Publication List

Antônio Horta Ribeiro

September 12, 2022

Most relevant publications

Bellow the list of my five most relevant publications to the moment.

Antônio H. Ribeiro, Manoel Horta Ribeiro, Gabriela M. M. Paixão, Derick M. Oliveira, Paulo R. Gomes, Jéssica A. Canazart, Milton P. S. Ferreira, Carl R. Andersson, Peter W. Macfarlane, Wagner Meira Jr., Thomas B. Schön, and Antonio Luiz P. Ribeiro. "Automatic Diagnosis of the 12-Lead ECG Using a Deep Neural Network". In: *Nature Communications* 11.1 (2020), p. 1760. DOI: 10.1038/s41467-020-15432-4. arXiv: 1904.01949.

> **Relevance:** It was a pioneering work on the use of deep neural networks for the analysis of 12-lead ECGs. We made the implementation and the datasets available and thousands of researchers downloaded them. According to Google Scholar, it was cited more than 150 times in less than two years.
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> **Contribution:** I contributed to all aspects of the work, including its conception, implementation and analysis. I also presented intermediary results in conferences.

Emilly M. Lima, **Antônio H. Ribeiro**, Gabriela MM Paixão, Manoel Horta Ribeiro, Marcelo M. Pinto Filho, Paulo R. Gomes, Derick M. Oliveira, Ester C. Sabino, Bruce B. Duncan, Luana Giatti, Sandhi M. Barreto, Wagner Meira, Thomas B. Schön, and Antonio Luiz P. Ribeiro. "Deep Neural Network Estimated Electrocardiographic-Age as a Mortality Predictor". In: *Nature Communications* 12 (2021). DOI: 10.1038/s41467-021-25351-7.

> **Relevance:** We use artificial intelligence to deal with a task predicting age from the ECG. We have shown that the ECG predicted age is a good predictor of risk and is related to mortality risk. The work points to the fact that even normal ECG contains additional information for risk assessment and machine learning might be a useful tool for extracting this information.
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> **Contribution:** I am co-first author together with Emilly and Gabriella (equal contribution). I contributed to the implementation of all machine learning algorithms, the conception of the work, and the writing. They contributed respectively with the statistical and the medical analysis.

Antônio H. Ribeiro, Koen Tiels, Jack Umenberger, Thomas B. Schön, and Luis A. Aguirre. "On the Smoothness of Nonlinear System Identification". In: *Automatica* 121 (Nov. 2020), p. 109158. DOI: 10.1016/j.automatica.2020.109158. arXiv: 1905.00820.

> **Relevance:** We study the challenges of parameter estimations for nonlinear dynamical systems. We show how regions of the parameter space could easily become hard to navigate due to the system's instability or chaos. We propose as a solution to it a method called multiple shooting, which divides the problem into smaller and well-behaved subproblems.
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> **Contribution:** I contributed to the implementation, writing, mathematical development and analysis.

Antônio H. Ribeiro, Koen Tiels, Luis A. Aguirre, and Thomas B. Schön. "Beyond Exploding and Vanishing Gradients: Attractors and Smoothness in the Analysis of Recurrent Neural Network Training". In: *Proceedings of the 23rd International Conference on Artificial Intelligence and Statistics (AISTATS), PMLR*. Vol. 108. 2020, pp. 2370–2380. arXiv: 1906.08482.

> **Relevance:** In this paper, which complements and extends the previous one, we discuss how regions of the parameter space could become hard to navigate due to the system's unstability or chaos. We discuss this problem in recurrent neural networks and the role of dynamic attractors in storing information in these models.
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> **Contribution:** I contributed with the implementation, writing, mathematical development and analysis.

Antônio H. Ribeiro and Luis A. Aguirre. ""Parallel Training Considered Harmful?": Comparing Series-Parallel and Parallel Feedforward Network Training". In: *Neurocomputing* 316 (Nov. 2018), pp. 222–231. ISSN: 0925-2312. DOI: 10.1016/j.neucom.2018.07.071.

> **Relevance:** It was the first journal publication of my Ph.D. It studied the computational challenges and asymptotic properties of estimators with recurrence in their architecture. It shows how recurrent structures can be better for certain types of noise contamination. It also presents an analysis of the computational cost of the approach.
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> **Contribution:** I contributed with the implementation, writing, mathematical development and analysis.

Full publication list

Preprints

[P1] Stefan Gustafsson, Daniel Gedon, Erik Lampa, **Antônio H. Ribeiro**, Martin J. Holzmann, Thomas B. Schön, and Johan Sundstrom. "Artificial Intelligence-Based ECG Diagnosis of Myocardial Infarction in High-Risk Emergency Department Patients". In: *SSRN* (June 2021). DOI: 10.2139/ssrn.3857655.

[P2] Veer Sangha, Bobak J. Mortazavi, Adrian D. Haimovich, **Antônio H. Ribeiro**, Cynthia A. Brandt, Daniel L. Jacoby, Wade L. Schulz, Harlan M. Krumholz, Antonio Luiz P. Ribeiro, and Rohan Khera. "Automated Multilabel Diagnosis on Electrocardiographic Images and Signals". In: *medRxiv* (Sept. 2021). DOI: 10.1101/2021.09.22.21263926.

Journal Papers

[J1] Shany Biton, Sheina Gendelman, **Antônio H Ribeiro**, Gabriela Miana, Carla Moreira, Antonio Luiz P Ribeiro, and Joachim A Behar. "Atrial Fibrillation Risk Prediction from the 12-Lead ECG Using Digital Biomarkers and Deep Representation Learning". In: *European Heart Journal - Digital Health* (2021). ISSN: 2634-3916. DOI: 10.1093/ehjdh/ztab071.

[J2] Emilly M. Lima, **Antônio H. Ribeiro**, Gabriela MM Paixão, Manoel Horta Ribeiro, Marcelo M. Pinto Filho, Paulo R. Gomes, Derick M. Oliveira, Ester C. Sabino, Bruce B. Duncan, Luana Giatti, Sandhi M. Barreto, Wagner Meira, Thomas B. Schön, and Antonio Luiz P. Ribeiro. "Deep Neural Network Estimated Electrocardiographic-Age as a Mortality Predictor". In: *Nature Communications* 12 (2021). DOI: 10.1038/s41467-021-25351-7.

[J3] Gabriela M. M. Paixão, Emilly M. Lima, Paulo R. Gomes, Derick M. Oliveira, Manoel H. Ribeiro, Jamil S. Nascimento, **Antonio H. Ribeiro**, Peter W. Macfarlane, and Antonio L. P. Ribeiro. "Electrocardiographic Predictors of Mortality: Data from a Primary Care Tele-Electrocardiography Cohort of Brazilian Patients". In: *Hearts* 2.4 (Dec. 2021), pp. 449–458. DOI: 10.3390/hearts2040035.

[J4] Wagner Meira Jr, Antonio L. P. Ribeiro, Derick M. Oliveira, and **Antonio H. Ribeiro**. "Contextualized Interpretable Machine Learning for Medical Diagnosis". In: *Communications of the ACM* (2020). DOI: 10.1145/3416965.

[J5] Gabriela M. M. Paixão, Luis Gustavo S. Silva, Paulo R. Gomes, Emilly M. Lima, Milton P. F. Ferreira, Derick M. Oliveira, Manoel H. Ribeiro, **Antonio H. Ribeiro**, Jamil S. Nascimento, Jéssica A. Canazart, Leonardo B. Ribeiro, Emelia J. Benjamin, Peter W. Macfarlane, Milena S. Marcolino, and Antonio L. Ribeiro. "Evaluation of Mortality in Atrial Fibrillation: Clinical Outcomes in Digital Electrocardiography (CODE) Study". In: *Global Heart* 15.1 (July 2020), p. 48. ISSN: 2211-8179. DOI: 10.5334/gh.772.

[J6] **Antônio H. Ribeiro**, Manoel Horta Ribeiro, Gabriela M. M. Paixão, Derick M. Oliveira, Paulo R. Gomes, Jéssica A. Canazart, Milton P. S. Ferreira, Carl R. Andersson, Peter W. Macfarlane, Wagner Meira Jr., Thomas B. Schön, and Antonio Luiz P. Ribeiro. "Automatic Diagnosis of the 12-Lead ECG Using a Deep Neural Network". In: *Nature Communications* 11.1 (2020), p. 1760. DOI: 10.1038/s41467-020-15432-4. arXiv: 1904.01949.

[J7] **Antônio H. Ribeiro**, Koen Tiels, Jack Umenberger, Thomas B. Schön, and Luis A. Aguirre. "On the Smoothness of Nonlinear System Identification". In: *Automatica* 121 (Nov. 2020), p. 109158. DOI: 10.1016/j.automatica.2020.109158. arXiv: 1905.00820.

[J8] Pauli Virtanen, Ralf Gommers, Travis E. Oliphant, Matt Haberland, Tyler Reddy, David Cournapeau, Evgeni Burovski, Pearu Peterson, Warren Weckesser, Jonathan Bright, Stéfan J. van der Walt, Matthew Brett, Joshua Wilson, K. Jarrod Millman, Nikolay Mayorov, Andrew R. J. Nelson, Eric Jones, Robert Kern, Eric Larson, C. J. Carey, İlhan Polat, Yu Feng, Eric W. Moore, Jake VanderPlas, Denis Laxalde, Josef Perktold, Robert Cimrman, Ian Henriksen, E. A. Quintero, Charles R. Harris, Anne M. Archibald, **Antônio H. Ribeiro**, Fabian Pedregosa, Paul van Mulbregt, and SciPy 1.0 Contributors. "SciPy 1.0–Fundamental Algorithms for Scientific Computing in Python". In: *Nature Methods* 17.3 (2020), pp. 261–272. DOI: 10.1038/s41592-019-0686-2. arXiv: 1907.10121.

[J9] Gabriela M. M. Paixão, Emilly M. Lima, Paulo R. Gomes, Milton P. Ferreira, Derick M. Oliveira, Manoel Horta Ribeiro, **Antônio H. Ribeiro**, Jamil Nascimento, Jéssica A. Canazart, Gustavo Cardoso, Leonardo B. Ribeiro, and Antonio Luiz P. Ribeiro. "Evaluation of Mortality in Bundle Branch Block Patients from an Electronic Cohort: Clinical Outcomes in Digital Electrocardiography (CODE) Study". In: *Journal of Electrocardiology* (Sept. 2019). ISSN: 0022-0736. DOI: 10.1016/j.jelectrocard.2019.09.004.

[J10] Antonio Luiz P. Ribeiro, Gabriela M. M. Paixão, Paulo R. Gomes, Manoel Horta Ribeiro, **Antônio H. Ribeiro**, Jéssica A. Canazart, Derick M. Oliveira, Milton P. Ferreira, Emilly M. Lima, Jermana Lopes de Moraes, Nathalia Castro, Leonardo B. Ribeiro, and Peter W. MacFarlane. "Tele-Electrocardiography and Bigdata: The CODE (Clinical Outcomes in Digital Electrocardiography) Study". In: *Journal of Electrocardiology* (Sept. 2019). ISSN: 0022-0736. DOI: 10/gf7pwg.

[J11] **Antônio H. Ribeiro** and Luis A. Aguirre. ""Parallel Training Considered Harmful?": Comparing Series-Parallel and Parallel Feedforward Network Training". In: *Neurocomputing* 316 (Nov. 2018), pp. 222–231. ISSN: 0925-2312. DOI: 10.1016/j.neucom.2018.07.071.

Conference Papers

[C1] Johannes N. Hendriks, Fredrik K. Gustafsson, **Antônio H. Ribeiro**, Adrian G. Wills, and Thomas B. Schön. "Deep Energy-Based NARX Models". In: *Proceedings of the 19th IFAC Symposium on System Identification (SYSID) - IFAC-PapersOnLine* 54.7 (2021), pp. 505–510. DOI: 10.1016/j.ifacol.2021.08.410. arXiv: 2012.04136.

[C2] **Antonio H. Ribeiro** and Thomas B. Schon. "How Convolutional Neural Networks Deal with Aliasing". In: *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*. IEEE, 2021, pp. 2755–2759. DOI: 10.1109/ICASSP39728.2021.9414627.

[C3] **Antônio H. Ribeiro**, Johannes N. Hendriks, Adrian G. Wills, and Thomas B. Schön. "Beyond Occam's Razor in System Identification: Double-Descent When Modeling Dynamics". In: *Proceedings of the 19th IFAC Symposium on System Identification (SYSID) - IFAC-PapersOnLine*. Vol. 54. Elsevier, 2021, pp. 97–102. DOI: 10.1016/j.ifacol.2021.08.341. arXiv: 2012.06341.

[C4] Derick M. Oliveira, **Antônio H. Ribeiro**, João A. O. Pedrosa, Gabriela M.M. Paixao, Antonio Luiz P. Ribeiro, and Wagner Meira Jr. "Explaining End-to-End ECG Automated Diagnosis Using Contextual Features". In: *Machine Learning and Knowledge Discovery in Databases. European Conference on Machine Learning and Principles and Practice of Knowledge Discovery in Databases (ECML-PKDD)*. Vol. 12461. Lecture Notes in Computer Science}. Ghent, Belgium: Springer, Sept. 2020, pp. 204–219. DOI: 10.1007/978-3-030-67670-4_13.

[C5] **Antônio H. Ribeiro**, Koen Tiels, Luis A. Aguirre, and Thomas B. Schön. "Beyond Exploding and Vanishing Gradients: Attractors and Smoothness in the Analysis of Recurrent Neural Network Training". In: *Proceedings of the 23rd International Conference on Artificial Intelligence and Statistics (AISTATS), PMLR*. Vol. 108. 2020, pp. 2370–2380. arXiv: 1906.08482.

[C6] Carl Andersson, **Antônio H. Ribeiro**, Koen Tiels, Niklas Wahlström, and Thomas B. Schön. "Deep Convolutional Networks in System Identification". In: *Proceedings of the 58th IEEE Conference on Decision and Control (CDC)* (Sept. 2019), pp. 3670–3676. DOI: 10.1109/CDC40024.2019.9030219. arXiv: 1909.01730.

[C7] **Antonio H. Ribeiro** and Luis A. Aguirre. "Lasso Regularization Paths for NARMAX Models via Coordinate Descent". In: *2018 Annual American Control Conference (ACC)*. June 2018, pp. 5268–5273. ISBN: 2378-5861. DOI: 10.23919/ACC.2018.8430924.

[C8] **Antônio H. Ribeiro** and Luis A. Aguirre. "Shooting Methods for Parameter Estimation of Output Error Models". In: *Proceedings of the 20th IFAC World Congress. IFAC-PapersOnLine* 50.1 (July 2017), pp. 13998–14003. ISSN: 2405-8963. DOI: 10.1016/j.ifacol.2017.08.2421.

[C9] **Antônio H. Ribeiro** and Luis A. Aguirre. "Selecting Transients Automatically for the Identification of Models for an Oil Well". In: *Proceedings of the 2nd IFAC Workshop on Automatic Control in Offshore Oil and Gas Production. IFAC-PapersOnLine* 48.6 (2015), pp. 154–158. DOI: 10.1016/j.ifacol.2015.08.024.

Workshop papers, conference abstracts and extended abstracts

[W1] Daniel Gedon, Stefan Gustafsson, Erik Lampa, **Antônio H. Ribeiro**, Martin J. Holzmann, Thomas B. Schön, and Johan Sundström. "ResNet-based ECG Diagnosis of Myocardial Infarction in the Emergency Department". In: *Machine Learning from Ground Truth: New Medical Imaging Datasets for Unsolved Medical Problems Workshop at NeurIPS*. 2021.

[W2] Daniel Gedon, **Antônio H. Ribeiro**, Niklas Wahlström, and Thomas B. Schön. "First Steps Towards Self-Supervised Pretraining of the 12-Lead ECG". In: *Computing in Cardiology (CinC)*. Vol. 48. Sept. 2021, pp. 1–4. DOI: 10.23919/CinC53138.2021.9662748.

[W3] Johannes N. Hendriks, Fredrik K. Gustafsson, **Antônio H. Ribeiro**, Adrian G. Wills, and Thomas B. Schön. "Deep Energy-Based NARX Models". In: *Workshop on Nonlinear System Identification* (2021).

[W4] **Antonio H Ribeiro** and Thomas B Schön. "Overparametrized Regression Under L2 Adversarial Attacks". In: *Workshop on the Theory of Overparameterized Machine Learning (TOPML)*. Apr. 2021.

[W5] **Antônio H. Ribeiro**, Johannes N. Hendriks, Adrian G. Wills, and Thomas B. Schön. "Beyond Occam's Razor in System Identification: Double-Descent When Modeling Dynamics". In: *Workshop on Nonlinear System Identification*. 2021.

[W6] Derick M Oliveira, **Antonio H Ribeiro**, Joao A O Pedrosa, Gabriela M M Paixao, Antonio L Ribeiro, and Wagner Meira Jr. "Explaining Black-Box Automated Electrocardiogram Classification to Cardiologists". In: *2020 Computing in Cardiology (CinC)*. Vol. 47. 2020. DOI: 10.22489/CinC.2020.452.

[W7] **Antonio H Ribeiro**, Daniel Gedon, Daniel Martins Teixeira, Manoel Horta Ribeiro, Antonio L Pinho Ribeiro, Thomas B Schon, and Wagner Meira Jr. "Automatic 12-Lead ECG Classification Using a Convolutional Network Ensemble". In: *2020 Computing in Cardiology (CinC)*. 2020. DOI: 10.22489/CinC.2020.130.

[W8] **Antonio H Ribeiro**, Carl Andersson, Koen Tiels, Niklas Wahlstrom, and Thomas B Schon. "Deep Convolutional Networks Are Useful in System Identification". In: *Workshop on Nonlinear System Identification* (2019).

[W9] Gabriela Paixao, Luis Gustavo Silva e Silva, Paulo R. Gomes, Milton Ferreira, Derick Oliveira, Manoel Horta Ribeiro, **Antonio H. Ribeiro**, Jamil Nascimento, Gustavo Cardoso, Rodrigo Araujo, Bruno Santos, Jessica Canazart, Leonardo Ribeiro, and Antonio L. Ribeiro. "Clinical Outcomes in Digital Electrocardiography: Evaluation of Mortality in Atrial Fibrillation (Code Study)". In: *Circulation. Abstracts from American Heart Association's*. 138.Suppl_1 (Nov. 2018), A16594–A16594.

[W10] **Antônio H. Ribeiro**, Manoel Horta Ribeiro, Gabriela Paixão, Derick Oliveira, Paulo R. Gomes, Jéssica A. Canazart, Milton Pifano, Wagner Meira Jr., Thomas B. Schön, and Antonio Luiz Ribeiro. "Automatic Diagnosis of Short-Duration 12-Lead ECG Using a Deep Convolutional Network". In: *Machine Learning for Health (ML4H) Workshop at NeurIPS* (2018). arXiv: 1811.12194.

National Conference Papers (in Portuguese)

[N1] **Antônio H. Ribeiro** and Luis A. Aguirre. "Relaçoes Estáticas de Modelos NARX MISO e Sua Representaçao de Hammerstein". In: *XX Congresso Brasileiro de Automática*. 2014.

Thesis

[T1] **Antônio H. Ribeiro**. "Learning Nonlinear Differentiable Models for Signals and Systems: With Applications". PhD thesis. Belo Horizonte, Brazil: Universidade Federal de Minas Gerais, 2020.

[T2] **Antônio H. Ribeiro**. "Recurrent Structures in System Identification". MSc Dissertation. Belo Horizonte, Brazil: Universidade Federal de Minas Gerais, 2017.

[T3] **Antonio H. Ribeiro**. "Implementação de Uma Câmera Estéreo". BSc Thesis. Belo Horizonte, Brazil: Universidade Federal de Minas Gerais, Dec. 2015.