

Sarah Jane Hamilton

CONTACT INFORMATION

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RESEARCH INTERESTS

- Inverse Problems and Nonlinear solution methods
- Complex Geometrical Optics Solutions and D-bar Methods
- Medical imaging, in particular Electrical Impedance Tomography
- Including *a priori* data into imaging modalities

SPECIALTIES

- Nonlinear solution methods for partial differential equations using D-bar methods, Complex Geometrical Optics Solutions and nonlinear scattering transforms.
- Electrical Impedance Tomography

EDUCATION

Colorado State University, Fort Collins, Colorado USA

Ph.D., Mathematics, August 2012

- Dissertation Topic: “*A Direct D-bar Reconstruction Algorithm for Complex Admittivities in $W^{2,\infty}(\Omega)$ for the 2-D EIT Problem*”
- Advisor: Professor Jennifer L. Mueller

M.S., Mathematics, August 2009

- Topic: “*Simulation of Voltages on Electrodes for the 2-D EIT Forward Admittivity Problem by the Continuum and Electrode Models*”
- Advisor: Professor Jennifer L. Mueller

Saint Michael’s College, Colchester, Vermont USA

B.S., Mathematics, *Summa Cum Laude, Phi Beta Kappa*, May 2007

ACADEMIC POSITIONS

Marquette University: Department of Mathematics, Statistics and Computer Science
Assistant Professor, 2014-present

University of Helsinki: *Centre of Excellence in Inverse Problems Research*
Department of Mathematics & Statistics, Helsinki, Finland

Post-doctoral Researcher, August 2012-May 2014

Supervisor: Professor Samuli Siltanen (samuli.siltanen@helsinki.fi)

General Electrical Healthcare, Helsinki, Finland

Imaging Science Research Consultant, November 2012-present

Contact: Kimmo Uutela, kimmo.uutela@med.ge.com, Phone: +358 10 39411

INTERDISCIPLINARY RESEARCH

Electrical Impedance Tomography: 2008-present
The nature of the Electrical Impedance Tomography (EIT) problem is interdisciplinary which has led me to develop collaborative relationships with mathematicians, biomedical and electrical engineers, medical doctors, and physicists resulting in strong ties with *GE Healthcare, Colorado State University, Rennelear Polytechnic Institute, University of Helsinki, University of Eastern Finland, Danmarks Tekniske Universitet (DTU)*, and *University College London*.

PrIMES: 2007-2012

Fellow of the interdisciplinary research team for the PRogram in Interdisciplinary Mathematics Ecology and Statistics (PrIMES) program, an NSF IGERT funded project, at Colorado State University. Our team studied management strategies used at Badlands National Park on the resident bison herd. Work involved on site research, determination of survival and breeding parameters of herd from annual roundup data, as well as Leslie matrix modeling of the herd to evaluate and test management strategies using adjoint-based sensitivity analysis.

FEScUE: 2010-2012

Mentor for the interdisciplinary Flexible and Extendable Scientific Undergraduate Experience (FEScUE) research program, an NSF UBM funded program, at Colorado State University.

JOURNAL
ARTICLES

- [1] **S. J. Hamilton**, “EIT Imaging of admittivities with a D-bar method and spatial prior: experimental results for absolute and difference imaging”, *Physiol Meas.* 2017 May 22; 38(6):1176-1192. doi: 10.1088/1361-6579/aa63d7.
- [2] M. Alsaker, **S. J. Hamilton**, and A. Hauptmann, “A Direct D-bar Method for Partial Boundary Data Electrical Impedance Tomography with A Priori Information”, *Inverse Problems and Imaging*, Volume 11, No. 3, 2017, 427-454, doi: 10.3934/ipi.2017020.
- [3] **S. J. Hamilton**, J. L. Mueller, M. Alsaker, “Incorporating a Spatial Prior into Nonlinear D-Bar EIT Imaging for Complex Admittivities”, *IEEE Trans. Med. Imag.*, Vol. 36, No. 2, February 2017, 457-466, doi: 10.1109/TMI.2016.2613511.
- [4] **S. J. Hamilton**, J. M. Reyes, S. Siltanen, and X. Zhang, “A Hybrid Segmentation and D-bar Method for Electrical Impedance Tomography”, *SIAM Journal on Imaging Sciences*, 9(2): 770-793, 2016.
- [5] **S. J. Hamilton**, A. Hauptmann, and S. Siltanen, “A Data-Driven Edge-Preserving D-bar Method for Electrical Impedance Tomography”, *Inverse Problems and Imaging*, 8(4): 1053-1072 (2014) .
- [6] **S. J. Hamilton**, M. Lassas, and S. Siltanen, “A Direct Reconstruction Method for Anisotropic Electrical Impedance Tomography”, *Inverse Problems*, 30(7):1-33, 2014.
- [7] **S. J. Hamilton** and S. Siltanen, “Nonlinear Inversion from Partial EIT Data: Computational Experiments”, *Contemporary Mathematics: Inverse Problems and Applications*, 615:105-129 (2014).
- [8] **S. J. Hamilton** and J. L. Mueller, “Direct EIT reconstruction of complex admittivities on a chest-shaped domain in 2-D”, *IEEE Transactions on Medical Imaging*, 32: 757-769. 2013.
- [9] **S. J. Hamilton**, C. N. L. Herrera, J. L. Mueller, and A. Von Herrmann, “A direct D-bar reconstruction algorithm for recovering a complex conductivity in 2D”, *Inverse Problems*, 28(095005): 24pp, 2012.
- [10] M. Buhnerkempe, N. Burch, **S. Hamilton**, K. Byrne, E. Childers, L. McManus, K. Holfelder, M. Pyne, G. Schroeder, P. Doherty, Jr., “The Utility of Transient Sensitivity for Wildlife Management and Conservation: Bison as a Case Study”, *Biological Conservation*, 144(6):1808-1815. 2011.
- [11] M. Pyne, K. Byrne, E. Childers, L. Davis, P. Doherty, Jr., **S. Hamilton**, K. Holfelder, and G. Schroeder, “Survival and Breeding Transitions for a Reintroduced Bison Population: a Multi-state Approach”, *Journal of Wildlife Management*, 74(7):1463-1471. 2010.
- [12] A. Dean, J. Ellis-Monaghan, **S. Hamilton**, and G. Pangborn, “Unit rectangle visibility graphs”, *Electronic Journal of Combinatorics*, 15 (2008), #R79, 1-24.

REFEREED
CONFERENCE
PAPERS

Michelle M. Mellenthin, Jennifer L. Mueller, Erick Dario León Bueno de Camargo, Fernando Silva de Moura, **Sarah J. Hamilton**, and Raul Gonzalez Lima, “The ACE1 Thoracic Electrical Impedance Tomography System for Ventilation and Perfusion”, *37th Annual International Conference of the IEEE Engineering in Medicine and Biology Society*, MiCo, Milano Conference Center, Milano, Italy, August 25-29, 2015.

GRANTS

Summer Faculty Fellowship, Marquette University (funded \$5,500 for Summer 2017).
“Improving Visualization of Heart and Lung Function in ICU Patients with Electrical Impedance Tomography.”

Sloan Research Fellowship, Sloan Foundation (applied 9/15/16 for \$60,000 over two years, not funded).

National Center for Faculty Development and Diversity Faculty Success Program Grant
Awarded Spring 2015 for Fall 2016 term.

Marquette University Strategic Innovation Grant, for a *Preclinical Lung Transplant Center*, Co-Investigator with PI’s Dr. Anne Clough and Dr. Said Audi. (not funded, March 2015)

NSF Travel Grant for Junior Scientists funded \$1,500, awarded March 2015.

Summer Faculty Fellowship, Marquette University (funded \$5,500 for Summer 2015).
“Improving Contrast in 3D Electrical Impedance Tomography Imaging for Stroke Classification.”

Summer Research Fellowship 2011, Mathematics Department, Colorado State University, Fort Collins, Colorado, USA.

HONORS AND
AWARDS

Project NExT Fellow (Gold14 Dot), Mathematics Association of America, 2014-2015.

Finnish Inverse Problems Society: Inducted in December 2012.

SalWe Research Fellowship: 2012-present, Mathematics Department, University of Helsinki, Helsinki, Finland.

Outstanding Graduate Teaching Assistant Award 2010-2011, Mathematics Department, Colorado State University, Fort Collins, Colorado, USA.

PrIMES Research Fellowship 2007, NSF-IGERT Grant DGE-#0221595, administered by the Program in Interdisciplinary Mathematics Ecology and Statistics (PrIMES) at Colorado State University, Fort Collins, Colorado, USA.

Phi Beta Kappa Society: Gamma Chapter of Vermont, *Saint Michael’s College*, inducted 2006.

PROFESSIONAL
ACTIVITIES

Co-Organizer of mini-symposium “Nonlinear Mathematics of Electrical Impedance Imaging” at the *SIAM Conference on Imaging Science 2016* (IS16).

Visiting Researcher at Institut Henri Poincaré, June 22-July 6, 2015, during the *Program on Inverse Problems*, Paris, France.

Organizer of mini-symposium “M41: Advances in Electrical Impedance Tomography imaging: Algorithms and Experimental Results” at the *Applied Inverse Problems conference 2015* (AIPC) in Helsinki, Finland, May 25-29, 2015.

Co-Editor of a Special Issue of *Inverse Problems and Imaging* (IPI vol 8 no. 4, November 2014) focused on Complex Geometrical Optics solutions, 2013-2014.

Co-Organizer of *Exceptional Circle Helsinki Workshop*, August 12-16, 2013
<https://wiki.helsinki.fi/display/mathstatHenkilokunta/Exceptional+Circle+Workshop+2013>

Member of the *International Steering Committee on Electrical Impedance Tomography*, 2013.

Visiting Researcher at Institut Mittag-Leffler: The Royal Swedish Academy of Sciences, March 1-31, 2013, *Inverse Problems and Applications*, Djursholm, Sweden.

Referee of scientific manuscripts for the following journals:

- *Inverse Problems*
- *IEEE Transactions on Medical Imaging*
- *Inverse Problems and Imaging*
- *Inverse Problems in Science & Engineering*
- *Journal of Inverse and Ill-Posed Problems*
- *SIAM J. of Applied Mathematics*
- *SIAM Undergraduate Research Online*
- *Journal of Mathematical Biology*

SERVICE AND
OUTREACH

Member of AWM Student Chapters Awards committee 2017. **2017**

Reviewer of *Computational Sciences Summer Fellowship Program* applications. **2017**

Coordinator of Colloquium Series in MSCS at Marquette University **2016-2017**

Volunteer for the *High School Math Day at Marquette University*. **Feb. 2017**

Volunteer for the *Summit Educational Association* (<http://www.summitea.org/>) **Su. 2016**

Reviewer of *Computational Sciences Summer Fellowship Program* applications. **2016**

Faculty Sponsor of the Marquette University student chapter of ASSOCIATION OF WOMEN IN MATHEMATICS. Founding member. **Fa. 2015 - Present**

Member of the *Student Chapters Committee* for the national organization ASSOCIATION OF WOMEN IN MATHEMATICS. Appointed position. Term length 3 years. **Jan. 2016 - Present**

Vice President of Colorado State University Chapter of SIAM **Fa. 2010 - Su. 2011**

Creator and Co-Organizer of *Special Seminar on Important Topics & Techniques in Applied Mathematics* at CSU. **2010**

Coordinator of Greenslopes Seminar at Colorado State University **Sp. 2010**

Math Day Volunteer, Colorado State University **2007 - 2012**

Co-President of Pi Mu Epsilon, Saint Michael's College **Fa. 2006 - Sp. 2007**

TEACHING
EXPERIENCE

Assistant Professor, Marquette University **Fa. 2014 - present**

- MATH 2451: *Differential Equations*
- MATH 2455: *Differential Equations for Biomedical and Civil Engineers*
- MATH 3100: *Linear Algebra*
- MATH 4510: *Elementary Partial Differential Equations*
- MATH 4630: *Mathematical Modeling and Analysis*
- MSCS 6040: *Applied Linear Algebra*

Instructor, University of Helsinki **Fa. 2013**

- MATH 57079: *Applications of Numerical Linear Algebra*

Instructor, Colorado State University

2007-2012

- M117: *College Algebra in Context I*
- M118: *College Algebra in Context II*
- M124: *Logarithmic and Exponential Functions*
- M155: *Calculus for Biological Sciences I*
- M161: *Calculus II for Physical Sciences*
- M255: *Calculus II for Biological Sciences*
- M340: *Introduction to Ordinary Differential Equations*
- M495: *M495: Independent Study for TREE Course for FEScUE*

SELECTED
CONFERENCE AND
INVITED TALKS

- “Direct Absolute EIT Imaging on Experimental Data”, *18th International Conference on Biomedical Applications of EIT*, Dartmouth College, USA, June 22, 2017.
- “Improving Image Quality for Practical Electrical Impedance Tomography Imaging with Direct D-bar Methods”, *MSCS Colloquium*, Marquette University, Milwaukee, WI, USA, March 9, 2017.
- “Improving image quality for complex Electrical Impedance Imaging: Incorporating a priori information into a direct nonlinear D-bar method”, *BCAM Scientific Seminar*, Basque Center for Applied Mathematics, Bilbao, Spain, June 23, 2016.
- “A Nonlinear Reconstruction Method with A Priori Data for EIT”, *16th International Conference on Electrical Bio-Impedance / 17th Conference on Electrical Impedance Tomography*, Stockholm, Sweden, June 22, 2016.
- “Incorporating a Spatial Prior into Nonlinear D-Bar Eit Imaging for Complex Admittivities”, *SIAM Conference on Imaging Science 2016 (IS16)*, Albuquerque, New Mexico, USA, May 25, 2016.
- “Improving images for Electrical Impedance Imaging with a spatial prior”, *Applied and Computational Mathematics Seminar*, University of Wisconsin-Milwaukee, Milwaukee, Wisconsin, USA, February 11, 2016.
- “Direct D-bar Reconstructions for Experimental EIT Data with Boundary Shape Determination”, *Applied Inverse Problems conference (AIPC) 2015*, University of Helsinki, Helsinki, Finland, May 29, 2015.
- “Pulmonary imaging using Electrical Impedance Tomography with a Direct D-bar Admittivity Method”, *Joint Mathematics Meeting 2015*, Special Session on Inverse Problems, San Antonio, Texas, January 11, 2015.
- “A Novel Data-Driven D-bar Reconstruction Algorithm for Experimental 2D Electrical Impedance Tomography Data”, *The 7th International Conference Inverse Problems: Modeling and Simulation (IPMS-2014)* Fethiye, Turkey, May 27, 2014.
- “A Novel Data-Driven Edge Sharpening D-bar Reconstruction Algorithm for Electrical Impedance Tomography”, *SIAM Imaging Science Conference 2014*, Minisymposium: Advances in Electrical Impedance Tomography, Hong Kong, Hong Kong, May 14, 2014.
- “A Variety of D-bar Methods in Electrical Impedance Tomography: Not Just for 2D Isotropic Conductivities!”, *Shanghai Jiao Tong University*, Shanghai, China, May 9, 2014.
- “Alternative uses for D-bar Methods in Electrical Impedance Tomography”, *Inverse Problems Seminar*, University College London, London, England, UK, April 23, 2014.

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- “A Novel Data-Driven Edge Sharpening D-bar Reconstruction Algorithm for 2D Electrical Impedance Tomography Imaging”, *Inverse Problems Seminar*, Colorado State University, Fort Collins, CO USA, February 20, 2014.
 - “A Direct D-bar Reconstruction Method for 2D Anisotropic Electrical Impedance Tomography”, *Inverse Days 2013*, Inari, Finland, December 12, 2013.
 - “Direct D-bar Methods for 2D Electrical Impedance Tomography”, *Danmarks Tekniske Universitet*, Copenhagen, Denmark, October 30, 2013.
 - “Computational Results for the Semiclassical Limit of the Defocusing DS-II Equation”, *Exceptional Circles Helsinki Workshop*, University of Helsinki, Helsinki, Finland, August 13, 2013.
 - “Non-Iterative D-bar Reconstructions of 2D Conductivities and Permittivities from Experimental EIT Data”, *Mini-symposium: Inverse problems with experimental data*, *Applied Inverse Problems Conference*, Daejeon, Korea, July 2, 2013.
 - “An Introduction to Partial Data EIT with CGOs”, *Technische Universität Graz*, Graz, Austria, June 18, 2013.
 - “Reconstructing conductivity and permittivity on chest shaped domains in 2D EIT with nonlinear direct D-bar methods”, *XV International Conference on Electrical Bio-Impedance (ICEBI) and the XIV Conference on Electrical Impedance Tomography 2013 (EIT)*, Heilbad Heiligenstadt, Germany, April 23, 2013.
 - “D-bar Methods in Direct and Inverse Problems”, *Applied Mathematics & Inverse Problems Joint Seminar*, Colorado State University, Fort Collins, Colorado, USA, April 11, 2013.
 - “A direct, nonlinear reconstruction algorithm for the 2D EIT problem using a partial data D-N map”, *Conference on Inverse Problems and Applications*, Linköping University, Linköping, Sweden, April 5, 2013.
 - “A Numerical Move Towards Nonlinear Inversion from Partial EIT Data in 2-D”, *Institut Mittag-Leffler*, Djursholm, Sweden, March 25, 2013.
 - “Direct D-bar reconstructions of complex admittivities on a chest-shaped domain in 2D EIT”, *Inverse Days*, University of Jyväskylä, Jyväskylä, Finland, December 18, 2012.
 - “Electrical Impedance Tomography”, *SalWe: Mind and Body Program Seminar*, GE Healthcare, Helsinki, Finland, November 7, 2012.
 - “A Direct D-bar Method for the Reconstruction of Complex Admittivities from EIT Data on Non-Circular Domains”, *Inverse Problems Seminar*, University of Helsinki, Helsinki, Finland, August 20, 2012.
 - “A Direct D-bar Method for the Reconstruction of Complex Admittivities from EIT Data”, *SIAM Conference on Imaging Science (IS12)*, Philadelphia, Pennsylvania, USA, May 22, 2012.
 - “Implementation of a Direct D-bar Reconstruction Algorithm for Recovering a Complex Admittivity Distribution from Electrical Impedance Tomography Data”, *Joint Mathematics Meeting*, Boston, Massachusetts, USA, January 8, 2012.
 - “A Direct Nonlinear D-bar Reconstruction Algorithm for Complex Admittivities in the 2-D EIT Problem”, *Finnish-Japanese-Korean Workshop on Inverse Problems*, Helsinki, Finland, December 14, 2012.
 - “Oh the Things You Can Do and the Places You’ll See With a Mathematics Degree From SMC!”, *Saint Michael’s College*, Colchester, Vermont, USA, November 28, 2011.

- “A Direct D-bar Reconstruction Method for Complex Admittivities in 2-D Electrical Impedance Tomography”, Inverse Problems Seminar, Department of Mathematics, Colorado State University, Fort Collins, Colorado, USA, November 10, 2011.
- “Simulation of Voltages on Electrodes for the 2-D EIT forward admittivity problem by the Continuum and Complete Electrode Models”, Inverse Problems Seminar, Department of Mathematics, Colorado State University, Fort Collins, Colorado, USA, April 16, 2009.
- “Unit Rectangle Visibility Graphs (URVGs)”, NASA Goddard Space Flight Station, Greenbelt, Maryland, USA, July, 2007.

SELECTED
CONFERENCES
ATTENDED

- **Program on Inverse Problems: Stability and Reconstruction Issues in Inverse Problems**, *Institut Henri Poincaré*, Paris, France, June 29-July 3, 2015.
- **Harmonic Analysis & Partial Differential Equations: Recent Developments & Future Directions**, University of Chicago, September 19-21, 2014.
- **2014 MAA MathFest**, Portland, OR, August 4-9, 2014.
- **Applied Inverse Problems Conference (AIPC)** May 21-27, 2011, Texas A&M, College Station, TX, USA.
- **Inverse Problems: Theory and Applications** November 8-12, 2010, Mathematical Sciences Research Institute, Berkeley, CA, USA.
- **Introductory Workshop on Inverse Problems and Applications** August 23-27, 2010, Mathematical Sciences Research Institute, Berkeley, CA, USA.
- **Connections for Women: Inverse Problems and Applications** August 19-20, 2010, Mathematical Sciences Research Institute, Berkeley, CA, USA.
- **Summer School on Computational Solution of Inverse Problems (FICS)** June 28-July 2, 2010, University of Helsinki, Helsinki, Finland.

REFERENCES

Professor Jennifer L. Mueller

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ADDITIONAL
INFORMATION

- Additional Languages: Spanish, as well as basic French and Swedish.
- Computer Languages: \LaTeX , as well as basic knowledge of Java, Python and HTML.
- Computer Applications: MATLAB, Maple, cloud computing in parallel with Windows Azure, common Windows word processing, spreadsheet, and presentation softwares.