Luis Gonzalo Sánchez Giraldo

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Education

Ph.D. in Electrical and Computer Engineering 2012
Dept. of Electrical and Computer Engineering, University of Florida, Gainesville, Florida, US.
Thesis title: Reproducing Kernel Hilbert Space Methods for Information Theoretic Learning.
Adviser: Prof. Jose C. Principe.

M.Eng. in Industrial Automation 2008
Dept. of Electrical, Electronics, and Computing Engineering, Universidad Nacional de Colombia, Manizales - Caldas, Colombia.
Thesis title: Characterization of the Stochastic Dynamics of Biomedical Signals for Pathology Detection Using Similarity and Dissimilarity Representations.
Adviser: Prof. Germán Castellanos-Domínguez.

Bachelor's degree in Electronics Engineering 2004
Dept. of Electrical, Electronics and Computing Engineering, Universidad Nacional de Colombia, Manizales - Caldas, Colombia.
Final project: PCA, KPCA and MANOVA on Speech: Lip Posture Images, and Audio Signals. Coauthored with Genaro Daza Santacoloma.
Adviser: Prof. Germán Castellanos-Domínguez.

Research interests

My interests encompass pattern recognition, machine learning, computational neuroscience, and their applications in computer vision and signal processing. Currently, I am working on learning representations for visual processing using contextual information and non parametric estimators of information theoretic quantities for machine learning.

Research experience

Assistant Professor ..... August 2019 to present
Department of Electrical and Computer Engineering at the University of Kentucky.
Research: Machine Learning, Signal Processing, Computational Neuroscience.

Postdoctoral Associate ..... November 2015 to August 2019
Department of Computer Science at the University of Miami.
Research: Representation learning models for vision using contextual information.
Adviser: Prof. Odelia Schwartz.

Chief Research Scientist ..... September 2012 to November 2015
Aventusoft LLC. Boca Raton, Florida
Research: Multiple source separation and detection-localization; deep belief networks and sparse algorithms in acoustic analysis.

Graduate Research Assistant ..... 2008 to 2012
Computational Neuro-Engineering Laboratory at the University of Florida.
Research: Machine learning for signal processing. Kernel methods and information theoretic learning.
Adviser: Prof. Jose C. Principe.

Student Research Assistant ..... 2004 to 2008
Control and Digital Signal Processing Group at Universidad Nacional de Colombia, Manizales.
Research: Machine learning for biomedical signal processing and industrial process monitoring.
Adviser: Prof. Germán Castellanos-Domínguez.

Undergraduate Research 2004
Control and Digital Signal Processing Group at Universidad Nacional de Colombia, Manizales **Project title:** *Acústica de la Voz en Pacientes de la Fundación Sonrisa y Clínica de LPH de Manizales.*
We developed tools for automated analysis of speech signals applied in the treatment of cleft lip and/or palate children. I developed and programmed methods for feature extraction, feature selection, and classification. Additionally, I contributed to the final report writing.
PI: Prof. Germán Castellanos-Domínguez.

Teaching experience

Co-organizer (Deep Learning discussion group at the University of Miami) 2018-2019
This is a discussion group that hold biweekly meetings to talk about relevant work on deep learning.

Lecturer (REU: Computing for Structure) 2018
Prepared materials and gave one day lectures on introductory topics in machine learning to undergraduate students participating in the program "Research Experience for Undergraduates," created and directed by the Department of Computer Science and Center for Computational Science at the University of Miami.

Speaker (Miami Machine Learning MeetUp Group) 2018
Gave a talk about my research on normalization models for deep convolutional neural networks.

Invited lecturer (Programming Languages) 2018
This was a course on the theory of programming languages for undergraduates students at the University of Miami offered by Professor Odelia Schwartz. I gave a presentation on the concept of differentiable programming.

Occasional lecturer (Computational Neuroscience) 2017
This was a course on computational neuroscience for advanced undergraduates and graduate students at the University of Miami offered by Professor Odelia Schwartz.

Lecturer (REU: Computing for Structure) 2017
Prepared materials and gave a lecture on Neural Networks to undergraduate students participating in the program "Research Experience for Undergraduates," created and directed by the Department of Computer Science and Center for Computational Science at the University of Miami.

Invited lecturer (Short Course on Deep Learning) 2017
Prepared and taught a one week intensive course on deep learning to graduate students at Universidad Tecnologica de Pereira, Colombia.

Invited speaker (Brain Korea 21 project. South Korea) 2017
Gave a talk about my research on advanced normalization models for deep convolutional neural networks to graduate students at Kyungpook National University, Daegu, Republic of Koreaa.

Auxiliary lecturer (Electric Circuits III) 2008

Auxiliary lecturer (Digital Signal Processing III) ..... 2007 to 2008
The course was divided into three modules: basic optimization methods, data analysis, and pattern recognition. I was in charge of the introductory module on mathematical optimization methods.

Auxiliary lecturer (Computer Programming III) ..... 2006 to 2008
The course focused on object oriented programming using C++.

Teaching assistant (Signals and Systems) 2004
Answered questions and graded exercises and homework assignments.

The last four items were undergraduate courses offered in the department of electrical, electronics, and computing engineering at Universidad Nacional de Colombia.
In Colombia, an auxiliary lecturer is the first teaching position in an academic career. The lecturer is in charge of the entire undergraduate class. This position is usually held by graduate students at masters and doctoral levels.

Distinctions and awards

Recipient of the Latin American fellowship for Ph.D. study ..... 2008 to 2012
Dept. of Electrical and Computer Engineering, University of Florida.

Meritorious master's thesis 2008
Universidad Nacional de Colombia.

Third place, student poster competition 2007
IEEE Summer School in Computational Intelligence EVIC 2007, Chile.

Recipient of the scholarship for outstanding graduate students ..... 2006 to 2008
Universidad Nacional de Colombia.

Reviewer

- Machine Learning Journal
- IEEE Transactions on Information Theory
- IEEE Transaction on Neural Networks and Learning Systems
- Neurocomputing
- Journal of Imaging Science and Technology
- International Joint Conference on Neural Networks

Computer skills

Operating systems: Linux, Windows.

Text editing: LaTeX.

Programming: C/C++, Python, MATLAB, INTEL assembler for μCs.

Publications

Patents (Granted)

[1] Kaustubh Kale and **Luis Gonzalo Sanchez Giraldo**. System and method of extraction, identification, marking and display of heart valve signals, July 2019. Patent No. US 10,362,997 A1.

[2] Kaustubh Kale and **Luis Gonzalo Sanchez Giraldo**. System and method of extraction of the heart valve signals, Jan 2019. Patent No. US 10,165,985 B2.

Patents (Under review)

[1] Kaustubh Kale and **Luis Gonzalo Sanchez Giraldo**. System and method of extraction, identification, making and display of the heart valve signals, July 13 2017. WO Patent App. PCT/US2017/012,031.

[2] Kaustubh Kale, **Luis Gonzalo Sanchez Giraldo**, Diego Pava, and Mahdi Esfahanian. System and method of marking cardiac time intervals from the heart valve signals, July 6 2017. US Patent App. 15/397,138.

[3] Kaustubh Kale, **Luis Gonzalo Sanchez Giraldo**, Diego Pava, and Mahdi Esfahanian. System and method of identification of the heart valve signals, July 6 2017. US Patent App. 15/397,088.

Preprints

[1] Md Nasir Uddin Laskar, **Luis G Sanchez Giraldo**, and Odelia Schwartz. Correspondence of Deep Neural Networks and the Brain for Visual Textures. *arXiv e-prints*, page arXiv:1806.02888.

Journal Publications

[1] **Luis G. Sanchez Giraldo** and Odelia Schwartz. Integrating flexible normalization into mid-level representations of deep convolutional neural networks. *Neural Computation*, in Press, 2019.

[2] Shujian Yu, **Luis Gonzalo Sanchez Giraldo**, Robert Jenssen, and Jose C. Principe. Multivariate Extension of Matrix-based Renyi's α-order Entropy Functional. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, in Press, 2019.

[3] **Luis G. Sanchez Giraldo**, Md Nasir Uddin Laskar, and Odelia Schwartz. Normalization and pooling in hierarchical models of natural images. *Current Opinion in Neurobiology*, 55:65–72, 2019.

[4] Max Turner†, **Luis G. Sanchez Giraldo**†, Odelia Schwartz, and Fred Rieke. Stimulus- and goal-oriented frameworks for understanding natural vision. *Nature Neuroscience*, 22:15–24, 2019. † **Equal contribution as first authors**.

[5] Odelia Schwartz and **Luis G. Sanchez Giraldo**. Behavioural and neural constraints on hierarchical representations in vision. *Journal of Vision*, 17(13), March 2017.

[6] Jihye Bae, **Luis G. Sanchez Giraldo**, Eric Pohlmeyer, Joseph Francis, Justin Sanchez, and Jose C. Principe. Kernel temporal differences for neural decoding. *Computational Intelligence and Neuroscience*, page 17, 2015. Article ID 481375.

[7] **Luis G. Sanchez Giraldo**, Murali Rao, and Jose C. Principe. Measures of entropy from data using infinitely divisible kernels. *IEEE Transactions on Information Theory*, 61(1):535–548, 2015.

[8] Erion Hasanbelliu, **Luis Sanchez Giraldo**, and Jose C. Principe. Information theoretic shape matching. *IEEE Transactions on Pattern Analysis and Machine Intelligence*, 36(12):2436–2451, 2014.

[9] **Luis Gonzalo Sanchez Giraldo** and German Castellanos Dominguez. Weighted feature extraction with a functional data extension. *Neurocomputing*, 73(10-12):1760–1773, 2010.

Book Chapters

[1] Jose C. Principe, Badong Chen, and **Luis G. Sanchez Giraldo**. *Academic Press Library in Signal Processing, 1st Edition: Signal Processing Theory and Machine Learning*, chapter Information Based Learning, pages 1379–1414. Elsevier, 2013.

[2] Genaro Daza Santacoloma, **Luis Gonzalo Sanchez Giraldo**, Franklin Alexander Sepulveda, and Cesar German Castellanos Dominguez. *Encyclopedia of Healthcare Information Systems*, chapter Acoustic feature analysis for hypernasality detection in children, pages 16–22. IGI Global, 2008.

[3] Edilson Delgado Trejos, German Castellanos Dominguez, **Luis Gonzalo Sanchez Giraldo**, and Julio Fernando Suarez. *Encyclopedia of Healthcare Information Systems*, chapter Feature Selection in Pathology Detection using Hybrid Multidimensional Analysis, pages 587–593. IGI Global, 2008.

Abstracts

[1] **Luis G. Sanchez Giraldo** and Odelia Schwartz. Flexible normalization in deep convolutional neural networks. Computational and Systems Neuroscience (Cosyne) 2017, 2017.

[2] Md Nasir Uddin Laskar, **Luis G. Sanchez Giraldo**, and Odelia Schwartz. Deep learning captures v2 selectivity for natural textures. Computational and Systems Neuroscience (Cosyne) 2017, 2017.

[3] Md Nasir Uddin Laskar, **Luis G. Sanchez Giraldo**, and Odelia Schwartz. Deep learning captures v2 selectivity for natural textures. Brains and Bits: Neuroscience Meets Machine Learning: NIPS, 2016.

[4] **Luis G. Sanchez Giraldo** and Odelia Schwartz. Flexible normalization in deep convolutional neural networks. 15th Neural Computation and Psychology Workshop, 2016.

[5] **Luis G. Sanchez Giraldo** and Jose Principe. Rate-distortion auto-encoders. Deep Learning and Representation Learning Workshop: NIPS, 2014.

[6] **Luis G. Sanchez Giraldo** and Jose Principe. Rate-distortion auto-encoders. International Conference on Learning Representations, workshop track, 2014.

Conferences and Symposiums

[1] **Luis Gonzalo Sanchez Giraldo**, Erion Hasanbelliu, Murali Rao, and Jose Principe. Group-wise point-set registration based on rényi's second order entropy. In *The Thirtieth IEEE/CVF Conference on Computer Vision and Pattern Recognition*, pages 2454–2462, 2017.

[2] Austin Brockmeier, Eder Santana, **Luis Gonzalo Sanchez Giraldo**, and Jose Principe. Projentropy: Using entropy to optimize spatial projections. In *International Conference on Acoustics, Speech and Signal Processing 2014*, pages 4538–4542, 2014.

[3] Jihye Bae, **Luis Gonzalo Sanchez Giraldo**, Joseph Francis, and Jose Principe. Correntropy kernel temporal differences for reinforcement learning brain machine interfaces. In *International Joint Conference on Neural Networks 2014*, pages 2713–2717, 2014.

[4] Evan Kriminger, Austin J. Brockmeier, **Luis Gonzalo Sanchez Giraldo**, and Jose Principe. Metric learning for invariant feature generation in reinforcement learning. In *1st Multidisciplinary Conference on Reinforcement Learning and Decision Making*, 2013.

[5] Austin Brockmeier, **Luis Gonzalo Sanchez Giraldo**, John Stephen Choi, Joseph Thachil Francis, and Jose Principe. Learning multiscale neural metrics via entropy minimization. In *6th International IEEE EMBS Neural Engineering Conference*, pages 247–250, 2013.

[6] **Luis Gonzalo Sanchez Giraldo** and Jose C. Principe. Information theoretic learning with infinitely divisible kernels. In *International Conference on Learning Representations*, 2013.

[7] Jihye Bae, **Luis Gonzalo Sanchez Giraldo**, Eric A. Pohlmeyer, Justin C. Sanchez, and Jose Principe. A new method of concurrently visualizing states, values, and actions in reinforcement based brain machine interfaces. In *35th International Conference IEEE Engineering in Medicine and Biology Society*, pages 5402–5405, 2013.

[8] Austin Brockmeier, **Luis Gonzalo Sanchez Giraldo**, Matthew Emigh, Jihye Bae, John Stephen Choi, Joseph Thachil Francis, and Jose Principe. Information-theoretic metric learning: 2-d projections of neural data for visualization and classification. In *35th International Conference IEEE Engineering in Medicine and Biology Society*, pages 5586–5589, 2013.

[9] Jihye Bae, **Luis Sanchez Giraldo**, Pratik Chhatbar, Joseph Francis, Justin Sanchez, and Jose Principe. Stochastic kernel temporal difference for reinforcement learning. In *Machine Learning for Signal Processing*, September 2011.

[10] Erion Hasanbelliu, **Luis Sanchez Giraldo**, and Jose C. Principe. A robust point matching algorithm for non-rigid registration using the cauchy-schwarz divergence. In *Machine Learning for Signal Processing*, September 2011.

[11] **Luis G. Sanchez Giraldo** and Jose C. Principe. A reproducing kernel hilbert space formulation of the principle of relevant information. In *Machine Learning for Signal Processing*, September 2011.

[12] **Luis Gonzalo Sanchez Giraldo** and Jose C. Principe. An efficient rank-deficient computation of the principle of relevant information. In *International Conference on Acoustics, Speech and Signal Processing*, pages 2176–2179. IEEE, 2011.

[13] Erion Hasanbelliu, **Luis Sanchez Giraldo**, and Jose C. Principe. A recursive online kernel pca algorithm. In *International Conference on Pattern Recognition*, pages 169–172. IEEE Computer Society, 2010.

[14] **Luis Gonzalo Sanchez Giraldo**, Fernando Martinez Tabares, and German Castellanos Dominguez. Functional feature selection by weighted projections in pathological voice detection. In *Proceedings of the 14th Iberoamerican Conference on Pattern Recognition*, pages 329–336. Sringer-Verlag, 2009.

[15] **Luis Sanchez**, Fernando Martinez, German Castellanos, and Augusto Salazar. Feature extraction of weighted data for implicit variable selection. In *International Conference on Computer Analysis of Images and Patterns Lecture Notes in Computer Science*, volume 4673, pages 840–847. Springer, 2007.

[16] German Castellanos, Genaro Daza, **Luis Sanchez**, Julio Suarez, and Edilson Delgado. Feature selection in pathology detection using hybrid multidimensional analysis. In *28th International Conference IEEE Engineering in Medicine and Biology Society, New York*, pages 5503–5506, August 2006.

[17] German Castellanos, Genaro Daza, **Luis Sanchez**, Omar Castrillon, and Julio Suarez. Acoustic speech analysis for hypernasality detection in children. In *28th International Conference IEEE Engineering in Medicine and Biology Society, New York*, pages 5507–5510, August 2006.

[18] Augusto Salazar, Genaro Daza, **Luis Sanchez**, Flavio Prieto, Colombia Quintero, and German Castellanos. Feature extraction & lips posture detection oriented to the treatment of CLP children. In *28th International Conference IEEE Engineering in Medicine and Biology Society, New York*, pages 5747–5750, August 2006.

Theses and Dissertation

[1] **Luis Gonzalo Sanchez Giraldo**. *Reproducing Kernel Hilbert Space Methods for Information Theoretic Learning*. PhD thesis, University of Florida, 2012.

[2] **Luis Gonzalo Sanchez Giraldo**. Characterization of the stochastic dynamics of biomedical signals for pathology detection using similarity and dissimilarity representations. Master's thesis, Universidad Nacional de Colombia, 2008.

[3] Genaro Daza-Santacoloma and **Luis Gonzalo Sanchez-Giraldo**. PCA, KPCA y MANOVA sobre senales de voz en imágenes de posturas labiales y audio (PCA, KPCA and MANOVA on voice signals: Lip postures and speech). Undergraduate Final Project, Universidad Nacional de Colombia, 2004.