

# Antonio R. Paiva

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## PROFESSIONAL EXPERIENCE

- **Principal Data Scientist** *March 2022 – present*  
Allstate, Chicago, IL (Remote – based in NJ)
  - Research new approaches to measure the traffic safety risk of driver-assistance and autonomous driving systems.
  - Developed new models for information extraction from aerial images.
- **Advanced Data Analytics Researcher** *Aug. 2015 – March 2022*  
ExxonMobil, Annandale, NJ
  - Led research projects on deep learning probabilistic models, geophysical uncertainty quantification, and occupational safety data analytics.
  - Developed machine learning models for microbial modeling and fault detection.
- **Technical Team Lead** *Jan. 2014 – July 2015*  
ExxonMobil, Houston, TX
  - Managed research deployment and Agile software development and deployment.
  - Commercialized two software products and initiated development of 3 new projects.
- **Pattern Recognition Researcher** *Oct. 2010 – Dec. 2013*  
ExxonMobil, Houston, TX
  - Developed pattern recognition and signal processing methods for analysis of geophysical (i.e., seismic) image volumes. Innovations included in 8 patents.
  - Contributions include algorithm that produced 100x speed-up of previous approach, enabling the analysis to be deployed and performed on user’s workstations.
- **Post-Doctoral Fellow** *Aug. 2008 – Sept. 2010*  
Scientific Computing and Imaging Institute  
University of Utah, Salt Lake City, UT  
*Advisor:* Dr. Tolga Tasdizen
  - Developed neural network and image pattern recognition methods, with applications in cell detection, identification, and reconstruction from electron microscope image volumes.
- **Research Assistant** *Aug. 2004 – July 2008*  
University of Florida, Gainesville, FL
  - Developed new kernel machine learning framework for point processes.
  - Applied new kernel methods for neurophysiological signal data analysis.

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## EDUCATION

- **Ph.D.**, Electrical & Computer Engineering *Aug. 2008*  
University of Florida, Gainesville, FL, USA  
*Advisor:* Dr. José C. Príncipe  
*Dissertation:* “Reproducing Kernel Hilbert Spaces for Point Processes, with applications to Neural Activity Analysis.”
- **M.S.**, Electrical & Computer Engineering *Dec. 2005*  
University of Florida, Gainesville, FL, USA
- **Licentiate**, Electronics & Telecommunications Engineering *Sept. 2003*  
University of Aveiro, Aveiro, Portugal

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## PATENTS (INCLUDING PATENT APPLICATIONS)

- [1] **Antonio R. C. Paiva** and G. Pilloni, “Automated differential expression analysis of RNA sequencing data,” *Patent Application*, filed Aug. 2018.
- [2] W. Sun, **Antonio R. Paiva**, and P. Xu, “Methods and systems for fault detection and identification,” U.S. Patent 11,314,242, granted Apr. 2022.
- [3] **Antonio R. C. Paiva**, A. Kushwaha, P. Dimitrov, and M. Imhof, “Method for selecting horizon surfaces,” U.S. Patent 10,605,940, granted Mar. 2020.
- [4] L. A. Wahrmond, **Antonio R. C. Paiva**, and S. Hanson-Hedgecock, “Seismic stratigraphic surface classification,” U.S. Patent 10,641,915, granted May 2020.
- [5] —, “Seismic stratigraphic surface classification,” U.S. Patent 10,139,507, granted Nov. 2018.
- [6] D. N. Burch, **Antonio R. C. Paiva**, and R. van den Bosch, “Determining well parameters for optimization of well performance,” U.S. Patent 10,963,815, granted Mar. 2021.
- [7] —, “Determining well parameters for optimization of well performance,” U.S. Patent 9,946,974, granted Apr. 2018.
- [8] E. Bas, G. Matteucci, A. Can, J. Rittscher, W. Ge, K. E. Wrobel, M. G. Imhof, L. A. Wahrmond, and **Antonio R. C. Paiva**, “Context based geo-seismic object identification,” U.S. Patent 9,952,340, granted Apr. 2018.
- [9] M. Imhof, P. Dimitrov, and **Antonio R. C. Paiva**, “Method for decomposing complex objects into simpler components,” U.S. Patent 9,824,135, granted Nov. 2017.
- [10] **Antonio R. C. Paiva** and M. Casey, “Method for analysis of relevance and interdependencies in geoscience data,” U.S. Patent 9,014,982, granted Apr. 2015.
- [11] **Antonio R. C. Paiva** and T. Tasdizen, “Characterizing datasets using sampling, weighting, and approximation of an eigendecomposition,” U.S. Patent 8,412,651, granted Apr. 2, 2013.

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## PUBLICATIONS

### Book chapters

- [1] **Antonio R. C. Paiva**, Il Park, Jose C. Principe, and Justin C. Sanchez. Instantaneous cross-correlation analysis of neural ensembles with high temporal resolution. In Dario Farina, Winnie Jensen, and Metin Akay, editors, *Introduction to Neural Engineering for Motor Rehabilitation*, chapter 10. Wiley / IEEE Press, 2013.
- [2] Jose C. Principe, Jianwu Xu, Robert Jenssen, **Antonio R. C. Paiva**, and Il Park. A reproducing kernel Hilbert space framework for information-theoretic learning. In Jose C. Principe, editor, *Information Theoretic Learning: Renyi's Entropy and Kernel Perspectives*, chapter 9. Springer, 2010.
- [3] **Antonio R. C. Paiva**, Il Park, and Jose C. Principe. Inner products for representation and learning in the spike train domain. In Karim G. Oweiss, editor, *Statistical Signal Processing for Neuroscience and Neurotechnology*, chapter 8. Academic Press, 2010.
- [4] **Antonio R. C. Paiva**, Il Park, and Jose C. Principe. Optimization in reproducing kernel Hilbert spaces of spike trains. In Wanpracha Chaovalitwongse, Panos M. Pardalos, and Petros Xanthopoulos, editors, *Computational Neuroscience*, chapter 1. Springer, 2010.

### Refereed journal articles

- [1] Zhonghua Zheng, Arlene M. Fiore, Daniel M. Westervelt, George P. Milly, Jeff Goldsmith, Ruth S. DeFries, Alexandra N. Karambelas, Gabriele Curci, Cynthia A. Randles, **Antonio R. Paiva**, Chi Wang, and Qingyun Wu. Automated machine learning to evaluate the information content of tropospheric trace gas columns for fine particle estimates over India: a modeling testbed. *Journal of Advances in Modeling Earth Systems*, 15(3), March 2023. (Article featured in EOS review.).
- [2] **Antonio R. Paiva** and Giovanni Pilloni. Inferring microbial biomass yield and cell weight using probabilistic macrochemical modeling. *IEEE/ACM Transactions on Computational Biology and Bioinformatics*, 20(1), January 2023.
- [3] **Antonio R. Paiva** and Ashutosh Tewari. Methodology for testing and evaluation of safety analytics approaches. *Safety Science*, 152, August 2022.
- [4] Aaron A. Jones, Giovanni Pilloni, Joshua T. Claypool, **Antonio R. Paiva**, and Zarath M. Summers. Evidence of sporulation capability of the ubiquitous oil reservoir microbe *Halanaerobium congolense*. *Geomicrobiology Journal*, 38(4):283–293, April 2021. Impact factor: 1.989.
- [5] Weike Sun, **Antonio R. Paiva**, Peng Xu, Anantha Sundaram, and Richard Braatz. Fault detection and identification using Bayesian recurrent neural networks. *Computers & Chemical Engineering*, 141, October 2020. Impact factor: 3.334.

- [6] Il Park, Sohan Seth, **Antonio R. C. Paiva**, Lin Li, and Jose C. Principe. Kernel methods on spike train spaces for neuroscience: a tutorial. *IEEE Signal Processing Magazine*, 30(4):149–160, July 2013.
- [7] Elizabeth Jurrus, Shigeki Watanabe, Richard J. Giuly, **Antonio R. C. Paiva**, Mark H. Ellisman, Erik M. Jorgensen, and Tolga Tasdizen. Semi-automated neuron boundary detection and nonbranching process segmentation in electron microscopy images. *Neuroinformatics*, 11(1):5–29, January 2013.
- [8] **Antonio R. C. Paiva** and Tolga Tasdizen. Fingerprint image segmentation using data manifold characteristic features. *International Journal of Pattern Recognition and Artificial Intelligence*, 24(6), June 2012.
- [9] Luke Hoglebe, **Antonio R. C. Paiva**, Elizabeth Jurrus, Cameron Christensen, Michael Bridge, Rebecca Pfeifferd, Patrick R. Hofe, Badrinath Roysam, Julie R. Korenberg, and Tolga Tasdizen. Serial section registration of axonal confocal microscopy datasets for long-range neural circuit reconstruction. *Journal of Neuroscience Methods*, 207(2):200–210, June 2012.
- [10] Elizabeth Jurrus, **Antonio R. C. Paiva**, Shigeki Watanabe, James Anderson, Bryan Jones, Ross Whitaker, Erik M. Jorgensen, Robert Marc, and Tolga Tasdizen. Detection of neuron membranes in electron microscopy images using a series of neural networks. *Medical Image Analysis*, 14(6):770–783, December 2010.
- [11] **Antonio R. C. Paiva**, Il Park, and Jose C. Principe. A comparison of binless spike train measures. *Neural Computing and Applications*, 19(3):405–419, April 2010.
- [12] Yiwen Wang, **Antonio R. C. Paiva**, Jose C. Principe, and Justin C. Sanchez. Sequential Monte Carlo point process estimation of kinematics from neural spiking activity for brain machine interfaces. *Neural Computation*, 21(10):2894–2930, October 2009.
- [13] **Antonio R. C. Paiva**, Il Park, and Jose C. Principe. A reproducing kernel Hilbert space framework for spike train signal processing. *Neural Computation*, 21(2):424–449, February 2009.
- [14] Jian-Wu Xu, **Antonio R. C. Paiva**, Il Park, and Jose C. Principe. A reproducing kernel Hilbert space framework for information-theoretic learning. *IEEE Transactions on Signal Processing*, 56(12):5891–5902, December 2008.
- [15] Il Park, **Antonio R. C. Paiva**, Thomas B. DeMarse, and Jose C. Principe. An efficient algorithm for continuous-time cross correlation of spike trains. *Journal of Neuroscience Methods*, 128(2):514–523, March 2008.
- [16] Jeongho Cho, **Antonio R. C. Paiva**, Sung-Phil Kim, Justin C. Sanchez, and Jose C. Principe. Self-organizing maps with dynamic learning for signal reconstruction. *Neural Networks*, 20(2):274–284, March 2007.
- [17] Armando J. Pinho, **Antonio R. C. Paiva**, and António J. R. Neves. On the use of standards for microarray lossless image compression. *IEEE Transactions on Biomedical Engineering*, 53(3):563–566, March 2006.

## Refereed conference articles

- [1] Ashutosh Tewari, Brent Wheelock, **Antonio R. Paiva**, Arash Fathi, and Myun-Seok Cheon. Towards practical Bayesian inversion of geobodies using geologic priors. In *First International Meeting for Applied Geoscience & Energy*, Denver, CO, USA, September 2021. Society of Exploration Geophysicists.
- [2] Haining Zheng and **Antonio R. Paiva**. Assessing machine learning approaches to address IoT sensor drift. In *4rd Intl. Workshop on Artificial Intelligence of Things*, ACM International Conference on Knowledge Discovery and Data Mining (KDD), Singapore, August 2021.
- [3] Haining Zheng, **Antonio R. Paiva**, and Chris Gurciullo. Advancing from predictive maintenance to intelligent maintenance with AI and IIoT. In *3rd Intl. Workshop on Artificial Intelligence of Things*, ACM International Conference on Knowledge Discovery and Data Mining (KDD), San Diego, CA, August 2020.
- [4] **Antonio R. C. Paiva**. Information-theoretic dataset selection for fast kernel learning. In *Proceedings of the IEEE International Joint Conference on Neural Networks*, Anchorage, AK, USA, May 2017.
- [5] Rainer van den Bosch and **Antonio R. C. Paiva**. Benchmarking unconventional well performance predictions. In *Proceedings of the SPE/EAGE European Unconventional Resources Conference and Exhibition*, Vienna, Austria, March 2012.
- [6] Mojtaba Seyedhosseini, **Antonio R. C. Paiva**, and Tolga Tasdizen. Fast AdaBoost training using weighted novelty selection. In *Proceedings of the IEEE International Joint Conference on Neural Networks*, San Jose, CA, USA, August 2011.
- [7] Luke Hoglebe, **Antonio R. C. Paiva**, Elizabeth Jurrus, Cameron Christensen, Michael Bridge, Julie R. Korenberg, and Tolga Tasdizen. Trace driven registration of neuron confocal microscopy stacks. In *Proceedings of the IEEE International Symposium on Biomedical Imaging*, Chicago, IL, USA, April 2011.
- [8] **Antonio R. C. Paiva** and Jose C. Principe. A fixed point update for kernel width adaptation in information theoretic criteria. In *Proceedings of the International Workshop on Machine Learning for Signal Processing*, Kittilä, Finland, August 2010.
- [9] **Antonio R. C. Paiva** and Tolga Tasdizen. Detection of salient image points using principal subspace manifold structure. In *Proceedings of the International Conference on Pattern Recognition, ICPR-2010*, Istanbul, Turkey, August 2010.
- [10] **Antonio R. C. Paiva**, Elizabeth Jurrus, and Tolga Tasdizen. Using sequential context for image analysis. In *Proceedings of the International Conference on Pattern Recognition, ICPR-2010*, Istanbul, Turkey, August 2010.
- [11] Mojtaba Seyedhosseini, **Antonio R. C. Paiva**, and Tolga Tasdizen. Image parsing with a three-state series neural network classifier. In *Proceedings of the International Conference on Pattern Recognition, ICPR-2010*, Istanbul, Turkey, August 2010.

- [12] **Antonio R. C. Paiva** and Tolga Tasdizen. Fast semi-supervised image segmentation by novelty selection. In *Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing*, Dallas, TX, USA, March 2010.
- [13] Elizabeth Jurrus, **Antonio R. C. Paiva**, Shigeki Watanabe, Ross Whitaker, Erik M. Jorgensen, and Tolga Tasdizen. Serial neural network classifier for membrane detection using a filter bank. In *Proceedings of the Workshop on Microscopic Image Analysis with Applications in Biology, MIAAB-2009*, Bethesda, MD, USA, September 2009.
- [14] Kannan U. Venkataraju, **Antonio R. C. Paiva**, Elizabeth Jurrus, and Tolga Tasdizen. Automatic markup of neural cell membranes using boosted decision stumps. In *Proceedings of the IEEE International Symposium on Biomedical Imaging, ISBI-2009*, Boston, MA, USA, June 2009.
- [15] **Antonio R. C. Paiva**, Il Park, and Jose C. Principe. Peri-event cross-correlation over time for analysis of interactions in neuronal firing. In *Proceedings of the International Conference IEEE Engineering in Medicine and Biology Society, EMBC-2008*, Vancouver, BC, Canada, August 2008.
- [16] **Antonio R. C. Paiva**, Il Park, and Jose C. Principe. Reproducing kernel Hilbert spaces for spike train analysis. In *Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing, ICASSP-2008*, Las Vegas, NV, USA, April 2008.
- [17] Shalom Darmanjian, **Antonio R. C. Paiva**, and Jose C. Principe. Hierarchical decomposition of neural data using boosted mixtures of Hidden Markov Chains and its application to a BMI. In *Proceedings of the IEEE International Joint Conference on Neural Networks, IJCNN-2007*, Orlando, FL, USA, August 2007.
- [18] Yiwen Wang, **Antonio R. C. Paiva**, Jose C. Principe, and Justin C. Sanchez. A Monte Carlo sequential estimation of point process optimum filtering for brain machine interfaces. In *Proceedings of the IEEE International Joint Conference on Neural Networks, IJCNN-2007*, Orlando, FL, USA, August 2007.
- [19] Sudhir Rao, **Antonio R. C. Paiva**, and Jose C. Principe. A novel weighted LBG algorithm for neural spike compression. In *Proceedings of the IEEE International Joint Conference on Neural Networks, IJCNN-2007*, Orlando, FL, USA, August 2007.
- [20] Il Park, **Antonio R. C. Paiva**, Jose C. Principe, and John G. Harris. A closed form solution for multiple-input spike based adaptive filters. In *Proceedings of the IEEE International Joint Conference on Neural Networks, IJCNN-2007*, Orlando, FL, USA, August 2007.
- [21] **Antonio R. C. Paiva**, Sudhir Rao, Il Park, and Jose C. Principe. Spectral clustering of synchronous spike trains. In *Proceedings of the IEEE International Joint Conference on Neural Networks, IJCNN-2007*, Orlando, FL, USA, August 2007.
- [22] **Antonio R. C. Paiva**, Jose C. Principe, and Justin C. Sanchez. Gravity transform for input conditioning in brain machine interfaces. In *Proceedings of the International*

*Conference IEEE Engineering in Medicine and Biology Society, EMBC-2006*, New York City, NY, September 2006.

- [23] Jian-Wu Xu, Puskal Pokharel, **Antonio R. C. Paiva**, and Jose Príncipe. Nonlinear component analysis based on correntropy. In *Proceedings of the IEEE International Joint Conference on Neural Networks, IJCNN-2006*, Vancouver, BC, Canada, July 2006.
- [24] Yiwen Wang, **Antonio R. C. Paiva**, and Jose C. Príncipe. A monte carlo sequential estimation for point process optimum filtering. In *Proceedings of the IEEE International Joint Conference on Neural Networks, IJCNN-2006*, Vancouver, BC, Canada, July 2006.
- [25] **Antonio R. C. Paiva**, Jian-Wu Xu, and Jose C. Príncipe. Kernel principal components are maximum entropy projections. In *Proceedings of the International Conference on Independent Component Analysis and Blind Source Separation, ICA-2006*, pages 846–853, Charleston, SC, March 2006. Acceptance ratio: 55%.
- [26] António J. R. Neves, Armando J. Pinho, and **Antonio R. C. Paiva**. Lossless bit-plane compression of microarray images using 3D context models. In *Proceedings of the IASTED International Conference on Visualization, Imaging and Image Processing, VIIP-2005*, Benidorm, Spain, September 2005.
- [27] **Antonio R. C. Paiva**, Jose C. Principe, and Justin C. Sanchez. Compression of spike data using the self-organizing map. In *Proceedings of the International IEEE-EMBS Conference on Neural Engineering*, pages 233–236, Arlington, VA, March 2005.
- [28] **Antonio R. C. Paiva** and Armando J. Pinho. Evaluation of some reordering techniques for image VQ index compression. In *Proceedings of the International Conference on Image Analysis and Recognition, ICIAR-2004*, volume LNCS 3211, pages 302–309, Porto, Portugal, September 2004. Springer-Verlag.

## Abstracts

- [1] Weike Sun, **Antonio R. Paiva**, Peng Xu, Anantha Sundaram, and Richard Braatz. Fault detection and identification using Bayesian recurrent neural networks. In *Proceedings of the CACHE Conference on Foundations of Process Analytics and Machine learning*, Raleigh, NC, August 2019. Abstract.
- [2] Mohor Chatterjee, Kuang He, **Antonio R. C. Paiva**, Zarath Summers, and Giovanni Pilloni. Indole-mediated regulation of anaerobic biofilm formation in *Desulfovibrio vulgaris Hildenborough*: Implications in microbiologically influenced corrosion. In *Proceedings of the International Symposium on Applied Microbiology and Molecular Biology in Oil Systems*, Halifax, NS, Canada, June 2019. Abstract.
- [3] Frederick von Netzer, Kristopher A. Hunt, Drew Gorman-Lewis, Everett Shock, Serdar Turkarslan, Christina E. Arens, Anne W. Thompson, Nitin S. Baliga, Aifen Zhou, Jizhong Zhou, Jessica Hardwicke, Chiachi Hwang, Matthew W. Fields, **Antonio R. C. Paiva**, Giovanni Pilloni, and David A. Stahl. Microcalorimetric analyses of microbial energy partitioning between growth and maintenance under optimal and suboptimal environmental

conditions. In *Proceedings of the International Symposium on Microbial Ecology*, Leipzig, Germany, August 2018. Abstract.

- [4] **Antonio R. C. Paiva** and Il Park. Which measure should we use for unsupervised spike train learning? In *Proceedings of the International Workshop on Statistical Analysis of Neuronal Data, SAND5*, Pittsburgh, PA, USA, May 2010. Abstract.
- [5] **Antonio R. C. Paiva**, Il Park, and Jose C. Principe. Innovating signal processing for spike train data. In *Proceedings of the International Conference IEEE Engineering in Medicine and Biology Society, EMBC-2007*, Lyon, France, October 2007. Abstract.
- [6] Il Park, **Antonio R. C. Paiva**, Thomas B. DeMarse, and Jose C. Principe. An efficient computation of continuous-time correlogram of spike trains. In *Proceedings of the Computational and Systems Neuroscience meeting, COSYNE-2007*, Salt Lake City, UT, USA, February 2007. Abstract.

## Technical Reports and Dissertation

- [1] Ashutosh Tewari and **Antonio R. Paiva**. Modeling and mitigation of occupational safety risks in dynamic industrial environments. Technical report, ExxonMobil Corporate Strategic Research, May 2022. arXiv: 2205.00894.
- [2] Mojtaba Seyedhosseini, **Antonio R. C. Paiva**, and Tolga Tasdizen. Multi-scale series contextual model for image parsing. SCI Technical Report UUSCI-2011-004, SCI Institute, University of Utah, March 2011.
- [3] Elizabeth Jurrus, **Antonio R. C. Paiva**, Shigeki Watanabe, Ross Whitaker, Erik M. Jorgensen, and Tolga Tasdizen. Serial neural network classifier for membrane detection using a filter bank. SCI Technical Report UUSCI-2009-006, SCI Institute, University of Utah, June 2009.
- [4] **Antonio R. C. Paiva** and Tiago J. Martins Duarte. Architectures for open access hotspots. *Revista do DETUA* 4(2), pages 235–240, University of Aveiro, January 2004.
- [5] **Antonio R. C. Paiva**. *Reproducing Kernel Hilbert Spaces for Point Processes, with Applications to Neural Activity Analysis*. PhD thesis, University of Florida, 2008.

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## PROFESSIONAL MEMBERSHIPS AND ACTIVITIES

- **Associate Editor**, IEEE Transactions on Neural Networks and Learning Systems  
*Jan. 2017 – present*
- **Associate Editor**, IEEE Signal Processing Journal  
*July 2016 – June 2020*
- **IEEE Senior Member**  
*Apr. 2019 – present*
- **IEEE Member**  
*Jan. 2005 – Mar. 2019*



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## TECHNICAL SKILLS

- Machine Learning: Deep learning/neural network models (e.g., CNNs, RNNs, VAEs, Normalizing Flows), Probabilistic Graphical Models, Statistical Learning, Adaptive Signal Processing, Image Processing
- Programming: Python, Stan, Matlab, Bash, C
- Data Analytics/Machine Learning software: PyTorch, Tensorflow, Keras, Scikit-learn, Numpy, Pandas, pyStan
- Web development: HTML, PHP, CSS, SQL
- Operating systems: Windows and Linux
- Server management: HTTP (Apache), MySQL, DHCP, DNS
- Productivity software: L<sup>A</sup>T<sub>E</sub>X and Microsoft Office

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## LANGUAGES

Portuguese and English