

# Dr. NICOLETA VIRGINIA BILA

Department of Mathematics and Computer Science, Fayetteville State University  
1200 Murchison Road, Fayetteville, NC 28301  
E-mail: nbila@uncfsu.edu • Phone: (910) 672-2204 • <http://faculty.uncfsu.edu/nbila>

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## RESEARCH INTERESTS

- Symmetry analysis of differential equations: classical and nonclassical symmetries, potential symmetries, group-invariant solutions, variational symmetries and conservation laws
- Applications of symmetry analysis theory to mathematical models arising in mathematical physics, mathematical biology, image processing, engineering, and other research fields
- Geometric approach to parameter identification problems modeled by partial differential equations (PDEs) and their applications to numerical analysis
- Nonlinear PDEs, in particular Monge-Ampère equations
- Symbolic manipulation programs for symmetry analysis
- Approximate analytical solutions to ordinary differential equations

## RESEARCH EXPERIENCE

**POSTDOCTORAL RESEARCH ASSOCIATE** 04/2004 - 03/2005  
**Johann Radon Institute for Computational and Applied Mathematics (RICAM)**  
Austrian Academy of Sciences, Linz, Austria

- A new approach to parameter identification problems modelled by partial differential equations from the point of symmetry reduction methods

**POSTDOCTORAL RESEARCH ASSOCIATE** 10/2002 - 03/2004  
**Johannes Kepler University**  
Institute for Industrial Mathematics, Linz, Austria

Principal Investigator: Prof. Heinz W. Engl  
SFB Project F013/F1308: “*Large Scale Inverse problems*”

- A new approach to parameter identification problems modelled by partial differential equations; Equivalence transformations for a mathematical model arising in the car windshield design; Applications of the equivalence transformations to certain regularization methods

**EPSRC POSTDOCTORAL RESEARCH ASSOCIATE** 10/2001 - 09/2002  
**University of Cambridge**  
Department of Applied Mathematics and Theoretical Physics, Cambridge, United Kingdom

Principal Investigator: Prof. Arieh Iserles  
EPSRC Project: “*Geometric Integration of Partial Differential Equations*”<sup>1</sup>

- A new procedure for finding the determining equations of the nonclassical symmetries for a partial differential equation; the MAPLE subroutine `gendefnc`

**EPSRC POSTDOCTORAL RESEARCH ASSOCIATE** 10/2000 - 09/2001  
**University of Kent at Canterbury**  
Institute of Mathematics, Statistics and Actuarial Science, Canterbury, United Kingdom

Principal Investigator: Prof. Elizabeth L. Mansfield  
EPSRC Project: “*Geometric Integration of Partial Differential Equations*”

- Symmetry reductions, variational symmetries and conservation laws associated with the shallow water and the semi-geostrophic equations arising in meteorology

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<sup>1</sup>This is a collaborative project between the University of Cambridge, the University of Kent, the University of Bath and the European Center for Medium Range Weather Forecasts (ECMWF)

## TEACHING EXPERIENCE

### ASSISTANT PROFESSOR

2006 - present

Fayetteville State University, Department of Mathematics, Fayetteville, NC

- Taught 12 credit hours • Created and graded weekly assignments and tests • Graded papers in final examinations
- Taught courses: *Introduction to College Algebra, College Algebra, Precalculus, Linear Algebra and Differential Equations with Maple, and Algebra and Trigonometry.*

### ASSISTANT PROFESSOR

1997 - 2000

University “Politehnica” of Bucharest, Department of Mathematics I, Bucharest, Romania

- Taught 12 credit hours • Created and graded weekly assignments and short tests • Graded papers in final examinations
- Taught courses: *Linear Algebra, Analytic and Differential Geometry, Differential Equations, Numerical Analysis, Real and Complex Mathematical Analysis, and Special Mathematics*

### INSTRUCTOR

1992 - 1997

University “Politehnica” of Bucharest, Department of Mathematics I, Bucharest, Romania

- Taught courses: *Differential Equations, Analytic and Differential Geometry, and Linear Algebra*

### TEACHER OF MATHEMATICS

1990 - 1992

High School, Bucharest, Romania

- Taught subjects: *Algebra, Geometry, Trigonometry, and Calculus*

## EDUCATION <sup>2</sup>

**Ph.D. in Mathematics** (1999) - University “Politehnica” of Bucharest, Bucharest, Romania

Ph.D. Thesis: “*Symmetry Groups and Conservation Laws for Certain Partial Differential Equations*”  
Supervisor: Prof. Constantin Udriste

**M.Sc. in Mathematics** (1991) - University of Bucharest, Bucharest, Romania

**B.Sc. in Mathematics** (1990) - University of Bucharest, Bucharest, Romania

## PROFESSIONAL MEMBERSHIPS

- Society for Industrial and Applied Mathematics (SIAM) & Activity Group on Analysis of Partial Differential Equations (SIAG/APDE)
- American Mathematical Society (AMS)
- Association for Women in Mathematics (AWM)

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<sup>2</sup>Diplomas accredited by the American Association of Collegiate Registrars and Admissions Officers (AACRAO)

## CONFERENCE TALKS

- *American Mathematical Society Spring Southeastern Section Meeting, Special Session on Geometry of Differential Equations*, North Carolina State University, Raleigh, NC, April 4–5, 2009.
- *Applications of Computer Algebra: ACA 2008, Symbolic Symmetry Analysis and Its Applications*, Research Institute for Symbolic Computation, Castle of Hagenberg, Linz, Austria, July 27–30, 2008.
- *American Mathematical Society Fall Southeastern Sectional Meeting, Special Session on Applied Partial Differential Equations*, Murfreesboro, TN, November 3–4, 2007.
- *Applications of Computer Algebra: ACA 2007, Symbolic Symmetry Analysis and Its Applications*, Oakland University, Rochester, MI, USA, July 19–22, 2007.
- *The Seventh International Conference, Symmetry in Nonlinear Mathematical Physics*, Institute of Mathematics, National Academy of Sciences of Ukraine, Kiev, Ukraine, June 24–30, 2007.
- *Nonclassical equivalence transformations associated with a parameter identification problem*, The 26th Annual Southeastern-Atlantic Regional Conference on Differential Equations, Greensboro, North Carolina, October 27–28, 2006.
- *Application of symmetry analysis to a PDE arising in the car windshield design*, AMS 2005 Spring Eastern Sectional Meeting, Special Session on Symmetry Methods for Partial Differential Equations, Newark, Delaware, U.S.A., April 2–3, 2005.
- *Application of symmetry analysis to a PDE arising in the car windshield design*, Workshop on Lie group methods and control theory, International Center for Mathematical Sciences, Edinburgh, U.K., June 28 – July 1, 2004.
- *Application of symmetry analysis to a PDE arising in the car windscreen design*, Fifth International Conference, Symmetry in Nonlinear Mathematical Physics, Institute of Mathematics, National Academy of Sciences of Ukraine, Kiev, Ukraine, June 23–29, 2003.
- *Symmetry Group Analysis for Nonlinear PDEs*, SFB–Conference on Computational Methods for Inverse Problems, Strobl, Austria, August 25–31, 2002.
- *On a new procedure for finding nonclassical symmetries*, Symbolic Analysis Workshop, Foundations of Computational Mathematics, University of Minnesota, U.S.A., August 5–14, 2002.
- *A new procedure to find nonclassical symmetries. Application to the MAPLE package DESOLV*, Computer Algebra in applications to Integrable Systems, Isaac Newton Institute for Mathematical Science, Cambridge, U.K., November 16–17, 2001.
- *Monge–Ampère equations and symmetry reductions*, MASESS II Mechanics and Symmetry, Euro Summer School, Peyresq, France, September 2–15, 2001.
- *A new procedure to find nonclassical symmetries. Application to the MAPLE package DESOLV*, Progress in Partial Differential Equations, International Centre For Mathematical Sciences, U.K., July 9–13, 2001.
- *Symmetry reductions for the Monge–Ampère equations*, Geometry Third Conference, University “Politehnica” of Bucharest, Bucharest, Romania, July 31 - August 3, 2000.
- *Symmetry reductions for the Monge–Ampère equations*, LMS Durham Symposium Geometric Integration, Durham University, Durham, U.K., July 13–23, 2000.
- *Symmetry Groups of Tzitzeica PDEs*, Flows and Geometric Dynamics, University “Politehnica” of Bucharest, Bucharest, Romania, October 15–19, 1999.

- *Symmetries of Monge–Ampère–Tzitzeica, Camassa–Holm and Blair PDEs*, The Fourth International Workshop on Differential Geometry and Its Applications, University Transilvania, Brasov, Romania, September 16–22, 1999.
- *Infinitesimal Symmetries of Camassa–Holm Equation*, Conference on Geometry and Its Applications in Technology and Workshop on Global Analysis, Differential Geometry, Lie Algebras, Aristotle University, Thessaloniki, Greece, June 23–26, 1999.
- *Symmetry Groups of Tzitzeica Surface PDE*, Conference of Mathematical Analysis and Its Applications, Workshop on Algebras and Geometry, University West of Timisoara, Romania, November 14–15, 1998.
- *Lie Groups Applications to Minimal Surfaces PDE*, Second Conference of Balkan Society of Geometers, Workshop on Global Analysis, Differential Geometry, Lie Algebras, Aristotle University, Thessaloniki, Greece, June 24–27, 1998.
- *The characters of the general linear group*, International Workshop on Differential Geometry and Its Applications, University “Politehnica” of Bucharest, Bucharest, Romania, June 21–28, 1993.

## INVITED TALKS AND SEMINARS

- *Nonclassical equivalence transformations*, Department of Mathematics, North Carolina State University, March 29, 2007.
- *The Research Initiative for Scientific Enhancement (FSU-RISE)*, Sixth Annual Research Colloquium, Fayetteville State University, NC, March 29, 2008.
- *The Research Initiative for Scientific Enhancement (FSU-RISE)*, Fifth Annual Research Colloquium, Fayetteville State University, NC, March 23, 2007.
- *Classical Lie symmetries for partial differential equations*, Institute of Fluid Mechanics and Heat Transfer, University of Technology, Graz, Austria, March, 2005.
- *Nonclassical equivalence transformations related to a parameter identification problem modelled by a partial differential equation*, Johann Radon Institute for Computational and Applied Mathematics, Linz, Austria, November, 2004.
- *Applications of symmetry analysis to parameter identification problems*, Institute for Industrial Mathematics, Johannes Kepler University, Linz, Austria, March, 2004.
- *Conditional symmetries related to a parameter identification problem arising in the car windshield design*, Institute for Industrial Mathematics, Johannes Kepler University, Linz, Austria, January, 2003.
- *Introduction to Symmetry Analysis. Monge–Ampère equations*, Institute for Industrial Mathematics, Johannes Kepler University, Linz, Austria, October, 2002.
- *Symmetry reductions for the Monge–Ampère equations*, Internal Seminar Series, Institute of Mathematics and Statistics, University of Kent, UK, March, 2001.

## OTHER RESEARCH WORKSHOPS ATTENDED

- Glass–Days 2002, Analysis and Simulation of Processes in Glass Production and Processing, Wattersn, Austria, November 21–22, 2002.
- LMS/EPSRC Short Instructional Course, New trends in computational differential equations, Centre for Mathematical Sciences, Cambridge, U.K., March 24–28, 2002.

- Workshop on Hamiltonian Dynamics Systems, Imperial College London, U.K., February 11–15, 2002.
- Euro Summer School “What is Integrability?,” Isaac Newton Institute for Mathematical Science, Cambridge, U.K., August 13–24, 2001.
- Geometric Evolution Equations and Nonlinear Elliptic Equations, Isaac Newton Institute for Mathematical Science, Cambridge, U.K., March 26 – April 1, 2001.
- Short Course on Wave Motion, School of Mathematics and Statistics, University of Birmingham, U.K., January 8–12, 2001.

## GRANTS AND AWARDS

I have received grants for attending conferences, workshops and summer schools from:

- AWM-NSF 2007 Travel Grant for Women Researchers (\$1,993)
- European Commission for young researchers
- Spezialforschungsbereich (SFB), Austria
- Engineering and Physical Sciences Research Council (EPSRC), Grant GR/M28866 “Geometric Integration of PDEs”, United Kingdom
- Isaac Newton Trust, United Kingdom
- Meteorological Office, United Kingdom
- London Mathematical Society, United Kingdom.

## PUBLICATIONS

### JOURNAL ARTICLES

- [1] N. Bilă and J. Niesen, *A new class of symmetry reductions for parameter identification problems*, to be published in Journal of Nonlinear Mathematical Physics (2009), <http://arxiv.org/abs/0807.1462>
- [2] N. Bila, E. L. Mansfield and P. A. Clarkson, *Symmetry group analysis of the shallow water and semi-geostrophic equations*, The Quarterly Journal of Mechanics and Applied Mathematics, 59, 1(2006), 95–123.
- [3] N. Bila, *Symmetry groups and Lagrangians associated to Tzitzeica surfaces*, Balkan Journal of Geometry and Its Applications, 10, 1(2005), 73–91.
- [4] N. Bila, *Application of symmetry analysis to a PDE arising in the car windshield design*, SIAM Journal on Applied Mathematics, 65, 1(2004), 113–130.
- [5] N. Bila and J. Niesen, *On a new procedure for finding nonclassical symmetries*, Journal of Symbolic Computation, 38, 6(2004), 1523–1533.
- [6] N. Bila, *Symmetry Groups and Conservation Laws of Certain Partial Differential Equations*, Balkan Journal of Geometry and Its Applications, 5, 1(2000), 39–56.
- [7] C. Udriste and N. Bila, *Symmetry Groups of Tzitzeica Surface PDE*, Balkan Journal of Geometry and Its Applications, 4, 2(1999), 123–140.

- [8] N. Bila, *Symmetry Lie Group of Surfaces with Constant Gaussian Curvature*, Scientific Bulletin, University “Politehnica” of Bucharest, Series A, 61, 1–2(1999), 123–136.
- [9] C. Udriste and N. Bila, *Symmetry Lie Group of Monge–Ampère Equation*, Balkan Journal of Geometry and Its Applications, 3, 2(1998), 121–133.
- [10] N. Bila, *Invariance of  $n$ -th order ODEs under a one-parameter Lie group of transformations*, Scientific Bulletin, University “Politehnica” of Bucharest, Series A, 60, 3–4 (1998), 57–71.
- [11] N. Bila, *Invariance of second order ODEs under two-parameter Lie group of transformations*, Scientific Bulletin, University “Politehnica” of Bucharest, Series A, 60, 3–4 (1998), 13–27.
- [12] N. Bila, *About the minimal surfaces equation*, Gazeta Matematica, XIV(XCIII), 3(1996), 143–149.
- [13] C. Udriste, C. Albu and N. Bila, *The characters of the general linear group*, Scientific Bulletin, University “Politehnica” of Bucharest, Series A, 55, 3–4(1993), 267–271.

### CONFERENCE ARTICLES

- [14] N. Bila, *Symmetries of Monge–Ampère–Tzitzeica, Camassa–Holm and Blair PDEs*, In Proceedings of The Fourth International Workshop on Differential Geometry and Its Applications, University Transilvania, Brasov, Romania, September 1999, 39–45.
- [15] N. Bila and C. Udriste, *Infinitesimal Symmetries of Camassa–Holm Equation*, Proceedings of the Workshop on Global Analysis, Differential Geometry and Lie Algebras, BSG Proceedings, 4(1999), G. Tsagas (ed.), Geometry Balkan Press, 149–160.
- [16] N. Bila, *Lie Groups Applications to Minimal Surfaces PDE*, Proceedings of the Workshop on Global Analysis, Differential Geometry and Lie Algebras, BSG Proceedings, 3(1999), G. Tsagas (ed.), Geometry Balkan Press, 197–205.

### TECHNICAL REPORTS

- [17] N. Bila, *Symmetry reductions for the Monge–Ampere equations*, IMS Report UKC/IMS/01/36, IMS, University of Kent, 2001.
- [18] N. Bila, *Symmetries of PDE systems in solar physics and contact geometry*, IMS Report UKC/IMS/01/25, University of Kent, 2001.

### ARTICLES IN PREPARATION

- [19] N. Bilă, *A special class of symmetry reductions for PDEs involving arbitrary functions*, in preparation <http://faculty.uncfsu.edu/nbila/data/paper1.pdf>
- [20] N. Bilă, *A method for finding weak conditional symmetries*, in preparation.
- [21] N. Bilă, *On a particular symmetry reduction for a parameter identification problem* in preparation.

### TEXTBOOKS

- V. Balan, N. Bila, *Differential Geometry – Exercises and Problems*, University “Politehnica” of Bucharest, Bucharest, 1997 (in Romanian)
- V. Balan, N. Bila, *Differential Equations – Elements of Theory and Problems*, University “Politehnica” of Bucharest, Bucharest, 1998 (in Romanian)

## PROFESSIONAL SERVICE

- **Reviewer:**

Journal of Physics A: Mathematical and General

Journal of Computational and Applied Mathematics

- **Item Writer - Thompson Prometric** for DSST College Algebra (2007–2008)

- **Workshop and Special Session Co-Organizer**

*Workshop on Symmetries, Inverse Problems and Image Processing*, Johann Radon Institute for Computational and Applied Mathematics, Linz, Austria, January 13–15, 2005.

*Symbolic Symmetry Analysis and Its Applications*, at the 13th International Conference on Applications of Computer Algebra, July 21–22, 2007, Oakland University, Rochester, MI, USA.

*Symbolic Symmetry Analysis and Its Applications*, at the 14th International Conference on Applications of Computer Algebra, Research Institute for Symbolic Computation, Hagenberg, Linz, Austria, July 27 - 30, 2008.

- **Departmental and University Committees (2006 – present)**

Member of the FSU Faculty Development Committee

Member of the FSU College of Arts and Science Honors and Awards Committee

Member of the Departmental Grant Writing Committee

Member of the Applied Mathematics Committee

- **Faculty Advisor and Founder** of the Fayetteville State University Student Chapter of the Association for Women in Mathematics

- **Faculty Advisor** (2008 – present)

- **Faculty Research Mentor** for North Carolina Louis Stokes Alliance for Minority Participation (2007–2008)

- **M.Sc. Thesis Committee Member:** Sarah Johnson, Fayetteville State University, 2008; M.Sc. Thesis: *Mathematical Modeling and Analysis of Cancer Radiotherapy*; Advisor: Dr. Frank Nani

- **Curriculum development:**

1) As part of the Topics in Mathematics course offered at FSU, I have proposed, designed, and taught a course on *Linear Algebra and Differential Equations with Maple*. This course is currently offered at FSU starting with the Fall Semester of 2008.

2) I have proposed and designed a course on *Numerical Methods* as part of the new program in Applied Mathematics at Fayetteville State University.

3) I am currently designing two courses on *Applied Mathematics* and *Symmetry Groups for Differential Equations*.

## COMPUTER SKILLS

Familiar with UNIX, Linux, Windows • Text editors: LaTeX, Word, Emacs • Work experience with MAPLE and MATLAB • Knowledge in HTML, C++, SAS, and Java.

## LANGUAGES

English (fluent) • Romanian (native) • French (beginner)