# Andrew S. Raich

Department of Mathematical Sciences               araich@uark.edu
SCEN 327                                          (479) 575-8630 (fax)
1 University of Arkansas
Fayetteville, AR 72701                   https://araich.hosted.uark.edu/
Citizenship: U.S.A.                            Pronouns: he/him/his

## Current Position

**Professor**, University of Arkansas                          Fall 2018-Current

## Past Positions

| | |
|---|---|
| **Visiting Professor**, Universidade Federal de São Carlos | Sept. 2018 |
| **Associate Professor**, University of Arkansas | Fall 2013-Spring 2018 |
| **Visiting Fellow**, Wolfson College, University of Cambridge | Fall 2015-Spring 2016 |
| **Assistant Professor**, University of Arkansas | Fall 2008-Spring 2013 |
| **Visiting Assistant Professor**, Texas A&M University | Fall 2005-Spring 2008 |
| **Visiting Fellow**, Isaac Newton Institute, Cambridge | May 2007 |
| **Visiting Fellow**, The Erwin Schrödinger International Institute, Vienna | Oct. 2005, Nov. 2006 |
| | Nov. 2009, Dec. 2010 |

## Education

**Ph.D.** Mathematics, University of Wisconsin-Madison                   May 2005
Thesis: *Heat Equations in $\mathbb{R} \times \mathbb{C}$*
Advisor: Alexander Nagel
Minor: Probability

**M.A.**  Mathematics, University of Wisconsin-Madison                   May 2000

**B.A.**  Mathematics and Physics, Williams College                     May 1998
Magna Cum Laude with Highest Honors
Senior Thesis: $\mathbb{Z}^2$ *Actions, Flows, and Ergodicity*
Advisor: Cesar Silva

## Research Areas

Several complex variables, partial differential equations, harmonic analysis.

## Grants

**Simons Foundation Collaboration Grant** ($42,000), University of Arkansas        2020-2025
Principal Investigator. This was an individual research grant designed to support my research
program in "Problems in Microglobal Analysis" by providing travel money for collaboration.
**NSF grant DMS-1841778** ($22,127), University of Arkansas                  2018-2019

Principal Investigator. This grant supported the UFSCar International Workshop on Partial Differential Equations and Complex Analysis.

**NSF grant DMS-1405100** ($133,318), University of Arkansas                    2014-2018
Principal Investigator. This was an individual research grant to support my research in Analysis and CR Geometry in Several Complex Variables.

**Simons Foundation Collaboration Grant** ($7,000), University of Arkansas       2013-2014

**NSF grant DMS-1157517** ($89,999), University of Arkansas                     2012-2015
Co-Principal Investigator. This grant supported the 2012, 2013, and 2014 Spring Lecture Series.

**NSF grant DMS-0963810** ($85,762), University of Arkansas                     2010-2013
Principal Investigator. This grant supported the 2010, 2011, and 2012 Spring Lecture Series.

**NSF grant DMS-0855822** ($95,602), University of Arkansas                     2009-2013
Principal Investigator. This was an individual research grant to support my research in Heat Equations, Boundary Operators and CR Geometry in Complex Analysis.

## Awards and Honors

**Plenary Speaker**, Spring Western Sectional Meeting of the AMS               Spring 2017
**Fulbright College Master Research Award**, University of Arkansas                  2016
**Cambridge Faculty Fellowship**, University of Arkansas          Fall 2015-Spring 2016
**Meritorious Service Award**, University of Arkansas                          Spring 2014
**Excellence in Teaching Award**, University of Arkansas                       Spring 2012
Selected by the Graduate Assistants in the Department of Mathematical Sciences
**You've Made a Difference**, Univeristy of Arkansas                            Fall 2011
Identified by a first-year student on the MAP-Works survey through University Housing as having helped the most in his/her college success during the first few weeks of school.
**2009 Conner Faculty Fellowship**, University of Arkansas                           2009
**New Faculty Commendation for Teaching Commitment**, University of Arkansas         2009

## Publications

Note: Authors in mathematical papers are listed *alphabetically.*

1. "Analysis on Quadrics", with Al Boggess, submitted. *

2. "Weighted Hardy spaces and ultradistributions", with Gustavo Hoepfner and Patricia Rampazo, submitted.

3. "The Fundamental Solution to $\Box_b$ on Quadric Manifolds With Nonzero Eigenvalues", with Albert Boggess, submitted.

4. "Global Gevrey vectors", with G. Hoepfner and P. Rampazo, submitted.

5. "Distributions with Decay and Restriction Problems", with Gustavo Hoepfner, submitted. (arXiv:1905.06793)

6. "Boundary invariants and the closed range property for $\bar{\partial}$", with Phillip Harrington, submitted. (arXiv:1805.05793)

7. "The Fundamental Solution to $\Box_b$ on Quadric Manifolds – Part 3. Asymptotics for a Codimension 2 Case in $\mathbb{C}^4$", with Albert Boggess, to appear, *J. Geom. Anal.*

8. "The Fundamental Solution to $\Box_b$ on Quadric Manifolds – Part 1. General Formulas", with Albert Boggess, to appear, *Proc. Amer. Math. Soc.*

9. "Strong Closed Range Estimates: Necessary Conditions and Applications", with Phillip Harrington, to appear, *Indiana Univ. Math. J.* (arXiv:1904.09345)

10. "Compactness of the complex Green operator on non-pseudoconvex CR manifolds", with Joel Coacalle, *Commun. Pure Appl. Anal.* **20**(6): 2139–2154, 2021.

11. "Closed range estimates for $\bar{\partial}_b$ on CR manifolds of hypersurface type", with Joel Coacalle, *J. Geom. Anal.*, **31**(1): 366–394, 2021. (arXiv:1904.10836)

12. "$L^p$-estimates for the $\bar{\partial}_b$-equation on a class of infinite type domains", with Khanh Tran, *Math. Nachr.*, **294**(1): 82–97, 2021. (arXiv:1605.06985).

13. "The complex Green operator with Sobolev estimates up to a finite order", with Bingyuan Liu, *Internat. J. Math.*, **31**(14), 2050122, 19pp, 2020.

14. "The Kohn-Laplace equation on abstract CR manifolds: Global regularity", with Khanh Tran, *Trans. Amer. Math. Soc*, **373**(11): 7575–7606, 2020. (arXiv:1612.07445)

15. "The Fundamental Solution to $\Box_b$ on Quadric Manifolds – Part 2. $L^p$ Regularity and Invariant Normal Forms", with Albert Boggess, *Complex Anal. Synerg.*, **6**(2): Paper No. 13, 19 pp, 2020.

16. "Closed range of $\bar{\partial}$ on unbounded domains in $\mathbb{C}^n$", with Phillip Harrington, *J. Anal. Math.*, **138**(1):185–208, 2019.

17. "Global $L^q$ Gevrey Functions, Paley-Weiner Theorems, and the FBI Transform", with Gustavo Hoepfner, *Indiana Univ. Math. J.*, **68**(3): 967–1002, 2019.

18. "Microglobal Regularity and the Global Wavefront Set", with Gustavo Hoepfner, *Math. Z.*, **291**(3-4): 971–988, 2019.

19. "The Bergman Kernel on Forms: General Theory", *Proc. Amer. Math. Soc.*, **146**(11): 4683–4692, 2018. (arXiv:1706.00725)

20. "Closed range of $\bar{\partial}$ in $L^2$-Sobolev spaces on unbounded domains in $\mathbb{C}^n$", with Phillip Harrington, *J. Math. Anal. Appl.*, **459**(2): 1040–1061, 2018. (arXiv:1704.07507)

21. "Green's function asymptotics near the internal edges of spectra of periodic elliptic operators. Spectral gap interior", with Minh Kha and Peter Kuchment, *J. Spect. Theory.*, **7**(4): 1171–1233, 2017. (arXiv:1508.06703)

22. "WHAT IS a CR Manifold?", with Phillip Harrington, *Notices Amer. Math. Soc.* **64**(7): 722-724, 2017.

23. "Global $L^q$-Gevrey functions and their applications", with Ziad Adwan and Gustavo Hoepfner, *J. Geom. Anal.*, **27**(3): 1874–1913, 2017.

24. "A remark on boundary estimates on unbounded $Z(q)$ domains in $\mathbb{C}^n$", with Phillip Harrington, *Complex Var. Elliptic Equ.*, **62**(9): 1192-1203, 2017.

25. "Schrödinger Operators With $A_\infty$ Potentials", with Michael Tinker, *Potential Anal.*, **45**(2): 387-402, 2016. (arXiv:1508.07150)

26. "Closed range for $\bar{\partial}$ and $\bar{\partial}_b$ on bounded hypersurfaces in Stein manifolds", with Phillip Harrington, *Ann. Inst. Fourier (Grenoble)*, **65**(4): 1711-1754, 2015.

27. "The Szegö kernel on a class of noncompact CR manifolds of high codimension", with Michael Tinker, *Complex Var. Elliptic Equ.*, **60**(10): 1366–1373, 2015.

28. "Taylor Series of Conformal Mappings onto Symmetric Quadrilaterals", with Loredana Lanzani and Jeanine Myers, *Complex Var. Elliptic Equ.*, **60**(8): 1133–1141, 2015.

29. "The Kerzman-Stein operator for piecewise continuously differentiable regions", with Michael Bolt, *Complex Var. Elliptic Equ.*, **60**(4): 478–492, 2015. (arXiv:1208.2192)

30. "Regularity equivalence of the Szegö projection and the complex Green operator", with Phillip Harrington and Marco Peloso, *Proc. Amer. Math. Soc*, **143**(1):353-367, 2015. (arXiv:1305.0188)

31. "$L^p$-Estimates for the $\bar{\partial}$-equation on a class of infinite type domains", with Ly Kim Ha and Khanh Tran, *Internat. J. Math.*, **25**(11): 2014. 1450106 (15 pages).

32. "Sobolev spaces and elliptic theory on unbounded domains in $\mathbb{R}^n$", with Phillip Harrington, *Adv. Differential Equations*, **19**(7/8): 635-692, 2014. (arXiv:1209.4044)

33. "Div-curl type inequalities for higher order operators", with Loredana Lanzani, *Advances in Analysis: The Legacy of Elias M. Stein* (Princeton Mathematical Series). Princeton U. Press (2013), ISBN: 9780691159416.

34. "Defining functions for unbounded $C^m$ domains", with Phillip Harrington, *Rev. Mat. Iberoam.* **29**(4):1405-1420, 2013.

35. "Fundamental solutions to $\Box_b$ on certain quadrics", with Albert Boggess, *J. Geom. Anal.*, **23**(4):1729-1752, 2013.

36. "Heat kernels, smoothness estimates and exponential decay", with Albert Boggess, *J. Fourier Anal. Appl.*, **19**:180-224, 2013.

37. "Green's function asymptotics near the internal edges of spectra of periodic elliptic operators. Spectral edge case.", with Peter Kuchment, *Math. Nachr.*, **285**:1880-1894, 2012.

38. "An Aronsson type approach to extremal quasiconformal mappings", with Luca Capogna, *J. Differential Equations.* **253**:851-877, 2012.

39. "Heat equations and the weighted $\bar{\partial}$-problem", *Commun. Pure Appl. Anal.* **11**(3):885-909, 2012.

40. "The $\Box_b$-heat equation on quadric manifolds", with Albert Boggess, *J. Geom. Anal.* **21**:256-275, 2011.

41. "Regularity results for $\bar\partial_b$ on CR-manifolds of hypersurface type", with Phillip Harrington, *Comm. Partial Differential Equations.* **36**:134-161, 2011.

42. "Compactness of the complex Green operator on CR-manifolds of hypersurface type", *Math. Ann.* **348**:81-117, 2010.

43. "A simplified calculation for the fundamental solution to the heat equation on the Heisenberg group", with Albert Boggess, *Proc. Amer. Math. Soc.* **137**:937-944, 2009.

44. "Compactness of the complex Green operator", with Emil J. Straube, *Math. Res. Lett.*, **15**(4): 761-778, 2008.

45. "Pointwise estimates for relative fundamental solutions of heat equations in $\mathbb{R} \times \mathbb{C}$", *Math. Z.*, **256**:193-220, 2007.

46. "Heat equations in $\mathbb{R} \times \mathbb{C}$", *J. Funct. Anal.*, **240**:1-35, 2006.

47. "One-parameter families of operators in $\mathbb{C}$", *J. Geom. Anal.*, **16**(2):353-374, 2006.

48. "Infinite ergodic index $\mathbb{Z}^d$-actions in infinite measure" with E. J. Muehlegger, C. E. Silva, M. P. Touloumtzis, B. Narasimhan and W. Zhao. *Colloq. Math.* **82**:167-190, 1999.

49. "Lightly mixing on dense algebras" with E. J. Muehlegger, C. E. Silva and W. Zhao. *Real Analysis Exchange* **23**:259-265, 1997/1998.

\* – Denotes an expository paper.

# Teaching Experience

**Introduction to Partial Differential Equations**, University of Arkansas

**Elementary Analysis**, University of Arkansas

**Complex Variables I, II**, University of Arkansas

**Advanced Calculus I, II**, University of Arkansas

**Functional Analysis**, University of Arkansas

**Calculus I, II**, University of Arkansas

**Partial Differential Equations**, University of Arkansas

**Ordinary Differential Equations**, University of Arkansas

**Differential Equations**, Texas A&M University,

**Business Mathematics I**, Texas A&M University

**Engineering Mathematics II,III**, Texas A&M University

**Business Calculus II**, Texas A&M University

# Service and Committee Work

**Chair:** Hiring Search Committee, Dept. Math. Sci., U. Arkansas                      Fall 2021-

**Co-organizer:** Virtual East West Several Complex Variables seminar                      Fall 2020-

**Graduate Coordinator:**, Dept. Math. Sci., U. Arkansas                      Fall 2021-

**Promotion and Tenure Committee:** Dept. Math. Sci., U. Arkansas            Fall 2021-

**Co-organizer:** Virtual East-West Several Complex Variables seminar,            Fall 2020-
This is a weekly seminar with 60-80 regular attendees coming from time zones ranging from California to Japan.

**Member:** Calculus Success Working Group,            Fall 2019-
This is a working group with Engineering, Pearson, Math, and the Student Success Folks to look at historical Pearson usage data among Calculus I and II students to build an early warning system to detect students at risk of a grade of D, W, or F. We debuted the system during the Fall 2020 semester.

**Graduate Committee:** Dept. Math. Sci., U. Arkansas            Fall 2020-Spring 2021

**Member:** Faculty Senate, University of Arkansas            Fall 2019-Spring 2021

**DEI Committee Co-chair**, Dept. Math. Sci., U. Arkansas            Fall 2019-Spring 2020
DEI stands for Diversity, Equity, and Inclusion, and the function of the committee is generate policy and actions for the Department of Mathematical Sciences to increase the representation and inclusion for Underrepresented Groups.

**Undergraduate Coordinator:**, Dept. Math. Sci., U. Arkansas            Fall 2017-Summer 2020

**Co-organizer:** Special Session on Partial Differential Equations in Several Complex Variables at the Fall 2018 Southeastern Sectional Meeting of the AMS, University of Arkansas.            Nov. 2018

**Co-organizer:** UFSCar International Workshop on Partial Differential Equations and Complex Analysis in São Carlos, Brazil. This was a official Satellite Conference of the 2018 ICM in Rio de Janeiro, Brazil.            August 2018

**Co-organizer:** Special Session on Several Complex Variables and PDEs at the Spring 2017 Western Sectional Meeting of the AMS, Washington State University.

**Instructor:** Osher Lifelong Learning Institute            March 2017
OLLI sponsored courses provide high quality, affordable educational, cultural, and engagement opportunities for seasoned adults. I taught a four hour class over two weeks about cardinality and the Cantor set.

**Curriculum Committee Chair:** U. Arkansas,            Fall 2016-Spring 2017

**Hiring Committee:**, Dept. Math. Sci., U. Arkansas            Fall 2016-Spring 2017

**Third Year Review Committee:** Dept. Math. Sci., U. Arkansas            Fall 2016-Spring 2017.

**Faculty Mentor:** Dept. Math. Sci., U. Arkansas            Fall 2014-current

**Steering Committee Chair**, Dept. of Math. Sci., University of Arkansas Fall 2015-Spring 2016

**Steering Committee**, Dept. of Math. Sci., University of Arkansas            Fall 2013-Spring 2015

**Contact Organizer:** "Harmonic Analysis, $\overline{\partial}$, and CR Geometry (15w5074)", BIRS-CMO
Oaxaca, Mexico            Oct. 2015

**Curriculum Committee Chair:** U. Arkansas,            Fall 2014-Spring 2015

**Hiring Committee:**, Dept. Math. Sci., U. Arkansas            Spring 2014-Spring 2015

**Co-Organizer:** "Celebration of the Mind"            Fall 2012, 2013
**Faculty Advisor:** "Celebration of the Mind"            Fall 2014-current
The Celebration of Mind is a math fair for K-12 students andand the community at large. We

enlisted graduate and undergraduate math students design interactive math games and projects for the fair. We tied the projects directly to the *Common Core Standards for Mathematics* and provided handouts for the teachers that detailed the activities and their tie-in to the standards. Our goal was to increase the number of math and statistics majors at the University of Arkansas and anticipate that the fair will happen annually.

**M-SEA Instructor** <span style="float:right">Summer 2011, 2012, 2013</span>

My colleague Janet Woodland and I organized a session for the Mathematics, Science and Engineering Academy (M-SEA) run by the Cooperative Developmental Energy Program (CDEP) at Fort Valley State University. CDEP is a program whose goal is to increase the number of women and minorities in the geosciences. Fort Valley offers a 3-2 program – earn a B.S. at Fort Valley in three years and a second B.S. at a partner institution in two years. The University of Arkansas is one of the partner institutions. The M-SEA is a program that identifies and prepares talented girls and minorities to enter CDEP. The students enroll in eighth grade and their summers are spent at Fort Valley and the partner institutions receiving education and training. Dr. Woodland and I developed a class in which we had the students derive a discrete version of Fick's Law of Diffusion and model lake pollution. We then pointed out that the mathematical underpinnings of Fick's Law of Diffusion are the same as Newton's Law of Cooling, Fourier's Law of Heat Conduction, and Ohm's Law of Electrical Conduction.

**Organizer:** U. of Arkansas Spring Lecture Series in the Mathematical Sciences 2010, 2011, 2014.

**Article Referee:** Annali della Scuola Normale Superiore di Pisa, Complex Variables and Elliptic Equations, Illinois Journal of Mathematics, Journal of Differential Geometry, Journal of Geometric Analysis, Journal of Mathematical Analysis and Applications, Journal of Topology and Analysis, Mathematische Annalen, Mathematische Nachrichten, Mathematics Zeitschrift, Michigan Mathematical Journal, Proceedings of the American Mathematical Society, Revista Mat. Iber., Rocky Mountain Journal of Mathematics, Transactions of the American Mathematical Society

**Project Evaluator:** Università degli Studi di Milano, Università degli Studi di Padova

**Co-organizer:** Special Session on Several Complex Variables and CR Geometry at the Fall 2013 Eastern Sectional Meeting of the AMS, Temple University.

**Graduate Committee**, Dept. of Math. Sci., University of Arkansas <span style="float:right">Fall 2010-Spring 2013</span>

**Reviewer: Mathematical Reviews** (American Mathematical Society) <span style="float:right">Fall 2008-current</span>

**MASC Library Representative** <span style="float:right">Fall 2009-Spring 2013</span>

**Mathematical Sciences Hiring Committee** <span style="float:right">Fall 2008</span>

**Volunteer Instructor**, Summer Educational Enrichment in Math <span style="float:right">June 2006, July 2007</span>

Planned and led three 2.5 hour workshops titled "How Google Works" for incoming 6th, 7th, and 8th graders. SEE-Math is a yearly program run by the Texas A&M Mathematics Department.

**Organizer**, Several Complex Variables Seminar, Texas A&M University <span style="float:right">June 2006-May 2008</span>

# Invited Talks (International)

1. "The $\square_b$-equation on quadric submanifolds", Virtual East-West Several Complex Variables seminar, May 2020.

2. "Distributions with Decay and Restriction Problems"

(a) 10th Workshop on Geometric Analysis of PDEs and Several Complex Variables, Serra Negra, Brazil, Aug. 2019.

(b) PDE Seminar, University of São Paulo, São Carlos, Brazil, Aug. 2019.

3. "Introduction to CR Geometry and the Tangential Cauchy-Riemann Operator", A Minicourse at the 10th Workshop on Geometric Analysis of PDEs and Several Complex Variables, Serra Negra, Brazil, Aug. 2019.

(a) Lecture 1: An Introduction to CR Geometry

(b) Lecture 2: The tangential Cauchy-Riemann operator and the Levi form

(c) Lecture 3: The $\bar{\partial}_b$-problem on the Heisenberg group

(d) Lecture 4: CR Geometry and d-bar today: The $\square_b$-problem on Quadric Submanifolds of $\mathbb{C}^n \times \mathbb{C}^m$.

4. "Strong Closed Range Estimates: Necessary Conditions and Applications", Analysis and Geometry in Several Complex Variables III, Doha, Qatar, Jan. 2019.

5. "The complex Green operator on quadric submanifolds", II Joint Meeting of the Spanish and Brazilian Mathematics Societies, Special Session in Complex Analysis and Operator Theory, Cadiz, Spain, Dec. 2018.

6. "The Global Behavior of the Fourier and FBI Transforms", Partial Differential Equations Seminar, University of Wollongong, Australia, Oct. 2018.

7. "Closed range of the Cauchy-Riemann operator on domains in $\mathbb{C}^n$, Mathematics Colloquium, Universidade Federal de São Carlos, Brazil, Sep. 2018.

8. "Global $L^q$ Gevrey Functions and Applications", Symposium in Harmonic Analysis and Geometric Measure Theory, University of São Paulo, Ribeirão Preto, Brazil, August 2018.

9. "Boundary invariants and the closed range property for $\bar{\partial}$", UFSCar International Workshop on Partial Differential Equations and Complex Analysis, Universidade Federal de São Carlos, Brazil, Aug. 2018.

10. "CR Invariants and Solvability of the $\bar{\partial}$-equation", CR-Geometry and PDEs VIII, Levico Terme, Italy, June 2018.

11. "The Global Behavior of the Fourier and FBI transforms",

(a) Analysis Seminar, Università degli Studi di Milano, Milan, Italy, June 2018.

(b) Ninth Workshop on the Geometric Analysis of PDEs and SCV, Serra Negra, Brazil, Aug. 2017.

12. "The complex Green operator on quadric submanifolds in $\mathbb{C}^4$", Workshop on d-bar at NTNU Trondheim, Norway, Trondheim, Norway, Oct. 2017.

13. "The complex Green operator on quadric submanifolds", Analysis and geometry in several complex variables II, Doha, Qatar, Jan. 2017.

14. "The $L^2$-theory of the $\bar{\partial}$-equation on unbounded domains", Mathematics Colloquium, Fudan University, Shanghai, June 2016.

15. "Global $L^q$-Gevrey Functions Spaces with Applications", Workshop on *Harmonic Analysis and Several Complex Variables*, Vietnam Institute for the Advances Study in Mathematics, Hanoi, Vietnam, June 2016.

16. "Complex Analysis – Simplified!", Wolfson College Science Society Seminar, University of Cambridge, Cambridge, UK, Apr. 2016.

17. "Global $L^q$-Gevrey Function Spaces",

    (a) Mathematics Colloquium, Universidade Federal de São Carlos, Mar. 2016

    (b) Several complex variables and CR geometry, Erwin Schrödinger Institute, Vienna, Austria, Nov. 2015.

18. "The $\bar{\partial}$-equation on unbounded domains",

    (a) Geometric Analysis and Partial Differential Equations Seminar, University of Cambridge, Cambridge, England, Oct. 2015.

    (b) Harmonic Analysis, $\bar{\partial}$, and CR Geometry, BIRS-CMO, Oaxaca, Mexico, Oct. 2015.

19. "The $\Box_b$-heat equation on quadric submanifolds", Analysis Seminar, Università degli Studi di Milano, Milan, Italy, June 2015.

20. "Regularity of the Bergman projection", Analysis and geometry in several complex variables, Doha, Qatar, Jan. 2015.

21. "The $\Box_b$-heat equation for the Heisenberg group and quadric submanifolds", Università degli Studi di Milano, Milan, Italy, June 2014.

22. "$L^p$-Sobolev and Hölder Estimates for the Bergman kernel", Università degli Studi di Padova, Padua, Italy, June 2014.

23. "$\Box_b$-heat kernel decay and the Fourier transform", Analysis Seminar. University of British Columbia, Vancouver, BC, Canada, Nov., 2012.

24. "Closed range for $\bar{\partial}$ on $(0,q)$-forms and a weak $Z(q)$-condition", Workshop: CR-Geometry and PDEs - V, Levico Terme, Trento, Italy, June 5-8, 2012.

25. "Gaussian estimates for $\Box_b$-heat kernels and quantitative smoothness estimates", The $\bar{\partial}$-Neumann problem: Analysis, Geometry, and Potential Theory. International Erwin Schrödinger Institute for Mathematical Physics, Vienna, Austria, Dec. 2010

26. "Heat kernel decay via the Fourier transform", Spectral Theory of Operators in Analytic Functions Spaces. Centre International de Recontres Mathémathique, Marseilles, France, April 2010

27. "Closed range of $\bar{\partial}_b$ on CR-manifolds of hypersurface type", The $\bar{\partial}$-Neumann Problem: Analysis, Geometry and Potential Theory. International Erwin Schrödinger Institute for Mathematical Physics, Vienna, Austria, Nov. 2009

28. "Compactness of the Complex Green Operator on CR Manifolds of Hypersurface Type", First Joint International Meeting of the AMS with CMS, Special Session on Several Complex Variables and Applications, Shanghai, China, Dec. 2008

29. "Pointwise heat kernel estimates with applications to complex analysis". Complex Analysis, Operator Theory, and Applications to Mathematical Physics – Followup Fall 2006, International Erwin Schrödinger Institute for Mathematical Physics, Vienna, Austria, Nov. 15, 2006.

30. "Pointwise Estimates for Relative Fundamental Solutions of Heat Equations in $\mathbb{R} \times \mathbb{C}$." International Conference in PDE, Complex Analysis, and Differential Geometry, Notre Dame University, June 13, 2006.

31. "Estimates of heat kernels for the $\Box_{\tau p}$ heat equation in $\mathbb{R} \times \mathbb{C}$," Program in Complex Analysis, Operator Theory, and Applications to Mathematical Physics: Workshop: Complex Analysis and Partial Differential Equations, International Erwin Schrödinger Institute for Mathematical Physics, Vienna, Austria, Oct. 27, 2005

## Invited Talks (Domestic)

1. "Compactness of the complex Green operator on non-pseudoconvex CR manifolds", Joint Mathematics Meeting 2022, AMS Special Session on Partial Differential Equations and Complex Variables, Seattle, WA, Jan. 2022.

2. "The $\Box_b$-equation on quadric submanifolds and applications", Joint Mathematics Meeting 2022, AMS Special Session on Several Complex Variables Geometric PDE and CR Geometry, Seattle, WA, Jan. 2022.

3. "Recent progress on the $\Box_b$-equation on quadrics", Midwest Several Complex Variables Conference, Dearborn, MI, Oct. 2019.

4. "Distributions with Decay and Restriction Problems", AMS 2019 Fall Central Sectional Meeting #1150, Special Session on Recent Developments in Harmonic Analysis, Madison, WI, Sep. 2019.

5. "Strong Closed Range Estimates: Necessary Conditions and Applications", AMS 2019 Fall Central Sectional Meeting #1150, Special Session on Several Complex Variables, Madison, WI, Sep. 2019.

6. "Boundary invariants and the closed range property for $\bar{\partial}$",

   - Analysis Seminar, UCSD, Apr. 2018.
   - Analysis Seminar, Temple University, Mar. 2018.

7. "Boundary invariants and the closed range property for d-bar", AMS 2018 Spring Central Sectional Meeting #1136, Special Session on Several Complex Variables, Columbus, OH, Mar. 2018.

8. "The Global Behavior of the Fourier and FBI transforms", Analysis Seminar, UC-Irvine, Jan. 2018.

9. "The Bergman kernel on forms: General theory"

   - AMS 2017 Fall Eastern Sectional Meeting #1132, Special Session on CR Geometry and Partial Differential Equations in Complex Analysis, Buffalo, NY, Sep. 2017.
   - AMS 2017 Fall Western Sectional Meeting #1134, Special Session on Special Session on Several Complex Variables, Riverside, CA, Nov. 2017.

10. "Closed range of the Cauchy-Riemann operator on domains in $\mathbb{C}^n$," Plenary Address, AMS 2017 Spring Western Sectional Meeting #1128, Washington State University, April 2017.

11. "The Kohn-Laplace equation on abstract CR manifolds: Global regularity," AMS 2017 Spring Western Sectional Meeting #1128, Special Session on Several Complex Variables and PDEs, Washington State University, April 2017.

12. "The $\Box_b$-equation on quadric submanifolds"

   - Several Complex Variables Seminar, Texas A&M University, April 2015.
   - Analysis Seminar, University of Arkansas, April 2015.

13. "The Szegö kernel on a class of noncompact CR manifolds of high codimension," AMS 2015 Spring Central Sectional Meeting #1108, Special Session on Complex Analysis in Several Variables and its Applications, East Lansing, MI, March 2015.

14. "Closed range of $\bar{\partial}$ and a weak $Z(q)$ condition", Complex and Harmonic Analysis Lectures in Honor of Alex Nagel, Madison, WI, Apr. 2013.

15. "The Kerzman-Stein operator for piecewise continuously differentiable regions", AMS 2012 Fall Central Sectional Meeting #1084, Special Session on Complex Analysis and its Broader Impacts, Akron, OH, October 2012.

16. "Defining functions on unbounded domains in $\mathbb{R}^n$" AMS 2012 Spring Central Section Meeting #1081, Special Session on Interplay between Geometry and Partial Differential Equations in Several Complex Variables, Lexington, KY, Mar. 2012.

17. "Part 1: The Mathematics and Statistics Graduate Program at the University of Arkansas. Part 2: Convergence of Power Series – Think You're An Expert? Think Again!", Colloquium, University of Arkansas-Fort Smith, Nov. 2011.

18. "An Aronsson type approach to extremal quasiconformal mappings", AMS 2011 Fall Eastern Sectional Meeting #1072, Special Session on Geometric Aspects of Analysis and Measure Theory, Ithaca, NY, Sep. 2011.

19. "Heat kernels, Gaussian decay and the Fourier transform", Several Complex Variables Seminar, Texas A&M University, Feb. 2011.

20. "How to study for graduate math classes and conduct research in mathematics", Graduate Student Seminar, University of Arkansas, Aug. 2010.

21. "Applying for academic jobs in the mathematical sciences", Graduate Student Seminar, University of Arkansas, Mar. 2010.

22. "The $\square_b$-heat kernel on quadric manifolds", Mathematics Colloquium, Georgetown University, Oct. 2009.

23. "Compactness of the complex Green operator", Mathematics Colloquium, Notre Dame University, April 2009.

24. "Compactness of the complex Green operator on CR manifolds of hypersurface type", AMS Spring Central Sectional Meeting #1047, Special Session on Holomorphic and CR Mappings (Code: SS 9A), Urbana, IL, Mar. 2009.

25. "The weighted $\bar{\partial}$-heat equation with applications", Analysis and PDE Seminar, Johns Hopkins University, Nov. 2008.

26. "On A Class of Integral Operators Related to the Weighted $\bar{\partial}$-equation in $C$", AMS Southeastern Sectional Meeting #1037, Special Session on Harmonic Analysis and Partial Differential Equations in Real and Complex Domains, Baton Rouge, LA, Mar. 2008.

27. "Compactness of the complex Green operator II", AMS Eastern Sectional Meeting #1031, Special Session on Geometric Analysis of Complex Laplacians, New Brunswick, NJ, Oct. 6, 2007.

28. "Heat Kernel Estimates with Applications to Complex Analysis." AMS Spring Central Section Meeting #1025, Special Session on PDE Methods in Several Complex Variables, Miami University, Oxford, OH, Mar. 17, 2007.

29. "Pointwise Estimates for Heat Kernels in $\mathbb{R} \times \mathbb{C} \times \mathbb{C}$." AMS Southeastern Sectional Meeting #1022, S3A - Special Session on Boundary Operators in Real and Complex Domains, University of Arkansas-Fayetteville, Nov. 3, 2006.

30. "Pointwise estimates on kernels of a family of heat equations in $\mathbb{R} \times \mathbb{C}$ with applications to several complex variables."
    - Analysis Seminar, University of Georgia, May 3, 2006.
    - Several Complex Variables Seminar, Texas A&M University, April 26, 2006.

31. "An introduction to the spectral theorem with an application to PDEs", VIGRE Seminar, University of Georgia, May 2, 2006.

32. "Scaling and PDEs – how to solve a differential equation without doing any work", Pi Mu Epsilon Undergraduate Math Club Talk, Texas A&M University, April 24, 2006.

33. "The magic of conditional convergence." Math Week, Madison East High School, May 2005.

34. "Heat equations in $\mathbb{R} \times \mathbb{C}$."
    - Several Complex Variables Seminar, University of Illinois at Urbana-Champaign, Apr. 19, 2005.
    - Several Complex Variables Seminar, Texas A&M University, Apr. 8, 2005.

35. "Heat equations and the $\bar{\partial}$-problem on weighted $L^2$ spaces in $\mathbb{C}$." Special Session: Complex and Functional Analysis II, Joint Mathematical Meetings, Atlanta, Georgia, Jan. 8, 2005.

36. "Heat kernels and the weighted $\bar{\partial}$-equation on $\mathbb{C}$."

- Real and Complex Analysis Seminar, Ohio State University, Nov. 16, 2004.
- Several Complex Variables Seminar, University of Michigan, Oct. 25, 2004.
- Analysis Seminar, UW-Madison, Oct. 19, 2004.