

Rafael Silva

PhD Candidate – Inria, Epione Team

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Research Summary

PhD candidate at Inria (Epione) developing frugal and embedded deep-learning methods for real-time ECG analysis and automated defibrillation. My research focuses on lightweight, clinically-relevant models deployable on microcontrollers and constrained devices, with emphasis on model interpretability, regulatory compliance, and translational impact. I collaborate with clinical and industrial partners to bridge AI research and practical cardiac monitoring solutions.

Education

PhD in Computer Science (STIC)

Dec 2023 – Present

Université Côte d’Azur

Inria – Epione Team

Thesis: *Frugal Deep Learning for Cardiac Monitoring and Automated Defibrillation*

Supervisors: Maxime Sermesant, Pamela Mocerì

MSc in Biomedical Engineering

2019 – 2021

Instituto Superior Técnico, Universidade de Lisboa

Instituto de Telecomunicações - Pattern and Image Analysis Group

Thesis: *An Artificial Intelligence Approach to Atrial Fibrillation Detection in Single-lead Invisible ECG*

Supervisors: Hugo Plácido da Silva, Ana Fred

BSc in Biomedical Engineering

2016 – 2019

Instituto Superior Técnico, Universidade de Lisboa

Specialized Education Programmes

Methodologies and Techniques of Scientific Research

2022 – 2023

Instituto Superior Técnico, Universidade de Lisboa

Master in Technological Innovation in Health (MTiH)

2020 – 2022

EIT Health & Université Grenoble Alpes

Research and Project Experience

Miniaturized Portable Defibrillator – Inria, Inn’Pulse, 3IA Côte d’Azur

2024 – 2025

- Designed and implemented a lightweight deep-learning classifier for shockable rhythm detection from single-lead ECG data, optimized for real-time operation in STM32 microcontrollers.
- Achieved >90% sensitivity and >99% specificity, meeting international standards for Automated External Defibrillators (IEC 60601-2-4).
- Collaborated with hardware engineers to integrate inference pipeline on embedded systems.

Awarded with 2nd place of the Prix Pierre Laffitte 2025 (*Fondation Mines Paris*), and the Best Paper Award at the FIMH 2025 international conference.

CardioLeather – CardioID Technologies

2022 – 2023

- Developed a robust pipeline for ECG signal acquisition and processing for steering-wheel sensors.
- Proposed a deep-learning approach for driver drowsiness and physiological monitoring.
- Collaborated with 3 industrial partners and 2 academic institutions, and wrote project deliverables according to EU standards.
- Contributed to the company’s codebase, and published peer-reviewed articles.

Publications

Journal Articles

- Bota, P., **Silva, R.**, Carreiras, C., Fred, A., & Da Silva, H. P. (2024). “BioSPPy: A Python toolbox for physiological signal processing.” *SoftwareX*, 26, 101712. DOI:10.1016/j.softx.2024.101712.
- **Silva, R.**, Fred, A., & Da Silva, H. P. (2023). “Morphological Autoencoders for Beat-by-Beat Atrial Fibrillation Detection using Single-Lead ECG.” *Sensors*, 23(5), 2854. DOI:10.3390/s23052854.
- **Silva, R.**, Salvador, G., Bota, P., Fred, A., & Da Silva, H. P. (2022). “Impact of sampling rate and interpolation on photoplethysmography and electrodermal activity signals’ waveform morphology and feature extraction.” *Neural Computing and Applications*, 35(8), 5661–5677. DOI:10.1007/s00521-022-07212-6.

Conference Papers

- **Silva, R.**, Stehlé, C., Pétriat, G., Cadet, P.-H., Tibi, T. & Sermesant, M. (2025). “Frugal AI for Automated Cardiac Defibrillation: Balancing Performance & Hardware Constraints.” In 2025 Functional Imaging and Modeling of the Heart. DOI: 10.1007/978-3-031-94559-5_14.
- Rodriguez Padilla, J., **Silva, R.**, Ly, B., Wright, G., Pop, M., & Sermesant, M. (2025). “In silico Assessment of Arrhythmia Inducibility Dependence on Stimulus Location using Calibrated MR-based Infarcted Heart Models.” In 2025 Functional Imaging and Modeling of the Heart. DOI: 10.1007/978-3-031-94559-5_9.
- Rodriguez Padilla, J., **Silva, R.**, Ly, B., Pop, M. & Sermesant, M. (2024). “Personalisation of Action Potentials Based on Activation Recovery Intervals in Post-Infarcted Pigs: A Simulation Study.” In 2024 Computing in Cardiology, volume 51. DOI: 10.22489/CinC.2024.132.
- **Silva, R.**, Rodriguez Padilla, J., Pop, M. & Sermesant, M. (2024). “Automatic Analysis of Activation Recovery Interval in Heterogeneous Fibrotic Tissue from Chronically Infarcted Swine.” In 2024 Computing in Cardiology, volume 51. DOI: 10.22489/CinC.2024.417.
- **Silva, R.**, Yang, Y., Morier, M., Al-Ali, S. & Sermesant, M. (2024). “YOUR-Lead: YOLO and U-Net for Reconstruction of ECG Lead Signals.” In 2024 Computing in Cardiology, volume 51. DOI: 10.22489/CinC.2024.372.
- Raposo, A., **Silva, R.**, Rosário, L. B., Sanches, J. & Da Silva, H. P. (2023). “Smartphone Pulse Oximetry Using Two-tone Camera-based Photoplethysmography.” In IEEE 7th Portuguese Meeting on Bioengineering (ENBENG), pp. 40-43. DOI: 10.1109/ENBENG58165.2023.10175332.
- **Silva, R.**, Rodrigues, L. A., Lourenço, A., & Da Silva, H. P. (2023). “Temporal Dynamics of drowsiness detection using LSTM-Based models.” In Lecture notes in computer science (pp. 211–220). DOI: 10.1007/978-3-031-43085-5_17.

Thesis

- **Silva, R.** (2021). “An Artificial Intelligence Approach to Atrial Fibrillation Detection in Single-lead Invisible ECG.” Master’s Thesis, Instituto Superior Técnico, Lisbon, Portugal, 2021. (Link)

Software & Open-Source Contributions

- **BioSPPy** – Open-source Python toolbox for biosignal processing.
Main developer and maintainer. 753k+ downloads, 470+ citations.
github.com/ScientISST/BioSPPy

Awards and Honors

- Prix Pierre Laffitte 2025 - 2nd Place
- Best Paper Award – FIMH 2025
- Prix d'Excellence 2024 - Université Côte d'Azur
- Best PhysioNet Challenge Poster - Computing in Cardiology 2024
- MSc+BSc Academic Merit for excellent performance - Instituto Superior Técnico

Teaching and Mentoring

Université Côte d'Azur

2023 – 2025

- AI & Health, University of Medicine of Nice - helped healthcare professionals understand and use AI tools for medical applications.
- Analog Electronics, SophIA Tech - delivered lab sessions introducing basic electronic circuits and evaluated bachelor reports.

Instituto Superior Técnico

2022

- Introduction to Biomedical Engineering - created engaging and pedagogical notebooks to introduce students to scientific programming in Python in the context of biomedical applications.

Service to the Community

- Reviewer for Nature Scientific Reports, IEEE Xplore, ICLR, Computing in Cardiology, and other international conferences/journals.
- Participated in outreach activities with Inria and 3IA Côte d'Azur in Fête de la Science, SophIA Summit and World Artificial Intelligence Cannes Festival (2023, 2024, 2025)
- Participated in outreach activities with ScientISST (Instituto de Telecomunicações) in Maker Faire and at the university.

Technical Skills

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| – Programming: Python (PyTorch, TensorFlow, Keras), MATLAB, R, Java, SQL | – Soft Skills: Team collaboration, mentoring, technical writing, project coordination |
| – Tools: Git, Docker, LaTeX, Jupyter, Arduino | |
| – Domains: ECG/PPG analysis, signal processing, embedded AI, edge computing | – Languages: English (fluent), French (intermediate), Portuguese (native) |

References

Academic

- Ph.D. Maxime Sermesant, Inria, Université Côte d'Azur
- Ph.D. Hugo Plácido da Silva, Instituto de Telecomunicações, Instituto Superior Técnico
- Ph.D. Ana Fred, Instituto de Telecomunicações, Instituto Superior Técnico

Industrial

- Guillaume Pétriat, Inn'Pulse
- André Lourenço, CardioID Technologies