Matteo Pirotta

Research Scientist at Facebook AI Research

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Curriculum Vitae

Matteo Pirotta is a research scientist at Facebook AI Research in Paris (France). Before, he was postdoctoral researcher at INRIA – Team SequeL (France). He received his PhD in Computer Science from the Politecnico di Milano (Italy) in 2016. His main research interest is in machine learning, in particular *reinforcement learning* and online learning. His works are equally balanced between theory and applications. Dr. Pirotta has been employed in industry and has worked as scientific advisor.

Work Experience

10/18–present **Facebook AI Research**, *(Paris, France)*, Research Scientist.

01/17–10/18 **INRIA - Team SequeL**, *(Lille, France)*, Postdoctoral Researcher.
Working with A. Lazaric

- June 2018: ranked first for the research scientist position at INRIA Lille (Concours des Chargés de recherche de class normal 2018 - CRCN-LNE)

06/16–12/16 **Politecnico di Milano**, *(Milano, Italy)*, Postdoctoral Researcher.
Working with Prof. M. Restelli

11/15–05/16 **UniCredit**, *(Milano, Italy)*, Artificial Intelligence, ICT Project Manager.
Member of a small team applying machine learning to solve complex real problems.

Education

01/16 **PhD in Information Technology**, *Politecnico di Milano*, *PhD cum laude*.
Thesis: *"Reinforcement Learning: from Theory to Algorithms."*
Supervisors: Prof. L. Bascetta and Prof. M. Restelli

Awards:

- *Dimitris N. Chorafas Foundation Award 2016*.
- *Honourable mention* for the EurAI Distinguished Dissertation Award 2015.

Research visits:

- Intelligent Autonomous Systems, Technische Universitaet Darmstadt, Darmstadt (Germany), March-August 2015. Headed by Prof. Jan Peters.

PhD Schools:

- Online Learning Summer School, Copenhagen (Denmark), July 2015
- Machine Learning Summer School, Tübingen (Germany), August-September 2013
- Regularization Methods For High Dimensional Learning, Genova (Italy), June 2013

09/12 **Master of Science in Computer Engineering**, *Politecnico di Milano*, *110/110 cum laude*.
Thesis: *"Safe Policy Iteration: A Monotonically Improving Approximate Policy Iteration Approach."*

Awards:

- Special mention from AI*IA (Associazione Italiana per l'Intelligenza Artificiale) among best Italian master thesis

Honors

09/16 *Dimitris N. Chorafas Foundation Award 2016* (PhD thesis).

09/16 *Honourable mention* for the EurAI Distinguished Dissertation Award 2015 (PhD thesis).

12/12 *Special mention* from AI*IA (Associazione Italiana per l'Intelligenza Artificiale) among best Italian master thesis.

Publications

In Preparation or Under Review

[P8] E. Garcelon, V. Perchet, C. Pike-Burke and M. Pirotta. "Local Differentially Private Regret Minimization in Reinforcement Learning". `https://arxiv.org/abs/2010.07778`

[P7] J. Tarbouriech, M. Pirotta, M. Valko and A. Lazaric. "Sample Complexity Bounds for Stochastic Shortest Path with a Generative Model"

[P6] J. Tarbouriech, M. Pirotta, M. Valko and A. Lazaric. "A Provably Efficient Sample Collection Strategy for Reinforcement Learning". `https://arxiv.org/abs/2007.06437`

[P5] O. Darwiche Domingue, P. Ménard, M. Pirotta, E. Kaufmann and M. Valko. "Regret Bounds for Kernel-Based Reinforcement Learning". `https://arxiv.org/abs/2004.05599`

[P4] O. Darwiche Domingue, P. Ménard, M. Pirotta, E. Kaufmann and M. Valko. "A Kernel-Based Approach to Non-Stationary Reinforcement Learning in Metric Spaces". `https://arxiv.org/abs/2007.05078`

[P3] Y. Efroni, S. Mannor and M. Pirotta. "Exploration-Exploitation in Constrained MDPs". `https://arxiv.org/abs/2003.02189`

[P2] PA Kamienny, M. Pirotta, A. Lazaric, T. Lavril, N. Usunier, L. Denoyer. "Learning Adaptive Exploration Strategies in Dynamic Environments Through Informed Policy Regularization". `https://arxiv.org/abs/2005.02934`

[P1] R. Fruit, M. Pirotta and A. Lazaric. "Improved Analysis of UCRL2 with empirical Bernstein bounds". `https://arxiv.org/abs/2007.05456`

International Journals

[J4] S. Parisi, M. Pirotta and J. Peters. "Manifold-based Multi-objective Policy Search with Sample Reuse". In: *Neurocomputing 263* (November 2017), pp. 3–14.

[J3] G. Manganini, M. Pirotta, M. Restelli, L. Piroddi and M. Prandini. "Policy search for the optimal control of Markov decision processes: a novel particle-based iterative scheme". In: *IEEE Transactions on Cybernetics 46:11* (November 2016), pp. 2643–2655.

[J2] S. Parisi, M. Pirotta and M. Restelli. "Multi-objective Reinforcement Learning through Continuous Pareto Manifold Approximation". In: *Journal of Artificial Intelligence Research 57* (October 2016), pp. 187–227.

[J1] M. Pirotta, M. Restelli and L. Bascetta. "Policy Gradient in Lipschitz MDPs". In: *Machine Learning 100* (September 2015), pp. 255–283.

International Conferences and Workshops

[C32] A. Tirinzoni, M. Pirotta, M. Restelli and A. Lazaric. "An Asymptotically Optimal Primal-Dual Incremental Algorithm for Linear Contextual Bandits". In: *Advances in Neural Information Processing Systems 33, Virtual, December 2020.* (acceptance rate: 1900/9454 (20%))

[C31] J. Tarbouriech, M. Pirotta, M. Valko and A. Lazaric. "Improved Sample Complexity for Incremental Autonomous Exploration in MDPs". In: *Advances in Neural Information Processing Systems 33, Virtual, December 2020.* (acceptance rate: 1900/9454 (20%))

[C30] E. Garcelon, B. Roziere, L. Meunier, J. Tarbouriech, O. Teytaud, A. Lazaric and M. Pirotta. "Adversarial Attacks on Linear Contextual Bandits". In: *Advances in Neural Information Processing Systems 33, Virtual, December 2020.* (acceptance rate: 1900/9454 (20%))

[C29] J. Tarbouriech, S. Shekhar, M. Pirotta, M. Ghavamzadeh, A. Lazaric. "Active Model Estimation in Markov Decision Processes". In: *Proc. of Conference on Uncertainty in Artificial Intelligence, 2020.*

[C28] J. Tarbouriech, E. Garcelon, M. Valko, M. Pirotta, and A. Lazaric. "No-Regret Exploration in Goal-Oriented Reinforcement Learning". In: *Proc. of 37th International Conference on Machine Learning, 2020.*

[C27] E. Garcelon, M. Ghavamzadeh, A. Lazaric and M. Pirotta. "Conservative Exploration in Reinforcement Learning". In: *Proc. of 23th International Conference on Artificial Intelligence and Statistics, 2020.*

[C26] A. Zanette, D. Brandfonbrener, E. Brunskill, M. Pirotta, A. Lazaric. "Frequentist Regret Bounds for Randomized Least-Squares Value Iteration". In: *Proc. of 23th International Conference on Artificial Intelligence and Statistics, 2020.*

[C25] E. Garcelon, M. Ghavamzadeh, A. Lazaric and M. Pirotta. "Improved Algorithms for Conservative Exploration in Bandits". In: *Proc. of 34th AAAI Conference on Artificial Intelligence, AAAI, New York, New York, USA, February 2020.* AAAI Press, 2020.

[C24] J. Qian, R. Fruit, M. Pirotta and A. Lazaric. "Exploration Bonus for Regret Minimization in Undiscounted Discrete and Continuous Markov Decision Processes". In: *Advances in Neural Information Processing Systems 32, Vancouver, Canada, December 2019.* (acceptance rate: 1428/6743 (21.18%))

[C23] R. Ortner, M. Pirotta, A. Lazaric, R. Fruit and O-A Maillard. "Regret Bounds for Learning State Representations in Reinforcement Learning". In: *Advances in Neural Information Processing Systems 32, Vancouver, Canada, December 2019.* (acceptance rate: 1428/6743 (21.18%))

[C22] R. Fruit, M. Pirotta, and A. Lazaric. "Near Optimal Exploration-Exploitation in Non-Communicating Markov Decision Processes". In: *Advances in Neural Information Processing Systems 31, Montréal, Canada, December 2018.* (acceptance rate: 1011/4856 (20.82%), spotlight: 168/1011 (16.62%))

[C21] R. Fruit, M. Pirotta, A. Lazaric and R. Ortner. "Efficient Bias-Span-Constrained Exploration-Exploitation in Reinforcement Learning". In: *Proc. of 35th International Conference on Machine Learning, ICML, Stockholm, Sweden, July 2018.* (acceptance rate: 618/2473 (24.99%))

[C20] M. Papini, D. Binaghi, G. Canonaco, M. Pirotta and M. Restelli. "Stochastic Variance-Reduced Policy Gradient". In: *Proc. of 35th International Conference on Machine Learning, ICML, Stockholm, Sweden, July 2018.* (acceptance rate: 618/2473 (24.99%))

[C19] A. Tirinzoni, A. Sessa, M. Pirotta and M. Restelli. "Importance Weighted Transfer of Samples in Reinforcement Learning". In: *Proc. of 35th International Conference on Machine Learning, ICML, Stockholm, Sweden, July 2018.* (acceptance rate: 618/2473 (24.99%))

[C18] D. Di Febbo, E. Ambrosini, M. Pirotta, E. Rojas, M. Restelli, A. Pedrocchi and S. Ferrante. "Does Reinforcement Learning Outperform PID in the Control of FES Induced Elbow Flex-Extension?". In: *Proc. of 13th Annual IEEE International Symposium on Medical Measurements and Applications, Rome, Italy, June 2018.*

[C17] R. Fruit, M. Pirotta, A. Lazaric and E. Brunskill. "Regret Minimization in MDPs with Options without Prior Knowledge". In: *Advances in Neural Information Processing Systems 30, Long Beach, USA, December 2017.* (acceptance rate: 678/3240 (20.93%), spotlight: 112/678 (16.52%))

[C16] A. Metelli, M. Pirotta, and M. Restelli. "Compatible Reward Inverse Reinforcement Learning". In: *Advances in Neural Information Processing Systems 30, Long Beach, USA, December 2017.* (acceptance rate: 678/3240 (20.93%))

[C15] M. Papini, M. Pirotta, and M. Restelli. "Adaptive Batch Size for Safe Policy Gradients". In: *Advances in Neural Information Processing Systems 30, Long Beach, USA, December 2017.* (acceptance rate: 678/3240 (20.93%))

[C14] D. Tateo, M. Pirotta, A. Bonarini and M. Restelli. "Gradient-Based Minimization for Multi-Expert Inverse Reinforcement Learning". In: *IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning, ADPRL, Hawaii, USA, December 2017.*

[C13] S. Tosatto, M. Pirotta, C. D'Eramo and M. Restelli. "Boosted Fitted Q-Iteration". In: *Proc. of 34th International Conference on Machine Learning, ICML, Sydney, Australia, August 2017.* (acceptance rate: 433/1701 (25.46%))

[C12] C. D'Eramo, A. Nuara, M. Pirotta and M. Restelli. "Estimating the Maximum Expected Value in Continuous Reinforcement Learning Problems". In: *Proc. of 31th AAAI Conference on Artificial Intelligence, AAAI, San Francisco, California, USA, February 2017.* AAAI Press, 2017. (acceptance rate: 638/2590 (24.64%))

[C11] M. Pirotta and M. Restelli. "Inverse Reinforcement Learning through Policy Gradient Minimization". In: *Proc. of the 30th AAAI Conference on Artificial Intelligence, AAAI, Phoenix, Arizona, USA, February 2016.* AAAI Press, 2016. (acceptance rate: 549/2132 (25.8%), oral presentation: 263/2132 (12.3%))

[C10] M. Pirotta, S. Parisi and M. Restelli. "Multi-Objective Reinforcement Learning with Continuous Pareto Frontier Approximation". In: *Proc. of the 29th AAAI Conference on Artificial Intelligence, AAAI, Austin, Texas, USA, January 2015.* AAAI Press, 2015. (acceptance rate: 531/1991 (26.7%))

[C9] D. Caporale, L. Deori, R. Mura, A. Falsone, R. Vignali, L. Giulioni, M. Pirotta and G. Manganini. "Optimal Control to Reduce Emissions in Gasoline Engines: An Iterative Learning Control Approach for ECU Calibration Maps Improvement". In: *European Control Conference, ECC, Linz, Austria, July 2015.*

[C8] G. Manganini, M. Pirotta, M. Restelli and L. Bascetta. "Following Newton Direction in Policy Gradient with Parameter Exploration". In: *Proc. of the International Joint Conference on Neural Networks, IJCNN, Killarney, Ireland, July 2015.*

[C7] S. Parisi, M. Pirotta, N. Smacchia, L. Bascetta and M. Restelli. "Policy Gradient Approaches for Multi-Objective Sequential Decision Making: A Comparison". In: *IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning, ADPRL, Orlando, Florida, USA, December 2014.* IEEE, 2014.

[C6] S. Parisi, M. Pirotta, N. Smacchia, L. Bascetta and M. Restelli. "Policy Gradient Approaches for Multi-Objective Sequential Decision Making". In: *Proc. of the International Joint Conference on Neural Networks, IJCNN, Beijing, China, July 2014.*

[C5] M. Pirotta, G. Manganini, L. Piroddi, M. Prandini and M. Restelli. "A particle-based policy for the optimal control of Markov decision processes". In: *Proc. of the 19th IFAC World Congress, IFAC, Cape Town, South Africa, August 2014.*

[C4] M. Pirotta, M. Restelli and L. Bascetta. "Adaptive Step-Size for Policy Gradient Methods". In: *Advances in Neural Information Processing Systems 27, NIPS, Lake Tahoe, Nevada, USA, December 2013.* (acceptance rate: 360/1420 (25.3%))

[C3] M. Pirotta, M. Restelli, A. Pecorino, and D. Calandriello. "Safe policy iteration". In: *Proc. of the 30th International Conference on Machine Learning, ICML, Atlanta, Georgia, USA, July 2013.* (acceptance rate: 283/1204 (23.5%); oral presentation: 143/1204 (11.9%))

[C2] M. Migliavacca, A. Pecorino, M. Pirotta, M. Restelli and A. Bonarini. "Fitted Policy Search". In: *IEEE Symposium on Adaptive Dynamic Programming and Reinforcement Learning, ADPRL, Paris, France, April 2011.* IEEE, 2011.

[C1] M. Migliavacca, A. Pecorino, M. Pirotta, M. Restelli and A. Bonarini. "Fitted Policy Search: Direct Policy Search using a Batch Reinforcement Learning Approach". In: *Proc. of the 3rd International Workshop on Evolutionary and Reinforcement Learning for Autonomous Robot Systems, ERLARS, Lisboa, Portugal, August 2010.*

Teaching Activities and Supervision

2020 **Lecturer**, *École Normale Supérieure Paris-Saclay*, Paris, France.
Course "Reinforcement Learning", Prof. A. Lazaric,
Master MVA2 Mathématiques/Vision/Apprentissage

2020 **Lecturer**, *African Institute for Mathematical Sciences (AIMS)*, Accra, Ghana.
Course "Reinforcement Learning",
African Masters of Machine Intelligence

2019 **Teaching assistant**, *École Normale Supérieure Cachan*, Paris, France.
Course "Reinforcement Learning", Prof. A. Lazaric,
Master MVA2 Mathématiques/Vision/Apprentissage

2019 **Speaker**, *Reinforcement Learning Summer SCOOL*, Lille, France.

2018 **Teaching assistant**, *École Normale Supérieure Cachan*, Paris, France.
Course "Reinforcement Learning", Prof. A. Lazaric,
Master MVA2 Mathématiques/Vision/Apprentissage

2017 **Teaching assistant**, *École Normale Supérieure Cachan*, Paris, France.
Course "Reinforcement Learning", Prof. A. Lazaric,
Master MVA2 Mathématiques/Vision/Apprentissage

2015 **Teaching assistant**, *Politecnico di Milano*, Milano, Italy.
Course "Fondamenti di Informatica", Prof. C. Bolchini, Bachelor in Computer Engineering

2014 **Laboratory Tutor**, *Politecnico di Milano*, Milano, Italy.
Course "Informatica A", Prof. O. Mejri, Bachelor in Business Engineering

2014 **Laboratory Tutor**, *Politecnico di Milano*, Milano, Italy.
Course "Informatica B", Prof. V. Zaccaria, Bachelor in Mechanical Engineering

2013 **Teaching assistant**, *Politecnico di Milano*, Milano, Italy.
Course "Robotics", Prof. M. Restelli, Bachelor in Computer Engineering

2013 **Laboratory Tutor**, *Politecnico di Milano*, Milano, Italy.
Course "Fondamenti di Automatica", Prof. L. Bascetta, Bachelor in Aerospace Engineering

Supervision of Master's Students

Since 2014 I have been co-supervisor of more than 20 master thesis.

Scientific Activities

- Program Committee and Reviewer: AAAI (2017-2020), ICML (2018-2020), NIPS (2015, 2016, 2018-2020), IJCAI (2017, 2018), RLDM (2017), AISTATS (2020, 2021), ICLR (2021)
- Journal Reviewer: Journal of Machine Learning Research, Adaptive Behavior, IEEE Transactions on Robotics, Automatica
- **Workshop organizer**:
  - *Prediction and Generative Modeling in Reinforcement Learning*. Federated AI Meeting of AAMAS, ICML, and IJCAI (FAIM), July 2018, Stockholm, Sweden. Co-organized with Roberto Calandra (UC Berkeley), Sergey Levine (UC Berkeley), Martin Riedmiller (DeepMind) and Alessandro Lazaric (Facebook AI Research).
  - *The 14th European Workshop on Reinforcement Learning (EWRL 2018)*. October 2018, Lille, France.
- **Tutorials**:
  - AAAI 2020: "Exploration in Reinforcement Learning", Ghavamzadeh, Lazaric, Pirotta
  - ALT 2019: "Regret Minimization in Infinite-Horizon Finite Markov Decision Processes", Fruit, Lazaric, Pirotta

Project and Funding

Research Projects

2017 **Principal Investigator**, *Theoretically grounded efficient algorithms for high-dimensional and continuous reinforcement learning*, (PGMO Project).
Exploration-Exploitation in Reinforcement Learning.

2013 **Investigator**, *FIDELIO - FIxtureless DEburring of wheeLs by human demonstratIOn*, (EU Project).
Reinforcement Learning for deburring of wheels.

Industrial Projects

2016–2017 **Investigator**, *Reinforcement Learning for DVA Hedging*, Reply s.p.a..
Automatic DVA hedging via reinforcement learning.

2016–2017 **Investigator**, *Machine Learning for Swaption Calibration*, Intesa San Paolo Group Service.
Data-driven model for swaption calibration.

2016 **Investigator**, *Development of data-driven models for Cyber Tyre*, Pirelli s.p.a..
Detection of inflating point from tyre sensor data.