Partial Differential Equations", Numerical Methods for Partial Differential Equations, Volume 25, Issue 4, July, 2009, pp. 810-832.
3. Burg, C. O. E., "Analytic Study of 2D and 3D Grid Motion Using Modified Laplacian", International Journal of Numerical Methods in Fluids, Vol. 52, No. 2, Sept, 2006: pp. 163-197.
4. Burg, C. O. E., and Murali,, V. K., "The Residual Formulation of the Method of Manufactured Solutions for Computationally Efficient Code Verification", Int. J. for Computational Fluid Dynamics, Vol. 20, No.7 , August 2006, pp. 521-532.
5. Burg, C. O. E., Newman, J. C., III, "Computationally Efficient, numerically exact design space derivatives via the Complex Taylor's Series Expansion Method", Computers and Fluids (32), March 2003, pp. 373-383.
6. Burg, C. O. E., "Groundwater Parameter Estimation via the Unsteady Adjoint Variable Formulation of Discrete Sensitivity Analysis", Communications in Numerical Methods in Engineering, June, 2002, pp. 391-398.
7. Burg, C. O. E., Huddleston, D. H., Berger, R. C., "An Efficient, Robust Design Tool for Open-Channel Flow", ASCE Journal of Hydraulic Engineering, January 2001, pp. 62-71.

Refereed Conference Publications

1. Hackett, J., Burg, C. O. E., and Brewer, W., "Manufacturing Tolerance Effects on Ship Rudder Force/Cavitation Performance", SNAME Maritime Technology Conference & Expo, Houston, Texas, October 19-21, 2005.
2. Burg, C. O. E., "Use of Discrete Sensitivity Analysis to Transform Explicit Simulation Codes into Design Optimization Codes", Electronic Journal on Differential Equations, Proceedings of 4th Mississippi State Conference on Differential Equations and Computational Simulations, http://ejde.math.swt.edu/conf-proc/03/toc.html. 1999.

Conference Presentations with Publications

1. Burg, C. O. E. and Erwin, T., "Application of Richardson Extrapolation to the Numerical Solution of Partial Differential Equations in Two Dimensions", AIAA Paper 2009-3653, 19th AIAA Computational Fluid Dynamics Conference, San Antonio, June, 2009.

2. Burg, C. O. E., "CFD on Sony PS3", AIAA Paper 2009-4305, 39th AIAA Fluid Dynamics Conference, San Antonio, June, 2009.
3. Burg, C. O. E., "Single-Phase Level Set Simulation for Unstructured Incompressible Flows", AIAA Paper 2005-5350, 17th AIAA Computational Fluid Dynamics Conference, Toronto, Ontario, June, 2005.
4. Burg, C. O. E., "Higher-Order Variable Extrapolation for Unstructured Finite Volume RANS Flow Solvers", AIAA Paper 2005-4999, 17th AIAA Computational Fluid Dynamics Conference, Toronto, Ontario, June, 2005.
5. Burg, C. O. E., and Murali, V. K, "Efficient Code Verification Using the Residual Formulation of the Method of Manufactured Solutions", AIAA Paper 2004-2628, 34th AIAA Fluid Dynamics Conference, Portland, Oregon, June, 2004
6. Burg, C. O. E., "A Robust Unstructured Grid Movement Strategy using Three-Dimensional Torsional Springs", AIAA Paper 2004-2529, 34th AIAA Fluid Dyaamics Conference, June, 2004.
7. Burg, C. O. E., and Nandihalli, S., "Approximation of Surfaces and Solution of Partial Differential Equations Using B-Splines", AIAA Paper 2004-2230, 34th AIAA Fluid Dynamics Conference, Portland, Oregon, June, 2004.
8. Burg, C. O. E., Marcum, D. L., "Moving Towards High-Fidelity RANS Calculations of Maneuvering Surface Vessels Using Unstructured Grids", Proceedings of the 8th International Conference on Numerical Ship Hydrodynamics, Busan, Korea, Sept., 2003.
9. Burg, C. O. E., Sheng, C., Newman, J. C. III, Brewer, W., Blades, E., and Marcum, D.L., "Verification and Validation of Forces Generated by an Unstructured Flow Solver", AIAA Paper 2003-3983, 16th AIAA Computational Fluid Dynamics Conference, Orlando, 2003.
10. Burg, C. O. E., Sreenivas, K., Hyams, D. G., Mitchell, B., "Unstructured Nonlinear Free Surface Simulations for the Fully-Appended DTMB Model 5415 Series Hull Including Rotating Propulsors", Proceedings of 24th Symposium on Naval Hydrodynamics, Fukuoka, Japan, July, 2002.
11. Burg, C. O. E., Sreenivas, K., Hyams, D. G., Mitchell, B., "Unstructured Nonlinear Free Surface Flow Simulations: Validation and Verification", AIAA Paper 2002-2977, 32nd AIAA Fluid Dynamics Conference, St. Louis, June, 2002.
12. Murali, V., Burg, C. O. E., "Verification of 2D Navier-Stokes Codes by the Method of Manufactured Solutions", AIAA Paper 2002-3109, 32nd AIAA Fluid Dynamics Conference, St. Louis, June, 2002.
13. Huddleston, D. H., Burg, C. O. E., Berger, R. C., "Coupling Nonlinear Optimization and Computational Simulation to Design Flood Control Channels", Advances in Hydroscience and Engineering, Vol. 3., 1998.
14. Burg, C. O. E., Huddleston, D. H., Berger, R. C., "A Numerical Design Method for Open-Channel Flows", Water Resources Engineering '98, Volume Two, 1998.
15. Burg, C. O. E., "Using a Genetic Algorithm in Designing High-Velocity Drainage Channels", Developments in Theoretical and Applied Mechanics, Volume XIX, 1998.

Conference Presentations without Publications

1. Burg, C. O. E., and Erwin, Taylor, "Application of Richardson Extrapolation to the Numerical Solution of Partial Differential Equations", Seventh Mississippi State – UAB Conference on Differential Equations and Computational Simulations, Birmingham, AL, Nov. 1-3, 2007.
2. "Unstructured RANS Simulations for Open-Channel Flow", 7th U.S. National Congress on Computational Mechanics, Albuquerque, NM, July, 2003.
3. "Code Verification via the Method of Manufactured Solutions", Fifth Mississippi State University Conference on Differential Equations and Computational Simulations, Starkville, MS, May, 2001.
4. "Application of Discrete Sensitivity Analysis to Water Resource Applications", Finite Element Flow 2000 Conference, Austin, Texas, May 2000.
5. "Efficient and Accurate Numerical Optimization via the Complex Taylor's Series Expansion Method", Finite Element Flow 2000 Conference, Austin, Texas, May 2000.
6. "Using Complex Arithmetic to Identify Groundwater Modeling Parameters", Tri-State Professional Engineering Societies Conference, Destin, FL, June, 1999.

Invited Lectures

1. "Using Derivatives to Approximate Integrals", Mathematics Seminar, University of Central Arkansas, Dec. 2, 2009.
2. "Interactive Computational Sciences Platform", with Dane Womack and Ethan Hereth, Seminar, NASA Langley, October 16, 2008.
3. "Application of Richardson Extrapolation to the Numerical Solution of Partial Differential Equations in Two-Dimensions", with Taylor Erwin, Arkansas Space Grant Symposium, April 25, 2008.
4. "Computational Mathematics – New Tools for Scientific Investigations", UCA College of Natural Sciences and Mathematics Advisory Board Meeting, April 18, 2008.
5. "Richardson Extrapolation and Numerical Solutions of Partial Differential Equations", with Taylor Erwin, Seminar, SimCenter, National Center for Computational Engineering, University of Tennessee at Chattanooga, March 23, 2008.
6. "Higher Order Variable Extrapolation via Unstructured MUSCL", Seminar, SimCenter, National Center for Computational Engineering, University of Tennessee at Chattanooga, March 23, 2008.
7. "Application of Richardson Extrapolation to the Numerical Solution of Partial Differential Equations", with Taylor Erwin, Mathematics Seminar, Univ. of Central Arkansas, Jan. 16, 2008.
8. "Educational Technology Demonstration", with Long Le and Donna Foss, Mathematics Seminar, Univ. of Central Arkansas, Nov. 14, 2007.
9. "Richardson Extrapolation and Numerical Solutions to Partial Differential Equations", with Taylor Erwin, NASA Langley Research Center, May 30, 2007.
10. "Thorough analysis of the order of accuracy of unstructured PDE solvers on triangular meshes", Mathematics Seminar, Univ. of Central Arkansas, Dec., 2006.

11. "The finite volume method for solving hyperbolic systems of equations on unstructured meshes", Mathematics Seminar, Univ. of Central Arkansas, Feb., 2006.
12. "Numerically-exact derivatives via the Complex Taylor's Series Expansion Method", Mathematics Seminar, Univ. of Central Arkansas, Sept. 2005.
13. "Simulation of viscous flow around surface ships using an unstructured finite volume algorithm by moving the grid", Computation and Modeling Laboratory, Clark-Atlanta University, Nov., 2003.
14. "An overview of computational fluid dynamics and numerical design optimization", Department of Computer Science, Jackson State University, Feb. 1999.

Student Presentations

1. Womack, D., "Numerical Simulation of Population Distributions in Two Dimensions", 28th Southeastern Atlantic Regional Conference on Differential Equations, Little Rock, AR, Oct, 2008.
2. Hereth, E., "A Numerical Solver for Burgers' Equations in Two Dimensions", 28th Southeastern Atlantic Regional Conference on Differential Equations, Little Rock, AR, Oct, 2008.
3. Erwin, T., "Application of Richardson Extrapolation to the Numerical Solution of Partial Differential Equations", 28th Southeastern Atlantic Regional Conference on Differential Equations, Little Rock, AR, Oct, 2008.
4. Brozak, M, and Burg, C. O. E., "Implementation of the Space Time Finite Volume Method on a One Dimensional Wave Maker", Seventh Mississippi State – UAB Conference on Differential Equations and Computational Simulations, Birmingham, AL, Nov. 1-3, 2007.
5. Erwin, T., and Burg, C. O. E., "Application of Richardson Extrapolation to the Two Dimensional Shallow Water Equations", Seventh Mississippi State – UAB Conference on Differential Equations and Computational Simulations, Birmingham, AL, Nov. 1-3, 2007.

Student Posters acting as research advisor

1. Hereth, E., Womack, D., "Interactive Computational Sciences Website", Arkansas Space Grant Symposium, April 24, 2009.
2. Hereth, E., Womack, D., "Interactive Computational Sciences Website", UCA College of Natural Sciences and Mathematics Poster Symposium, April 24, 2009.
3. Erwin, T., "Improving the Accuracy of Computational Simulations Using a Century Old Technique", 1st Annual Conference of the Arkansas Science and Technology Authority, Oct., 2008.
4. Erwin, T., "Application of Richardson Extrapolation to the Numerical Solution of Partial Differential Equations in Two Dimensions", UCA College of Natural Sciences and Mathematics Poster Symposium, Spring, 2008.
5. Brozak, M., "Implementation of the Space Time Volume Method on a One Dimensional Wave Maker", College of Natural Sciences and Mathematics Poster Symposium, Spring, 2008.

6. Erwin, T. and Johnson, J., “Using Richardson Extrapolation to Increase the Spatial Accuracy of Existing Computational Solvers”, College of Natural Sciences and Mathematics Poster Symposium, Spring, 2007.

Poster Presentations

1. Burg, C. O. E., “Using the Tablet PC Technology to Enhance Learning in Upper Division Mathematics Courses”, 2008 HP Technology for Teaching Higher Education Conference, San Diego, CA, Feb. 18-19, 2008.

Technical Reports

1. Burg, C. O. E., Huddleston, D. H., and Berger, R. C., “A Computational Design Method for High-Velocity Channels”, Overview of Computational Science: HPCC Technology and Applications, DOD High Performance Computing Modernization Program, CEWES Major Shared Resource Center, May 1998.