

# Reinaldo Sanchez-Arias

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*Research Interests include:* Numerical Optimization, Operations Research, Numerical Linear Algebra, Data Mining, Machine Learning, and High Performance Computing.

## Research and Teaching Experience

- **Assistant Professor of Applied Mathematics** **St. Thomas University**  
**Program Director Master of Science in Big Data Analytics**, School of Science *August 2016 – Present*

Also serves as **Mathematics Coordinator**. Courses taught: (\* indicates graduate courses.)

MAC 1140   Precalculus	CIS 546   Data Visualization*
MAC 2311   Calculus I	CIS 544   Data Mining and Machine Learning*
CIS 204   Introduction to Data Science	MAT 602   Applied Machine Learning*
MAT 502   Statistical Methods*	CIS 626   Big Data Analytics Applications*
CIS 543   Programming for Big Data Analytics*	CIS 627   Big Data Analytics Capstone*

- **Assistant Professor of Applied Mathematics** **Wentworth Institute of Technology**  
*Department of Applied Mathematics* *September 2014 – July 2016*

Taught courses for Applied Mathematics and Engineering majors; served as Academic Advisor for Applied Mathematics students; nominated and served as the Faculty Advisor for the Society of Industrial and Applied Mathematics (SIAM) Student Chapter; coordinated multiple sections of MATH 2860; reviewed and developed material for MATH 1900, MATH 3700, and MATH 5000; and was member of the Science Committee for the BS in Engineering program.

Courses taught:

MATH 1500   Precalculus	MATH 2800   Finite Math
MATH 1850   Engineering Calculus II	MATH 2860   Linear Algebra and Matrix Theory
MATH 1900   Introduction to Operations Research	MATH 2500   Differential Equations
MATH 2025   Multivariable Calculus	MATH 3700   Operations Research
MATH 2300   Discrete Math	MATH 5000   Applied Math Final Year Design I

- **Postdoctoral Researcher** **The University of Texas at El Paso**  
*Department of Mathematical Sciences* *June 2013 – August 2014*

Postdoctoral Researcher in the Computational Science Program, for the Army High Performance Computing Research Center (AHPARC) grant in collaboration with Stanford University.

Advisors : Dr. Miguel Argaez and Dr. Martine Ceberio.

Emphasis: Reduced-order modeling, data analysis and sparse optimization.

- **Adjunct Instructor** **The University of Texas at El Paso**  
*Department of Mathematical Sciences* *January 2013 – December 2013*

Courses taught: MATH 2301 Mathematics for the Social Sciences II

- **Research Assistant** **The University of Texas at El Paso**  
*Department of Mathematical Sciences* *January 2009 – January 2013*

Computational Science Program, for the Army High Performance Computing Research Center (AHPARC) grant. PI: Dr. Miguel Argaez and Dr. Leticia Velazquez.

- Implementation of conjugate gradient based methods for large KKT systems in constrained optimization.
- Algorithmic implementation of  $\ell_1$ -optimization problems.
- Applications in Compressed Sensing, Large Scale Parameter Estimation, and Classification problems.

- Research Intern** **Repsol USA, The Woodlands, TX**  
*Research and Innovation Geophysics Department* *July 2012*  
 Seismic Image Segmentation and classification via Sparse Representation. PI: Dr. G. Larrazabal, Dr. P. Guillen and Dr. M. Argaez.
- Research Intern** **Repsol USA, The Woodlands, TX**  
*Research and Innovation Geophysics Department* *June 2011 – August 2011*  
 Study and implementation of absorbing boundary conditions for the wave equation. Dip and Azimuth angles computation for seismic ray tracing. PI: Dr. German Larrazabal and Dr. Miguel Argaez.
- Teaching Assistant** **The University of Texas at El Paso**  
*Department of Mathematical Sciences* *Fall 2008 and Fall 2009*  
 Grader for MATH 1411 Calculus I, MATH 2300 Discrete Mathematics, MATH 1319 Math in the Modern World, and MATH 3323 Matrix Algebra. Grader and responsible for MATLAB and problem solving sessions in MATH 5345 Numerical Optimization.
- Teaching Assistant** **Universidad del Valle. Cali, Colombia.**  
*Department of Mathematical Sciences* *January 2007 – June 2008*  
 Tutor and Problem Solving Session Leader for Calculus, Linear Algebra, and Differential Equations.

## Education

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- Ph.D. Computational Science** **The University of Texas at El Paso**  
*El Paso, TX. United States* *May 2013*  
 - Dissertation Title: “A Convex Optimization Algorithm for Sparse Representation and Applications in Classification Problems”  
 - Advisor: Dr. Miguel Argaez.  
 - Area of Study: Sparse Optimization, Dimensionality Reduction. GPA: 4.0/4.0
- M.S. Computational Science** **The University of Texas at El Paso**  
*El Paso, TX. United States* *May 2011*  
 - Thesis Title: “A Sparse Representation Technique for Classification Problems”  
 - Advisor: Dr. Miguel Argaez.  
 - Area of Study:  $\ell_1$ -optimization methods. GPA: 4.0/4.0
- B.S Mathematics** **Universidad del Valle**  
*Cali, Valle. Colombia* *May 2008*  
 - Thesis Title: “A Hierarchic a Posteriori Estimate for the Approximation of a Nonlinear Elastic Problem”, Honors Distinction.  
 - Advisor: Dr. Jairo Duque.  
 - Area of Study: Finite Element Methods for Elasticity Problems. GPA: 4.4/5.0

## Relevant Coursework.....

Computational Methods for Linear Algebra, Numerical Optimization, Numerical Partial Differential Equations, Numerical Analysis, Mathematical and Computer Modeling, Parallel and Concurrent Programming, Advanced Algorithms, Advanced Numerical Optimization, Digital Signal Processing, and Geophysical Inverse Theory.

## Awards

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- Travel Award.** *The National Conference on Race and Ethnicity in American Higher Education (NCORE).*  
 May 26-30th, 2015, Washington, D.C, USA.
- Travel Award. NSF funded NIMBioS Tutorial.** *Computing in the Cloud: What Every Computational Life Scientist Should Know.* National Institute for Mathematical and Biological Synthesis (NIMBioS).  
 April 6-8th 2014, Knoxville, TN, USA.
- Travel Award. NSF Funded Academic Careers Workshop 2014.**

- March 27-30th 2014, Northwestern University, Evanston, IL, USA.
- **Outstanding Ph.D. Dissertation Award Computational Science Program.**  
April 25th, 2014, El Paso, TX, USA.
- **Best Student Interval Paper Award.** *IFSA/NAFIPS Congress 2013.*  
June 24-28th 2013, Edmonton, Canada.
- **Academic Excellence Graduate Student Award UTEP College of Science.**  
May 10th 2013, El Paso, TX, USA.
- **Second Place Best Oral Presentation.** *UTEP Graduate Research Expo.*  
November 9th 2012, El Paso, TX, USA.

## Publications

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- Sanchez-Arias R., Sole A., Rojas J. "Semi-supervised Learning Methods for Early Prediction and Forecasting of Clinical Deterioration". *In Preparation*, 2017
- Sanchez-Arias R., Husowitz B. "A Machine Learning Approach to Designing Guidelines for Acute Aquatic Toxicity". *In Preparation*, 2017
- Bonavides-Aguilar C., Sanchez-Arias R., Lanzas C. "Accurate Prediction of Major Histocompatibility Complex Class II Epitopes by Sparse Representation via  $\ell_1$ -minimization". In: *BioData Mining*, vol. 7, 2014.
- Ramirez C., Sanchez R., Kreinovich K., Argaez M. " $\sqrt{x^2 + \mu}$  is the Most Computationally Efficient Smooth Approximation to  $|x|$ ". In: *Journal of Uncertain Systems*, vol. 8, no. 3, pp 205-210. 2014.
- Sanchez R., Servin C., Argaez M. "Sparse Fuzzy Techniques Improve Machine Learning". In: *Joint World Congress of the International Fuzzy Systems Association and Annual Conference of the North American Fuzzy Information Processing Society IFSA/NAFIPS*, pp. 531-535. 2013.
- Argaez M., Sanchez R., Ramirez C., "Face Recognition from Incomplete Measurements via  $\ell_1$ -minimization". In: *American Journal of Computational Mathematics AJCM*, vol. 2, no. 4, pp 287-294. 2012.
- Sanchez R., Argaez M., Guillen P. "Sparse Representation via  $\ell_1$ -minimization for Underdetermined Systems in Classification of Tumors with Gene Expression Data". In: *IEEE 33rd Annual International Conference Proceedings of the Engineering in Medicine and Biology Society*, pp. 3362 - 3366. August 2011.
- Guillen P., Martinez-de-Pinson F., Sanchez R., Argaez M., Velazquez L. "Characterization of Subcortical Structures during Deep Brain Stimulation utilizing Support Vector Machines". In: *IEEE 33rd Annual International Conference Proceedings of the Engineering in Medicine and Biology Society*, pp. 7949 - 7952. August 2011.
- Hernandez, M., Olaya, J., Sanchez, R., Ramirez, C., Romero, R., Velazquez, L., Argaez, M. "Performance Comparison of an HPC  $\ell_1$ -optimization algorithm for compressed sensing". In: *IEEE proceedings of Department of Defense High Performance Computing Modernization Program Users Group Conference*, pp. 391-400, June 2011.
- Argaez, M., Ramirez, C., Sanchez, R. "An  $\ell_1$ -algorithm for underdetermined systems and applications". In: *IEEE proceedings of the North American Fuzzy Information Processing Society*, pp.1 - 6. March 2011.
- Velazquez, L., Argaez, M., Sanchez, R., Ramirez, C., Hernandez, M., Culbreth, M., Jameson A. "Hybrid optimization schemes for wing modeling of micro-aerial vehicles". In: *IEEE proceedings of Department of Defense High Performance Computing Modernization Program Users Group Conference*, pp. 149-154. June 2010.

## Oral Presentations

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- ◇ "A Discussion on Data Analytics and Machine Learning Applications for Engineering and Science", *Florida International University, Department of Biomedical Engineering*, (Wallace H. Coulter Lecture Series), Miami, FL. USA. October 2017
- ◇ "Data Science and Big Data Analytics for Social Good", *Marines 4th Civil Affairs Group (CAG) Planning Exercise*, (Invited Talk), Miami, FL. USA. July 2017
- ◇ "A Duality Approach For Sparse Representation In Classification", *SIAM Annual Meeting 2016*, (Contributed Talk), Boston, MA. USA. July 2016
- ◇ "Introduction to Sparse Optimization and Applications in Machine Learning", *Taller de Avances en Matemática Aplicada y Biomatemática 2013*, Two-day mini-course. (Invited Talk at Universidad Autónoma de Occidente), Cali, Colombia. November 2013.
- ◇ "Sparse Representation and Applications in Classification - Keep it sparse, be happy -". *UTEP 2nd Annual Graduate Research Expo.*  
El Paso, TX, USA. November 2012.
- ◇ "Sparse Representation via  $\ell_1$ -minimization for Underdetermined Systems in Classification of Tumors with Gene Expression Data". *IEEE 33rd Annual International Conference Proceedings of the Engineering in Medicine and Biology*

Society. Boston, MA, USA. August 2011.

- ◇ “An  $\ell_1$ -algorithm for underdetermined systems and applications”. *North American Fuzzy Information Processing Society, NAFIPS 2011*. The University of Texas at El Paso, TX USA. March 2011.
- ◇ “Hybrid Optimization for Parameter Estimation Problems”. *The International Conference for High Performance Computing (SC10)*. Demonstration at AHPCRC booth. New Orleans, LA USA. November 2010.
- ◇ “Hybrid Optimization Schemes for Parameter Estimation Problems”. *Army High Performance Research Computing Center (AHPCRC) Annual Review*. Stanford University, Palo Alto, CA USA. July 2010.
- ◇ “A Path Following Method for large scale  $\ell_1$ -underdetermined problems”. *6th Joint UTEP/NMSU Workshop on Mathematics, Computer Science and Computational Sciences*. The University of Texas at El Paso. El Paso, TX USA. November 2009.
- ◇ “A Path Following Method for large scale  $\ell_1$ -underdetermined problems”. *XVII Colombian Congress of Mathematics*. Cali, Colombia. August 2009.

## Poster Presentations

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- ◇ “A dimensionality reduction and sparse representation approach for classification”. *Society for Industrial and Applied Math (SIAM) Annual Meeting 2012*, Minneapolis, MN. July 2012.
- ◇ “Project 4-6: Hybrid Optimization Schemes For Parameter Estimation Problems”. *Army High Performance Computing Research Center Program Management Board Meeting*, Stanford University, Palo Alto, CA. November 2011.
- ◇ “Characterization of Subcortical Structures during Deep Brain Stimulation utilizing Support Vector Machines”. *IEEE 33rd Annual International Conference Proceedings of the Engineering in Medicine and Biology Society*, Boston, MA. August 2011.
- ◇ “A Sparse Representation Technique for Classification Problems”. *7th International Congress on Industrial and Applied Mathematics - ICIAM 2011*, Vancouver, BC Canada. July 2011.
- ◇ “An algorithm for constrained  $\ell_1$ -minimization problems and applications”. *Sixth Blackwell-Tapia Conference*, Columbus, OH. November 2010.
- ◇ “A Path Following Method for large scale  $\ell_1$ -underdetermined problems”. *Minority Serving Institutions Research Partnerships Consortium (MSIRPC) Conference*, Baltimore, MD. April 2010.
- ◇ “A Path Following Method for large scale  $\ell_1$ -underdetermined problems”. *The International Conference for High Performance Computing (SC09)*, Portland, OR USA. November 2009.
- ◇ “A Fixed Point Algorithm for  $\ell_1$  large scale underdetermined systems”. *UTEP SACNAS Research Expo 2009*, El Paso, TX. April 2009.
- ◇ “Parallel Global Optimization Schemes for Solving Parameter Estimation Problems”. *The International Conference for High Performance Computing (SC08)*, Austin, TX. November 2008.

## Service

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- **UTEP SIAM Student Chapter Vice-president.** Spring 2011 - Spring 2013.
- **UTEP Graduate Research Expo Judge.** Fall 2013.
- **Member, Applied Mathematics Faculty Hiring Committee**  
Wentworth Institute of Technology. Spring 2015, Summer 2015, Spring 2016, Summer 2016
- **Faculty Advisor, SIAM Student Chapter.**  
Wentworth Institute of Technology. Summer 2015 - Summer 2016.
- **Member, Dean School of Science Search Committee.**  
St. Thomas University, Spring 2017.

## Affiliations

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- Society for Industrial and Applied Mathematics (SIAM).
- American Mathematical Society (AMS).

## Technical and Personal Skills

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- **Programming:** R, Python, C, MATLAB, TeX, UNIX Shell scripting
- **Languages:** English (Fluent), Spanish (Native).