

Abraham D. Smith

Work Address

Mathematics Department
Duke University, Box 90320
Durham, NC 27708-0320

Education DOCTOR OF PHILOSOPHY (MATHEMATICS) Duke University. Durham, NC, USA
May 2009

Integrability of Second-Order PDEs and the Geometry of $GL(2)$ -Structures

Directed by Robert L. Bryant.

In December 2004, received Master of Arts in Mathematics in passing.

BACHELOR OF SCIENCE University of Wisconsin. Madison, WI, USA
May 2003

Majors in Mathematics and Physics, with honors in Mathematics.

Research Interests

Differential Geometry, Geometric PDEs, Exterior Differential Systems,
Mathematics Education

Current Projects

I am interested in the geometry of PDEs and local differential geometry, especially in the sense of Élie Cartan.

Currently, I am studying $GL(2, \mathbb{R})$ structures on manifolds, which arise in the context of hydrodynamic second-order PDEs and the path geometry of ODEs. The existence of certain sub-manifolds in these structures correspond to the integrability of the PDE. I have recently classified all such integrable $GL(2, \mathbb{R})$ structures locally, and now I am trying to explicitly reconstruct and solve the corresponding PDEs. I have also recently worked on problems in Finsler geometry.

References

- [1] Abraham D. Smith, *Integrable $GL(2)$ -Structures in All Dimensions*, (in preparation), 2009.
- [2] _____, *A Classification of Second-Order PDEs with $GL(2)$ Geometry*, (in preparation), 2009.
- [3] _____, *Integrability of Second-Order PDEs and the Geometry of $GL(2)$ -Structures*, Ph.D. thesis, Duke University, May 2009. [pdf]
- [4] Rann Bar-On, Paul Bendich, Benjamin Cooke, Michael Gratton, Timothy Lucas, Michael Nicholas, Nicholas Robbins, Abraham Smith, and Joseph Spivey, *Graduate Calculus Curriculum Review, Spring 2007*, March 2007. [pdf]

Curriculum Developments

ELECTRONIC TEACHING RESOURCE Duke University
Fall 2008

Under a teaching mini-grant from the Duke Graduate School, developing an on-line repository for worksheets, quizzes, and tests using MySQL, Python, Django, and Javascript. Joint with Rann Bar-On.

CURRICULUM IMPROVEMENT Duke University
Spring 2008

Updated labs and teaching materials for experimental course, Math 41L.

CALCULUS CURRICULUM REVIEW Duke University
Spring 2007

Helped organize and participated in a graduate student review of the calculus curriculum. The main result was a completely new course, Math 41L, for which we designed a complete syllabus, including textbook selection, homework lists, and lab creation. Full report: www.math.duke.edu/~adsmith/proposal.pdf

Invited Talks AMS SOUTHEASTERN SECTIONAL MEETING NC State University, Raleigh, NC, USA
April, 2009
Special Session on the geometry of PDE. *A classification for 2nd order PDEs with $GL(2,R)$ geometry*

AMS/MAA JOINT MEETING Washington DC, USA
January, 2009
Panel member for *Beyond T.A. Training: Calculus Curriculum Development by Graduate Teaching Assistants*

GEOMETRY FORUM Duke University
October, 2008
Lie algebroids and integrability theorems

GRADUATE/FACULTY SEMINAR Duke University
November, 2007
DEs to EDS: How to “solve” PDEs without being clever

GEOMETRY SEMINAR University of California, Berkeley, CA, USA
October, 2007
 $GL(2,R)$ structures and integrability

GEOMETRY FORUM Duke University
April, 2007
Finsler geometry and the technique of moving frames

Teaching Experience

CALCULUS TEACHER Duke University
Spring 2009
Lecturer for two sections of Math 32L (Lab Calculus II).

COURSE SUPERVISOR AND CALCULUS TEACHER Duke University
Fall 2008

Course Supervisor for three sections of Math 41L (Lab Calculus II for entering freshmen).
Lecturer for one 30-students section. Lab Instructor for two sections.

PRE-QUAL INSTRUCTOR Duke University
Summer 2007

One of two instructors for Pre-Qualifier Preparation Program, a week-long intensive linear-algebra and analysis review for incoming graduate students.

CALCULUS TEACHER Duke University
Fall 2006

Lecturer for a 30-student section of Math 32 (Calculus II).

PRE-QUAL INSTRUCTOR Duke University
Summer 2006

One of two instructors for Pre-Qualifier Preparation Program, a week-long intensive linear-algebra and analysis review for incoming graduate students.

CALCULUS TEACHER Duke University
Spring 2006

Lecturer for a 30-student section of Math 32L (Lab Calculus II).

CALCULUS TEACHER Duke University
Fall 2005

Lecturer for a 30-student section of Math 32L (Lab Calculus II).

TIP MENTOR Duke University
Summer 2005

Solely developed and taught a 4-week course on algebraic topology as a special program for three extremely bright teenage students in Duke's Talent Identification Program.

LAB INSTRUCTOR Duke University
Fall 2004

Lab instructor for one 30-student section of Math 32L (Lab Calculus II).

TEACHING ASSISTANT University of Wisconsin
Spring 2003

Teaching assistant for two discussion sections of Math 222 (Calculus and Analytic Geometry II).

TEACHING ASSISTANT University of Wisconsin
Fall 2002

Teaching assistant for two discussion sections of Math 221 (Calculus and Analytic Geometry I).

Professional Service

Secretary, Graduate Calculus Curriculum Review Committee. 2007.

Organizer, Duke Graduate Student Geometry Seminar. 2006.

President, Duke Math Grad Student Association. 2005.

Computer Skills

Thorough UNIX/Linux system administration experience

Languages: L^AT_EX, Python, MAPLE, passing familiarity with many others