Julio Enrique Castrillón Candás

Research Objectives

My specific interests lie in data science, mathematically rigorous uncertainty quantification and large scale computational statistics that span pure and applied mathematics with high performance computing. The research is complemented with funded high impact applications in science and engineering from various governmental agencies.

- **Data Science/Statistics:** Integrate the fields of computational applied mathematics, numerical analysis and high performance computing with large scale spatial statistics. A functional analysis perspective to anomaly detection with applications to remote sensing.
- **Stochastic Machine Learning:** Developing a stochastic functional analysis tensor product theory for the construction of robust machine learning features with applications to Alzheimer's Disease.
- **Uncertainty Quantification:** Develop rigorous mathematical computational methods to solve high dimensional linear and non-linear Partial Differential Equations (PDEs) with random geometries. UQ for non-linear stochastic networks. Applications to power systems and protein interactions.

Education

Degree	**Doctor of Philosophy (PhD)**	**2001**
Dept.	**Electrical Engineering and Computer Science**	
University	**Massachusetts Institute of Technology**	Cambridge, MA
Degree	**Master of Science (MS)**	**1996**
Dept.	**Electrical Engineering and Computer Science**	
University	**Massachusetts Institute of Technology**	Cambridge, MA
Degree	**Ingeniero en Electronica y Comunicaciones (IEC)**	**1992**
Rank	**Graduated with Honors**	
University	**Instituto Tecnologico de Monterrey (ITESM-CEM)**	Atizapan, Mexico

Appointments

Period	**2023 – Present**
	Editorial Board Member
	ACM Transactions on Probabilistic Machine Learning

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

Period	**2017 – Present**
Institution	**Boston University** Boston, Massachusetts **Department of Mathematics and Statistics** **Research Assistant Professor**

Period	**2012 — 2016**
Institution	**SRI Center for Uncertainty Quantification in Computational Science and Engineering** Thuwal, Saudi Arabia **Co-Founder, Affiliate**

Cofounded the "SRI Center for Uncertainty Quantification in Computational Science and Engineering". Continuing research on stochastic PDEs and large scale Kriging.

Period	**2010 — 2013**
Institution	**King Abdullah University for Science and Technology** Thuwal, Saudi Arabia **Research Scientist IV**

Co-wrote and awarded funds for founding the SRI UQ Center. Lead researcher on Stochastic PDEs with random geometries. Lead researcher on large scale Radial Basis Function interpolation. Lead researcher on large scale covariance estimation and kriging. Taught graduate courses in mathematics.

Period	**2006 — 2010**
Institution	**Teledyne Scientific (formerly Rockwell Scientific)** Durham, NC **Research Scientist**

Radar Terrain Navigation: Developed a novel (patent-pending) algorithm(and software) for real-time Bayesian terrain navigation using a proprietary low-cost radar system. **Weather Radar Terrain Reconstruction:** Developed a novel (patent-pending) Bayesian real-time reconstruction algorithm (and software) for terrain using data collected from a proprietary low-cost radar system. The algorithm improved radar resolution by 6X. **Prediction of Human Image Search Timings:** Developed a novel algorithm based on an information theoretic method of the human visual cortex. Other duties included proposal writing participation.

Period	**2003 — 2005**
Institution	**Institute for Computational Engineering and Sciences** **University of Texas at Austin** Austin, TX **ICES Postdoctoral Fellow**

Awarded prestigious fellowship to conduct research in the area of scientific computing (Computational Sciences) applied to computational mechanics and biophysical phenomena. Developed a novel protein-protein docking algorithm based on Non-Equidistant FFTs. Developed a Hierarchical Compressed algorithm for representations of molecular structures.

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

Period	**2001**
Institution	**Massachusetts Institute of Technology** Cambridge, MA
	Postdoctoral Associate
	Developed novel multiscale numerical methods including hierarchal boundary elements, adaptive finite elements, and 3D reduced order complexity. Advised PhD students on research.

Consulting/Internships

Period	**1993**
Institution	**Siproco** Mexico City, Mexico
	Design Engineer

Period	**1991-1992**
Institution	**Division Graduado the Ingenieria. ITESM-CEM,** Atizapan, Mexico
	Research Assistant (Mexican social service)

Grants

Year	**2024**
Award	**DMS/NIGMS 1: Multilevel stochastic orthogonal subspace transformations for robust machine learning with applications to biomedical data and Alzheimer's disease subtyping. Award Number:2347698. 599,373 USD (PI)**
Year	**2023**
Award	**DMS/NGA ATD: Anomaly detection and functional data analysis with applications to threat detection for multimodal satellite data. Award Number: 2319011. 249,999 USD (PI)**
Year	**2018**
Award	**NIH/NIGMS Stochastic Dynamic Modeling of Cellular Protein Interactions. Award Number:1R01GM131409-01. 323,280 USD (Co-Investigator (co-PI), defacto PI)**
Year	**2017**
Award	**DMS/DOE AMPS: Uncertainty Quantification for Stochastic Analysis of Electrical Power Networks. Award Number:1736392. 229,279 USD (co-PI, defacto PI)**
Year	**2012**
Award	**SRI Center for Uncertainty Quantification in Computational Science and Engineering. 4,173,576 USD.**

Year	**2006**
Award	**New Approach to Rapid Protein-Protein Docking. National Institutes of Health, Grant Number 5R01GM073087. 1,273,217 USD.**

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

Year	**2005**
Award	**Hierarchical Methods for Large Bimolecular Complexes. National Institutes of Health Grant Number 1R01GM074258, PAR-03-106, Innovations in Biomedical Computational Science and Technology. 700,036 USD.**

Awards

Year	**2003**
Award	**ICES Postdoctoral Fellowship (University Of Texas, Austin)** Austin, TX
Year	**1993**
Award	**Fulbright scholarship (Offered, but not accepted)** Mexico City, Mexico
Year	**1992**
Award	**Graduated with Honors, IEC, ITESM-CEM** Atizapan, Mexico
Year	**1991**
Award	**First Prize, Institute wide engineering competition ITESM-CEM** Atizapan, Mexico

Professional Organization Memberships

Organization	Society for Industrial and Applied Mathematics (SIAM)
Organization	Sigma Xi

Boston University Teaching Experience

Year	**Fall 2024,**
Course	**CAS MA 213 Basic Statistics and Probability**
Position	**Lab instructor**
Year	**Spring 2024,**
Course	**CAS MA 575 Linear Models.**
Position	**Lecturer**
Year	**Fall 2023,**
Course	**CAS MA 575 Linear Models.**
Position	**Lecturer**
Year	**Spring 2023,**
Course	**CAS MA 575 Linear Models.**
Position	**Lecturer**
Year	**Fall 2022,**
Course	**CAS MA 575 Linear Models.**
Position	**Lab Instructor**

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

Year	**Spring 2022,**
Course	**CAS MA 575 Linear Models.**
Position	**Lecturer**

Year	**Fall 2021,**
Course	**CAS MA 575 Linear Models.**
Position	**Lab Instructor**

Year	**Spring 2021,**
Course	**CAS MA 575 Linear Models.**
Position	**Lab Instructor**

Year	**Fall 2020,**
Course	**CAS MA 575 Linear Models.**
Position	**Lab Instructor**

Year	**Spring 2020,**
Course	**CAS MA 575 Linear Models.**
Position	**Lecturer**

Year	**Fall 2019,**
Course	**CAS MA 575 Linear Models.**
Position	**Lab instructor**

Year	**Fall 2018,**
Course	**CAS MA 575 Linear Models.**
Position	**Lab instructor**

Year	**Spring 2018,**
Course	**CAS MA 213. Basic Statistics and Probability**
Position	**Lab instructor**

Year	**Fall 2017,**
Course	**CAS MA 575 Linear Models.**
Position	**Lab instructor**

KAUST Teaching Experience

Year	**Spring 2011, Spring 2012**
Course	**Hierarchical Basis and Wavelets with applications to Computational Modeling.**
Institution	**King Abdullah University for Science and Technology** Thuwal, Saudi Arabia

MIT Teaching Experience

Period	**1996-2001**	
Institution	**Massachusetts Institute of Technology**	Cambridge, MA

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

Term	**C**ode	**T**itle	**R**ole
ST2001	1.130 18.327	Wavelets and Filter Banks	Recitation instructor, grading and homework review
ST2000	1.130 18.327	Wavelets and Filter Banks	Teaching Assistant, Recitations and homework review
FT1999	6.003	Signal and Systems	Head Teaching Assistant Organized 4 T.As. for homework review and tutorials
ST1999	1.130 18.327	Wavelets and Filter Banks	Teaching Assistant, Recitations and homework review
FT1998	6.003	Signal and Systems	Head Teaching Assistant Organized 4 T.As. for homework review, and tutorials
SP1998	6.002	Circuits and Electronics	Head Teaching Assistant Organized 11 T.As. for labs, homework review, and tutorials
FT1997	6.003	Signal and Systems	Head Teaching Assistant Organized 4 T.As. for homework review and tutorials
ST1997	6.002	Circuits and Electronics	Teaching Assistant, lab, homework review and tutorials,
FT1996	6.003	Signal and Systems	Teaching Assistant, lab, homework review and tutorials,
ST1996	6.002	Circuits and Electronics	Teaching Assistant, lab, homework review and tutorials,

Reviewer

1. Computer and Mathematics with Applications
2. SIAM/ASA Journal on Uncertainty Quantification
3. Computer Methods in Applied Mechanics and Engineering
4. Journal of Natural Gas Science & Engineering
5. Expert Systems with Applications
6. IEEE Transactions on Signal processing
7. Statistica

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

Students (Current)

1. Trajan Murphy (Math, PhD)
2. Nanjie Chen (Math, PhD)
3. Kaili Shi (Statistics, PhD)
4. Anirudh Desikan (Bioinformatics, MS)
5. Kehan Qian (Mathematical Finance, MS)
6. Nora Leonard (BS)
7. Vishesh Jain (BS)
8. Simran Sahoo (BA, Princeton)

Students (Current Collaborators)

1. Hanfeng Gu (Dept of Earth & Environmental sciences, BU, PhD)
2. Caleb Meredith, (Mathematics, BU, PhD)
3. Caitlin Newman, (Neurobiology, BU, PhD)
4. Akshunna Dogra (Dept. of Mathematics, Imperial College London, PhD)

Research Group Alumni (Current Collaborators)

1. Trevor Norton (Math, PhD)
2. Brian Choi (Math, PhD)
3. Jie Xu (Math, PhD)
4. Wenrui Li (Statistics, PhD)

Students (Alumni)

1. Hanyue Cao (PhD, current collaborator)
2. Yulin Li (MS, current collaborator)
3. Sicheng Yang (MS, current collaborator)
4. You Lu (MS, current collaborator)
5. Junze Yin (MS, current collaborator)
6. Xiaoyu Wang (MS)
7. Jingxuan Guo (MS)
8. Alyssa Goins (BS)
9. Janavi Kasera (BS)

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

Research Collaborators

1. Mark Kon, Professor, Dept. of Mathematics & Statistics, Boston University
2. Sucharita Gopal, Professor, Dept. of Earth & Environmental Sciences, Boston University
3. Xiaoling Zhang, Associate Professor, School of Medicine, Boston University
4. Tianlong Chen, Incomming Assistant Professor, Dept. of Computer Science, University of North Carolina at Chapel Hill
5. Brian Choi, Assistant Professor, Dept. of Mathematical Sciences, United States Military Academy at West Point
6. Jie Xu, Postdoc, Dept. of Mathematics, Northeastern University, Boston
7. Trevor Norton, Postdoc, Dept. of Computer Science, Virginia Tech

Journal Publications/Manuscripts

1. J. E. Castrillón-Candás. *Spatial best linear unbiased prediction: A computational mathematics approach for high dimensional massive datasets.* Adv Comput Math **50**, 37 (2024)
2. N. Chen, D. Yu, D. Beglov, M. Kon, J. E. Castrillón-Candás. *Uncertainty quantification of receptor ligand binding sites prediction.* arXiv 2401.11312, (2024)
3. W. Li, X. Wang, Y. Sun, S. Milanovic, M. Kon and J. E. Castrillón-Candás. *Multilevel Stochastic Optimization for Imputation in Massive Medical Data Records.* IEEE transactions on Big Data, 10 (2), (2024)
4. T. Norton, J. Xu, B. Choi, M. Kon, and J. E. Castrillón-Candás, *Uncertainty quantification and complex analyticity of the nonlinear Poisson-Boltzmann equation for the interface problem with random domains*, arXiv 2309.16439. *In review Numerische Mathematik.* (2023)
5. J. E. Castrillón-Candás, D. Liu, S. Yang, and M. Kon. *Multilevel orthogonal Bochner function subspaces with applications to robust machine learning.* arXiv: 2110.01729. (2023)
6. B. Choi, J. Xu, T. Norton, M. Kon, and J. E. Castrillón-Candás, *Analytic regularity of strong solutions for the complexified stochastic non-linear Poisson Boltzmann Equation*, arXiv 2106.05811. *In review Computers and Mathematics with Applications.* (2023)
7. J. E. Castrillón-Candás, M. Kon. *Stochastic functional analysis and multilevel vector field anomaly detection.* arXiv:2207.06229. (2023)
8. J. E. Castrillón-Candás and M. Kon. *Anomaly Detection: A functional analysis perspective.* Journal of Multivariate Analysis, 189:104885, (2022)
9. J. E. Castrillón-Candás, F. Nobile, and R. F. Tempone, *A hybrid collocation-perturbation approach for PDEs with random domains*, Advances in Computational Mathematics, 47. (2021)

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

10. J. E. Castrillón-Candás and J. Xu, *A stochastic collocation approach for parabolic PDEs with random domain deformations*, Computers & Mathematics with Applications, 93, pp. 32–49. (2021)

11. J. E. Castrillon-Candas and Mark Kon, *Analytic regularity and stochastic collocation of high dimensional Newton iterates. Advances in Computational Mathematics*, 46(3):42, May (2020)

12. J. E. Castrillón-Candás, M.G Genton and R. Yokota. *Multi-Level restricted maximum likelihood covariance estimation and kriging for large non-gridded spatial datasets.* Spatial Statistics Volume 18, Part A, Pages 105-124. (2016)

13. J. E. Castrillón-Candás, F. Nobile and R. Tempone. *Analytic regularity and collocation approximation for PDEs with random domain deformations.* Computers and Mathematics with Applications. 71 (6), Pages 1173–1197. (2016)

14. J. E. Castrillón-Candás, J. Li and V. Eijkhout. *A discrete adapted hierarchical basis solver for radial basis function interpolation.* BIT Numerical Mathematics, Volume 53, Issue 1, pp 57-86. (2013)

15. J. E. Castrillón-Candás, V.K. Siddavanahalli and C. Bajaj. *Nonequispaced Fourier transforms for protein-protein docking*, ICES Technical Report, October (2005)

16. S.D. Heedene, K. Amaratunga and J. E. Castrillón-Candás, *Generalized hierarchical bases: a wavelet-ritz-Galerkin framework for Lagrangian FEM*, Engineering Computations. 22,1,15-37, (2005)

17. C. Bajaj, J. E. Castrillón-Candás, Vinay Siddavanahalli and Zaiqing Xu, *Compression of macromolecular structures and properties*, Special Issue of Macromolecular Assemblies Highlighted, Structure, 13,3, 463-471, (2005)

18. C. Bajaj, J. E. Castrillón-Candás, Vinay Siddavanahalli and Zaiqing Xu, *Hierarchical compressed volumetric representations of molecular structures*, ICES Technical Report (2005).

19. J. E. Castrillón-Candás and K. Amaratunga, *Spatially adapted multiwavelets and sparse representation of integral equations on general geometries*, SIAM Journal on Scientific Computing, 24, 5, 1530-1566, (2003)

20. J. E. Castrillón-Candás and K. Amaratunga, *Fast computation of continuous Karhunen-Loeve eigenfunctions using wavelets*, IEEE Transactions on Signal Processing, 50, 1, 78-86, (2002)

21. K. Amaratunga and J. E. Castrillón-Candás: *Surface Wavelets: A multiresolution signal processing tool for 3D computational modeling.* International Journal for Numerical Methods in Engineering, 52, 3, 239-271, (2001)

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

Recent Invited Talks, Professional Activities

1. J. E. Castrillón-Candás. *Spatial stochastic tensor maps for anomaly detection and machine learning.* Invited talk. University of Massachusetts, Boston. (TBD).

2. J. E. Castrillón-Candás. *Spatial stochastic tensor maps for anomaly detection and machine learning.* Invited talk. University of New Haven, November 2024.

3. J. E. Castrillón-Candás. *Spatial stochastic tensor maps for anomaly detection and machine learning.* Invited talk. National Science Foundation (NSF). PI meeting for the ATD Program. Alexandria, Virginia. Chair of session. October 2024.

4. J. E. Castrillón-Candás. *Uncertainty Quantification for Non-linear Stochastic Networks.* Invited session. New England Statistical Symposium. Storrs, CT. May 2024.

5. J. E. Castrillón-Candás. *Stochastic coordinate transformations in Bochner spaces with applications to anomaly detection and robust machine learning.* Invited talk. National Geospatial Intelligence Agency (NGA). November 2023.

6. J. E. Castrillón-Candás. *Stochastic coordinate transformations in Bochner spaces with applications to anomaly detection and robust machine learning.* Invited talk. National Science Foundation (NSF). PI meeting for the ATD Program. Fairfax, Virginia. Chair of session. October 2023.

7. J. E. Castrillón-Candás. *Stochastic coordinate transformations in Bochner spaces with applications to robust machine learning.* Invited session. New England Statistical Symposium. Boston, MA. June 2023.

8. J. E. Castrillón-Candás. *A stochastic functional (data) analysis perspective to anomaly detection and robust machine learning* Invited talk. Center for Information Systems and Engineering (CISE). Boston, MA. February 2023.

9. J. E. Castrillón-Candás, Mark Kon. *A stochastic functional (data) analysis perspective to anomaly detection and robust machine learning.* Invited talk. Seminario Conjunto de Estadística y Ciencia de Datos (CIMAT), Centro de Investigación en Matemáticas A.C., Guanajuato, Mexico (Virtual). May 2022.

10. J. E. Castrillón-Candás, Mark Kon. *Change and anomaly detection: A functional analysis perspective.* Invited talk. The Institute for Operations Research and the Management Sciences (Virtual), October 2021.

11. J. E. Castrillón-Candás, Mark Kon. *A stochastic functional (data) analysis interpretation of anomaly detection and robust machine learning.* Invited talk. New England Statistics Symposium. Providence, RI. October 2021.

12. J. E. Castrillón-Candás, M.G Genton, Xiaoyu Wang, R. Yokota. *Large Scale Kriging: A High Performance Multi-Level Computational Mathematics Approach.* Invited talk. Argonne national lab, Lemont, IL (Virtual). April 2021.

13. J. E. Castrillón-Candás. *Multilevel Radial Basis Function Interpolation for Stochastic Collocation in Random Power Flow Networks.* Invited talk. Algorithms for modern power systems (AMPS), PI meeting, Virtual. Chair of first session. Washington, DC. November 2020.

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

14. J. E. Castrillón-Candás, M.G Genton, Xiaoyu Wang, R. Yokota. *Large Scale Kriging: A High Performance Multi-Level Computational Mathematics Approach.* Invited talk. Department of Statistics, Harvard University, Cambridge, MA. December 2019.

15. J. E. Castrillón-Candás, M.G Genton, R. Yokota. *Large Scale Kriging: A High Performance Multi-Level Computational Mathematics Approach.* Invited talk. Department of Statistics, UCONN, Storrs, Mansfield, Connecticut. Hartford, CT, November 2019.

16. J. E. Castrillón-Candás, M.G Genton, R. Yokota. *Multi-level spaces with applications to large scale spatial statistics.* Invited talk. Department of mathematics, Tufts University, Medford, MA. November 2019.

17. J. E. Castrillón-Candás, Mark Kon. *Analytic regularity and stochastic collocation of high dimensional Newton iterates.* Invited talk. Algorithms for modern power systems (AMPS), PI meeting, George Washington University, Washington DC. October 2019.

18. J. E. Castrillón-Candás, M.G Genton, R. Yokota. *Large Scale Kriging: A High Performance Multi-Level Computational Mathematics Approach.* Invited talk. New England Statistical Society. Hartford, CT, May 2019.

19. J. E. Castrillón-Candás. NSF review panelist. Washington DC, April 2019.

20. J. E. Castrillón-Candás. *Analytic regularity and collocation approximation for PDEs with random domain deformations.* Invited Talk. Tufts, Department of Mathematics. Medford MA. Fall 2016.

21. J. E. Castrillón-Candás, *Multi-level restricted maximum likelihood covariance estimation and kriging for large non-gridded spatial datasets.* Invited Talk, Aerospace Computational Design Laboratory, Massachuetts Institute of Technology, October 31 2014.

Department of Mathematics and Statistics · Boston University
665 Commonwealth Avenue · Boston · MA 02215
http://math.bu.edu/people/jcandas
✉ jcandas@bu.edu ☎ (617)-943-9981

References

Kevin Amaratunga (PhD Advisor)
Vice-President of Engineering
Scalable Display Technologies
700 Massachusetts Avenue
Suite 2, Cambridge, MA 02139-2499
kevin@scalabledisplay.com, Tel 617-864-9300

Mark Kon
Professor
Department of Mathematics and Statistics
Boston University
111 Cummington Mall
Boston MA 02215
Tel: 617 - 353 - 9549
mkon@bu.edu

Sucharita Gopal
Professor
Department of Earth & Environment
Boston University
675 Commonwealth Ave Office 459
Boston MA, 022115
Tel: 617-353-6744
suchi@bu.edu

Xiaoling Zhang
Associate Professor of Medicine
School of Medicine
Associate Professor, Biostatistics
Boston University School of Public Health
Associate Professor, Bioinformatics Program
Computing & Data Sciences
Boston University
72 E. Concord St Evans Building
Boston MA, 02118
Tel: 617-358-3580
zhangxl@bu.edu

Skills

Languages	C++, Matlab, Julia, Python
Tools	Linux, MPI

Citizenship

United States