

Pedro Porto Buarque de Gusmão

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*“In God we trust; all others must bring data.”
- W. Edwards Deming*

Research Experiences

- 11/2020–current **Senior Research Associate**,
University of Cambridge, Machine Learning Systems Lab, under the supervision of Dr Nicholas Lane.
- I investigate the efficiency and scalability of Federated Learning (FL) solutions as part of the *REDIAL: Re-thinking Efficiency in Deep Learning under Accelerators and Commodity Processors* project.
 - I coordinate our group’s activities in FL, including internal research and external collaborations with companies such as Brave Software, the Korea Centre for Drug Discovery, and TCL.
 - I am a core developer of the Flower Federated Learning Framework.
- 11/2017–11/2020 **Postdoctoral Research Associate**,
University of Oxford, Research Group, under the supervision of Prof. Niki Trigoni and Prof. Andrew Markham.
- I investigated and developed intelligent, location-based services for fire-fighters using inertial sensors and thermal cameras. This position was funded by the NIST project *Pervasive, Accurate, and Reliable Location-based Services for Emergency Responders*.
 - I was responsible for the co-supervision of PhD students, planning and running experiments with firefighter collaborators, and writing up our research for publications.

Education

- 03/2013–02/2017 **Ph.D. in Electronic and Communications Engineering**,
Politecnico di Torino, Turin, Italy.
- **Thesis Title:** *Feature Extraction Using MPEG-CDVS and Deep Learning with Application to Robotic Navigation and Image Classification.*
- 09/2007–07/2009 **M.Sc. in Telecommunications Engineering, Double Degree**,
Final Mark: 110/110, Politecnico di Torino, Turin, Italy.
- **Thesis Title:** *Compressive Sampling.* This work was a first analysis on the use of Compressive Sampling for video compression.
- 02/2004–12/2010 **B.Sc. in Electrical Engineering-Telecommunications**,
Final Mark: 7.1/10, University of São Paulo, São Paulo, Brazil.
- **Thesis Title:** *A System for Image Recognition Using SURF Descriptors.*

Teaching Experiences

- 10/2022-current **Joint Lecturer**, Principles of Machine Learning Systems, Department of Computer Science, University of Cambridge, Cambridge, UK.
- 02/2023-02/2023 **Guest Lecturer**, Federated Learning, Department of Computer Science, University of Cambridge, Cambridge, UK.
- 09/2020-11/2023 **Specialist Lecturer**, Deep Neural Networks, Software Engineering Programme, University of Oxford, Oxford, UK.
- 11/2019-11/2019 **Teaching Assistant**, Deep Neural Networks, Software Engineering Programme, University of Oxford, Oxford, UK.
- 02/2017-02/2019 **CDT Course Lecturer**, Internet Of Things, AIMS courses University Oxford, Oxford, UK.
- 02/2018-02/2019 **Lab Assistant and Guest Lecturer**, Sensors Networks, AIMS courses University Oxford, Oxford, UK.

Research Interests

- **Federated Learning:** I study the applications and scalability of this novel privacy-preserving ML paradigm. My main research goal is to close the gap in performance between centralised and federated models.
- **Thermal Vision:** RGB cameras provide us with rich information about our surroundings under good lighting conditions. However, under low visibility, thermal sensors present themselves as the only viable alternative. It is a research goal of mine is to be able to perform full scene understanding using this challenging modality.
- **Reliable Navigation Systems:** Standard navigation systems, such as GPS, are either not reliable or not precise enough to be deployed in critical operations. I am interested in studying and developing reliable navigation systems based on multi-sensor, collaborative training.

Awards

- 03/2023 **UK PETs Prize Challenge Competition- First Prize, £50,000.00**, This challenge use case was focused on enhancing cross-organization, cross-border data access to support efforts to combat fraud, money laundering and other financial crime. Participants were asked to develop innovative, privacy-preserving FL solutions to enable the detection of potentially anomalous transactions, utilizing synthetic transaction data. This challenge was sponsored by the National Institute of Standards and Technology (NIST).
- 09/2007 **Alta Scuola Politecnica, Full Scholarship**, Multi-disciplinary programme between Politecnico di Torino and Politecnico di Milano that selects each year exceptionally talented and motivated students among the applicants to the Laurea Magistrale (LM) programs in Architecture, Design, and Engineering., Politecnico di Torino, Turin, Italy.

Talks

- 02/2023 **University of Exeter**, *Invited Speaker*, Federated Learning: Concepts and Application to Self-Supervised Learning in Video, Exeter-UK.
- 01/2023 **Universidade de Brasilia**, *Invited Speaker*, Federated Learning: An Introduction, Challenges and Opportunities, Brasilia-Brazil.
- 04/2022 **ETAPS 2022**, *Tutorial Speaker*, Federated Learning with Flower, Munich-Germany.
- 07/2021 **MobiUK**, *Presenter*, Flower: An Open-source Federated Learning Framework for both Industry and Research, Cambridge-UK.
- 06/2021 **ROS Dev Day**, *Speaker*, ROS and Flower: ROS Node Meet Real Federated Learning, Online.
- 12/2018 **Blue Light Conference**, *Invited Speaker*, Pervasive, Accurate and Reliable Location Based Services for Emergency Responders, London-UK.
- 10/2018 **Computer VISIONers Conference**, *Invited Speaker*, Visual Navigation in Challenging Environments using Deep Learning, Kyiv-Ukraine.

Academic Service

- **Member of:** Technical Program Committee of the Industry Track at IEEE International Conference on Pervasive Computing and Communications.
- **Reviewer for:** The IEEE Robotics and Automation Letters (RA-L); The IEEE Conference on Robotics and Automation (ICRA);
- **Reviewer for:** The IEEE/CVF Conference on Computer Vision and Pattern Recognition

Publications

- [1] Y. Mao, Z. Xiao, C.-T. Lin, P. Porto Buarque de Gusmão, N. Lane, C. Zach, and M. Alibeigi, “Decentralized training of 3d lane detection with automatic labeling using hd maps,” in *Vehicular Technology Conference: VTC2023-Spring*, 2023.
- [2] Y. Abbas ur Rehman, Y. Gao, J. Shen, P. Porto Buarque de Gusmão, and N. D. Lane, “Federated self-supervised learning for video understanding,” *European Conference on Computer Vision (ECCV)*, 2022.
- [3] Y. Almalioglu, M. Turan, M. R. U. Saputra, P. Porto Buarque de Gusmão, A. Markham, and N. Trigoni, “Selfvio: Self-supervised deep monocular visual-inertial odometry and depth estimation,” *Neural Networks*, vol. 150, pp. 119–136, 2022. [Online]. Available: <https://www.sciencedirect.com/science/article/pii/S0893608022000752>
- [4] Y. Gao, T. Parcollet, S. Zaiem, J. Fernandez-Marques, P. Porto Buarque de Gusmão, D. J. Beutel, and N. D. Lane, “End-to-end speech recognition

from federated acoustic models,” in *IEEE International Conference on Acoustics, Speech and Signal Processing (ICASSP)*, 2022.

- [5] X. Qiu, J. Fernandez-Marques, P. Porto Buarque de Gusmão, Y. Gao, T. Parcollet, and N. D. Lane, “ZeroFl: Efficient on-device training for federated learning with local sparsity,” in *International Conference on Learning Representations (ICLR)*, 2022.
- [6] M. R. U. Saputra, C. X. Lu, P. Porto Buarque de Gusmão, B. Wang, A. Markham, and N. Trigoni, “Graph-based thermal-inertial slam with probabilistic neural networks,” *IEEE Transactions on Robotics (T-RO)*, pp. 1–19, 2021.
- [7] W. Wang, P. Porto Buarque de Gusmão, B. Yang, A. Markham, N. Trigoni, K. Zhou, C. Chen, B. Wang, M. R. U. Saputra, N. Trigoni *et al.*, “Radarloc: Learning to relocalize in fmcw radar,” in *IEEE International Conference on Robotics and Automation (ICRA)*, 2020.
- [8] C. X. Lu, M. R. U. Saputra, P. Zhao, Y. Almalioglu, P. Porto Buarque de Gusmão, C. Chen, K. Sun, N. Trigoni, and A. Markham, “milliego: single-chip mmwave radar aided egomotion estimation via deep sensor fusion,” in *Proceedings of the 18th Conference on Embedded Networked Sensor Systems*, 2020, pp. 109–122.
- [9] M. R. U. Saputra, P. Porto Buarque de Gusmão, C. X. Lu, Y. Almalioglu, S. Rosa, C. Chen, J. Wahlström, W. Wang, A. Markham, and N. Trigoni, “Deeptio: A deep thermal-inertial odometry with visual hallucination,” *IEEE Robotics and Automation Letters (RA-L)*, vol. 5, no. 2, pp. 1672–1679, 2020.
- [10] J. Wahlström, M. Kok, P. Porto Buarque de Gusmão, T. E. Abrudan, N. Trigoni, and A. Markham, “Sensor fusion for magneto-inductive navigation,” *IEEE Sensors Journal*, vol. 20, no. 1, pp. 386–396, 2020.
- [11] J. Wahlström, P. Porto Buarque de Gusmão, A. Markham, and N. Trigoni, “Map-aided navigation for emergency searches,” in *2019 15th International Conference on Distributed Computing in Sensor Systems (DCOSS)*, 2019, pp. 25–32.
- [12] Y. Almalioglu, M. R. U. Saputra, P. Porto Buarque de Gusmão, A. Markham, and N. Trigoni, “Ganvo: Unsupervised deep monocular visual odometry and depth estimation with generative adversarial networks,” in *2019 International Conference on Robotics and Automation (ICRA)*, 2019, pp. 5474–5480.
- [13] M. R. U. Saputra, P. Porto Buarque de Gusmão, S. Wang, A. Markham, and N. Trigoni, “Learning monocular visual odometry through geometry-aware curriculum learning,” in *2019 International Conference on Robotics and Automation (ICRA)*, 2019, pp. 3549–3555.
- [14] M. R. U. Saputra, P. Porto Buarque de Gusmão, Y. Almalioglu, A. Markham, and N. Trigoni, “Distilling knowledge from a deep pose

regressor network,” in *2019 IEEE/CVF International Conference on Computer Vision (ICCV)*, 2019, pp. 263–272.

- [15] W. Wang, M. R. U. Saputra, P. Zhao, P. Porto Buarque de Gusmão, B. Yang, C. Chen, A. Markham, and N. Trigoni, “Deeppco: End-to-end point cloud odometry through deep parallel neural network,” in *2019 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS)*, 2019, pp. 3248–3254.
- [16] S. T. H. Rizvi, G. Cabodi, P. Porto Buarque de Gusmão, and G. Francini, “Gabor filter based image representation for object classification,” in *2016 International Conference on Control, Decision and Information Technologies (CoDIT)*, 2016, pp. 628–632.
- [17] P. Porto Buarque de Gusmão, S. Rosa, E. Magli, S. Lepsøy, and G. Francini, “Loop detection in robotic navigation using mpeg cdvs,” in *2015 IEEE 17th International Workshop on Multimedia Signal Processing (MMSP)*, 2015, pp. 1–6.
- [18] S. Lepsøy, G. Francini, G. Cordara, and P. Porto Buarque de Gusmão, “Statistical modelling of outliers for fast visual search,” in *2011 IEEE International Conference on Multimedia and Expo*, 2011, pp. 1–6.

Under Review

- [1] X. Qiu, T. Parcollet, J. Fernandez-Marques, P. Porto Buarque de Gusmão, D. J. Beutel, T. Topal, A. Mathur, and N. D. Lane, “A first look into the carbon footprint of federated learning,” *Under review for the Journal of Machine Learning Research (JMLR)*, 2023.
- [2] Y. Abbas ur Rehman, Y. Gao, J. Shen, M. Alibeigi, P. Porto Buarque de Gusmão, and N. D. Lane, “L-dawa: Layer-wise divergence aware weight aggregation in federated self-supervised visual representation learning,” *Under review for the International Conference on Computer Vision (ICCV)*, 2023.
- [3] V. Valadi, X. Qiu, M. Alibeigi, P. Porto Buarque de Gusmão, and N. Lane, “Fedval: Different good or different bad in federated learning,” in *Under review for the 32nd USENIX Security Symposium (USENIX Security 23 Winter)*, 2023.

Patents

- [1] G. Cordara, G. Francini, S. Lepsoy, and P. Porto Buarque de Gusmão, “Method and system for comparing images,” Patent, Apr. 14, 2015, -US Patent 9,008,424.
- [2] G. Francini, S. Lepsoy, and P. Porto Buarque De Gusmão, “Convolutional neural networks, particularly for image analysis,” Patent, Feb. 6, 2020, -US Patent App. 16/081,693.