

# Mario Diaz

## Research Associate C

Instituto de Investigaciones en Matemáticas Aplicadas y en Sistemas (IIMAS)

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## Education

Degree: **Ph.D. Mathematics and Statistics (2013 - 2017)**

Institution: Queen's University, Kingston, Canada

Advisors: James Mingo and Serban Belinschi

Thesis: *Global Fluctuations of Random Matrices and The Second-Order Cauchy Transform*

Degree: **M.Sc. Probability and Statistics (2011 - 2013)**

Institution: Centro de Investigación en Matemáticas A.C., Guanajuato, Mexico

Advisor: Víctor Pérez-Abreu

Thesis: *Analysis of the Asymptotic Spectra of Multiantenna Channels via Free Probability<sup>1</sup>*

Degree: **B.Eng. Electronics and Communications (2006 - 2011)**

Institution: Universidad de Guadalajara, Guadalajara, Mexico

Advisor: Víctor Pérez-Abreu

Thesis: *Analysis of the Asymptotic Ergodic Spectral Efficiency of MIMO Systems with Kronecker C.<sup>1</sup>*

## Academic Experience

### Postdoctoral Researcher

Centro de Investigación en Matemáticas A.C., México 2018 - 2019

Worked on the theoretical machine learning, data privacy and random matrices

### Joint Postdoctoral Scholar

Arizona State University (ECE) & Harvard University (SEAS), U.S. 2017 - 2018

Worked on the mathematical and statistical theory of data privacy

## Research Interests

My current research mainly focuses on data privacy, information theory and theoretical machine learning. I also keep a research stream on random matrices, free probability theory and their applications.

## Publications

### Journal Papers

1. M. Diaz, H. Wang, F. P. Calmon and L. Sankar. "On the robustness of information-theoretic privacy measures and mechanisms." *IEEE Transactions on Information Theory*, vol. 66, no. 4, pp. 1949 – 1978, 2020. DOI: [10.1109/TIT.2019.2939472](https://doi.org/10.1109/TIT.2019.2939472)
2. M. Diaz, J. Mingo and S. Belinschi. "On the global fluctuations of block Gaussian matrices." *Probability Theory and Related Fields*, vol. 176, no. 1 – 2, pp. 599 – 648, 2020. DOI: [10.1007/s00440-019-00925-1](https://doi.org/10.1007/s00440-019-00925-1)
3. S. Asoodeh, M. Diaz, F. Alajaji and T. Linder. "Estimation efficiency under privacy constraints." *IEEE Transactions on Information Theory*, vol. 65, no. 3, pp. 1512 – 1534, 2019. DOI: [10.1109/TIT.2018.2865558](https://doi.org/10.1109/TIT.2018.2865558)
4. M. Diaz and V. Pérez-Abreu. "On the capacity of block multiantenna channels." *IEEE Transactions on Information Theory*, vol. 63, no. 8, pp. 5286 – 5298, 2017. DOI: [10.1109/TIT.2017.2712711](https://doi.org/10.1109/TIT.2017.2712711)
5. S. Asoodeh, M. Diaz, F. Alajaji and T. Linder. "Information extraction under privacy constraints." *Information*, vol. 7, no. 1, Art. no. 15, 2016. DOI: [10.3390/info7010015](https://doi.org/10.3390/info7010015)

<sup>1</sup> Written in Spanish.

## Conference Papers

6. S. Asoodeh, M. Diaz and F. Calmon. "Privacy amplification of iterative algorithms via contraction coefficients." *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*, 2020.
7. T. Sypherd, M. Diaz, L. Sankar and G. Dasarathy. "On the  $\alpha$ -loss landscape in the logistic model." *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*, 2020.
8. T. Sypherd, M. Diaz, L. Sankar and P. Kairouz. "A tunable loss function for binary classification." *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*, pp. 2479 – 2483, 2019. DOI:10.1109/ISIT.2019.8849796
9. H. Wang, M. Diaz, JCS Santos Filho and F. P. Calmon. "An information-theoretic view of generalization via Wasserstein distance." *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*, pp. 577 – 581, 2019. DOI:10.1109/ISIT.2019.8849359
10. H. Wang, M. Diaz, F. P. Calmon and L. Sankar. "The utility cost of robust privacy guarantees." *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*, pp. 706 – 710, 2018. DOI:10.1109/ISIT.2018.8437735
11. S. Asoodeh, M. Diaz, F. Alajaji and T. Linder. "Privacy-aware guessing efficiency." *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*, pp. 754 – 758, 2017. DOI:10.1109/ISIT.2017.8006629
12. M. Diaz. "On the symmetries and the capacity achieving input covariance matrices of multiantenna channels." *Proceedings of the IEEE International Symposium on Information Theory (ISIT)*, pp. 1073 – 1077, 2016. DOI:10.1109/ISIT.2016.7541464

## Awards

1. Candidate Member of the National System of Researchers (SNI), Mexico 2019
2. Nominated by Queen's University for the 2018 *Canadian Mathematical Society (CMS) Doctoral Prize* Each Canadian university nominates at most one doctoral student for this outstanding performance award
3. *Ontario Trillium Scholarship*, Canada 2013 - 2017  
Only 75 of these scholarships are awarded every year in the whole province of Ontario
4. *Science and Technology National Council (CONACYT) Graduate Scholarship*, Mexico 2011 - 2013
5. *National System of Researchers (SNI) Undergraduate Research Assistantship*, Mexico 2009 - 2011

## Teaching Experience

### Lecturer

Aprendizaje Máquina Teórico. Universidad Nacional Autónoma de México, 2020

Teoría Matemática para Aprendizaje Máquina. Universidad de Guanajuato, 2019

Matrices Aleatorias: Teoría y Aplicaciones Contemporáneas<sup>2</sup>. Centro de Investigación en Matemáticas A.C., 2018

### Current and Past Students

Caudillo Amador, Diego de Jesús (M.Sc. Prob. & Stats. CIMAT, November 2019)

Tavarez Rodríguez, Judith (M.Sc. Prob. & Stats. CIMAT, August 2019)

Madrid Padilla, Carlos Misae<sup>3</sup> (B.Sc. Math. Universidad de Guanajuato, June 2019)

## Most Relevant Conferences and Workshops Attended

1. *XV Latin American Congress of Probability and Mathematical Statistics (CLAPEM)*. Merida, Mexico 2019  
**Invited Talk:** Analysis of artificial neural networks: old and new random matrix theory perspectives
2. *I Taller Inter-institucional de Ciencia de Datos e Inteligencia Artificial*. Puebla, Mexico 2019  
**Invited Talk:** Garantías teóricas de algunas metodologías de aprendizaje máquina
3. *52 Congreso Nacional de la SMM*. Monterrey, Mexico 2019  
**Invited Talk:** Garantías teóricas de algunos métodos de aprendizaje máquina en privacidad

<sup>2</sup> Jointly with V. Pérez Abreu and C. Vargas

<sup>3</sup> Jointly with V. Pérez Abreu

4. *Taller Conjunto de Deep Learning y Ciencia de Datos CIMAT - INAOE*. Guanajuato, Mexico 2019  
**Invited Talk:** A tunable loss function for classification
5. *Applications to Random Matrices and Free Probability of Free NC Functions*. Toronto, Canada 2019  
**Invited Talk:** Deep linear neural networks: a free probabilistic approach
6. *Free Probability: the Applied Perspective*. Montreal, Canada 2019  
**Invited Talk:** Utility cost of additive privacy mechanisms and eigenvalue gaps of sample covariance matrices
7. *Inter-institutional Seminar on Random Matrices (SIMA)*. Guanajuato, Mexico 2018  
**Mini course:** Some occurrences of random matrix theory in information theory
8. *Int'l Symposium on Information Theory (ISIT)*. Vail, U.S. 2018  
**Contributed Talk:** The Utility Cost of Robust Privacy Guarantees
9. *Information Theory and Applications Workshop (ITA)*. San Diego, U.S. 2018  
**Invited Talk:** Robust Privacy Guarantees for Privacy-Utility Trade-offs
10. XIII Symposium on Probability and Stochastic Processes. Mexico City, Mexico 2017  
**Invited Talk:** A New Approach to the CLT for the Linear Statistics of Random Matrices
11. *Inter-institutional Seminar on Random Matrices (SIMA)*. Guanajuato, Mexico 2017  
**Invited Talk:** Matricial Second-Order Conditional Expectations
12. *Mathematical Congress of the Americas (MCA)*. Montreal, Canada 2017  
**Invited Talk:** A New Application of Free Probability Theory: Data Privacy
13. *Canadian Ann. Symp. on Operator Algebras and Their Apps. (COSy)*. Thunder Bay, Canada 2017  
**Invited Talk:** On the fluctuations of block Gaussian matrices
14. *21st Int'l ITG Workshop on Smart Antennas*. Berlin, Germany 2017  
**Invited Talk:** Random operator-valued models: combining stochastic and algebraic models
15. *Analytic versus Combinatorial in Free Probability*. Banff International Research Station, Canada 2016  
**Invited Talk:** On the fluctuations of polynomials in Gaussian matrices
16. *Complex Analysis and Noncommutative Functions*. Toulouse, France 2016
17. *Int'l Symposium on Information Theory (ISIT)*. Barcelona, Spain 2016  
**Contributed Talk:** On the symmetries and the CAICM of multiantenna channels
18. *Canadian Ann. Symp. on Operator Algebras and Their Apps. (COSy)*. Montreal, Canada 2016
19. *Great Plains Operator Theory Symposium (GPOTS)*. Urbana-Champaign, U.S. 2016
20. *Canadian Ann. Symp. on Operator Algebras and Their Apps. (COSy)*. Waterloo, Canada 2015
21. *Inter-institutional Seminar on Random Matrices (SIMA)*. Guanajuato, Mexico 2015  
**Invited Talk:** Free probability based optimizations: capacity of multiantenna communication systems
22. *Conference on Stochastic Processes and their Applications (SPA)*. Buenos Aires, Argentina 2014  
**Contributed Talk:** On an operator-valued free probability based model for systems with block dynamics
23. *Free Probability Concentration Week*. College Station, U.S. 2014
24. *Workshop on Risk Analysis in Economics and Finance*. Guanajuato, Mexico 2013
25. *Random Matrices School (EMA)*. Guanajuato, Mexico 2012  
**Invited Talk:** Marchenko-Pastur law and multiantenna communications
26. *Workshop on Solutions to Industrial Problems*. Guanajuato, Mexico 2012
27. *Inter-institutional Seminar on Random Matrices (SIMA)*. Guanajuato, Mexico 2011  
**Invited Talk:** Some numerical aspects of the Stieltjes transform: correlated MIMO systems
28. *National Conference and Int'l Conference in Computer Science ANIEI*. Jalisco, Mexico 2010

## Seminar and Colloquium Talks

Seminar and colloquium talks given at Arizona State University (U.S.), Centro de Investigación en Matemáticas A.C. (Mexico), Huawei's Mathematical and Algorithmic Sciences Lab (France), Institut de Mathématiques de Toulouse (France), Instituto Politécnico Nacional (Mexico), Texas A&M University (U.S.), Universidad Autónoma de San Luis Potosí (Mexico), Universidad de Guadalajara (Mexico), Universität des Saarlandes (Germany), and Queen's University (Canada).

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## Miscellaneous Academic Activities

**Reviewer**<sup>4</sup> for ALEA Latin American Journal of Probability and Mathematical Statistics, AMS Mathematical Reviews, EURASIP Journal on Wireless Communications and Networking, IEEE Information Theory Workshop, IEEE International Symposium on Information Theory, IEEE Transactions on Information Forensics and Security, IEEE Transactions on Information Theory, International Symposium on Information Theory and Its Applications.

**Co-organizer** of the Non-Commutative Analysis Seminar  
Universidad Nacional Autónoma de México, Mexico 2020

**Co-organizer** of the Inter-institutional Seminar on Random Matrices (SIMA)  
Centro de Investigación en Matemáticas A.C., Mexico 2019

**Organizer** of the MAPLe Seminar (Matrices Aleatorias y Probabilidad Libre)  
Centro de Investigación en Matemáticas A.C., Mexico 2019

**Co-organizer** of the XVII School of Probability and Statistics  
Centro de Investigación en Matemáticas A.C., Mexico 2019

**Coordinator** of the Math & Stats Graduate Seminar  
Queen's University, Canada 2015 - 2016

**Organizer** of a series of mini courses on probability, statistics and related topics given by graduate students  
Centro de Investigación en Matemáticas A.C., Mexico 2013

**Lecturer** of a mini course on Coding Theory  
CUCEI Universidad de Guadalajara, Mexico 2011

**Coach** of the CUCEI Universidad de Guadalajara's programming contest teams  
Universidad de Guadalajara, Mexico 2008 - 2011

**TopCoder rating**<sup>5</sup>: 1351, 2009. Profile: <https://www.topcoder.com/members/Cumbias/>

**Coach** of the Jalisco team for the Mexican Mathematical Olympiad (high-school)  
Jalisco, Mexico 2006 - 2008

## Most Relevant Results in Academic Contests

1. *Mexico and Central America ACM ICPC Programming Contest*, Mexico 2010. **Sixth Place**  
Among approximately 80 teams from Mexico and Central America
2. *National Math Contest "Pierre Fermat"*, Mexico 2008. **Finalist**  
On-site final in a nationwide competition
3. *World Finals ACM ICPC Programming Contest*, Canada 2008. **Honorable Mention**  
Among approximately 100 teams from all around the world
4. *Mexico and Central America ACM ICPC Programming Contest*, Mexico 2007. **First Place**  
Among approximately 80 teams from Mexico and Central America
5. *Historical Essay Contest "Vida y Obra de Benito Juárez"*, Mexico 2006. **First Place**  
Among all the high-school in the city
6. *XIX Mexican Mathematical Olympiad*, Mexico 2005. **Second Place**  
Among approximately 200 contestants from Mexico
7. *XV National Contest in Physical Devices and Experiments*, Mexico 2005. **Participant**  
Among approximately 40 teams from Mexico

**Last Update: July 2020**

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<sup>4</sup> [AMS Mathematical Reviews](#); [Web of Science Peer Reviews](#).

<sup>5</sup> TopCoder is a company which organizes online computer programming competitions.

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