Miguel Vasco

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RESEARCH STATEMENT

I envision a world where artificial agents perceive their environment through multiple sensors and reason over their observations to act in challenging scenarios. My research focuses on developing agents able to encode multimodal representations [S2]–[S3] and to act effectively [S1] and robustly [S4] in their environment.

Keywords: Multimodal Machine Learning · Reinforcement Learning

SELECTED PUBLICATIONS

For a complete list of publications please refer to Google Scholar.

[S1] Miguel Vasco†, Takuma Seno†, Kenta Kawamoto, Kaushik Subramanian, Peter R. Wurman, and Peter Stone. *A Super-human Vision-based Reinforcement Learning Agent for Autonomous Racing in Gran Turismo*. In: Proceedings of the First Reinforcement Learning Conference (RLC). vol. 1. 2024 (**Outstanding Paper Award**) [pdf]

[S2] Petra Poklukar†, Miguel Vasco†, Hang Yin, Francisco S. Melo, Ana Paiva, and Danica Kragic. *Geometric Multimodal Contrastive Representation Learning*. In: Proceedings of the 39th International Conference on Machine Learning. 2022, pp. 17782–17800 [pdf]

[S3] Miguel Vasco, Hang Yin, Francisco S. Melo, and Ana Paiva. *Leveraging hierarchy in multimodal generative models for effective cross-modality inference*. In: Neural Networks (2021 Special Issue on AI and Brain Science: Brain-inspired AI) 146, 2022, pp. 238–255 [pdf]

[S4] Miguel Vasco, Hang Yin, Francisco S. Melo, and Ana Paiva. *How to Sense the World: Leveraging Hierarchy in Multimodal Perception for Robust Reinforcement Learning Agents*. In: 21st International Conference on Autonomous Agents and MultiAgent Systems (AAMAS). 2022, pp. 1301–1309 [pdf]

Note: The symbol † denotes shared first-authorship.

EXPERIENCE

- Postdoctoral Research Fellow — 2023–now
  KTH Royal Institute of Technology — *Sweden*
- Game AI Research Intern — 2023
  Sony AI — *Japan*
- Teaching Assistant — 2019–2022
  Instituto Superior Técnico, Universidade de Lisboa — *Portugal*
- Early Stage Researcher — 2018–2022
  GAIPS, INESC-ID — *Portugal*
- Visiting Researcher — 2021–2022
  KTH Royal Institute of Technology — *Sweden*
- Visiting Researcher — 2017–2018
  National Institute of Informatics — *Japan*

EDUCATION

- Ph.D. Computer Science (*Summa Cum Laude*) — 2018–2023
  Instituto Superior Técnico, University of Lisbon, Portugal
  - *Thesis Title*: Multimodal Representation Learning for Agent Perception and Agency
  - *Supervisors*: Prof. Ana Paiva and Prof. Francisco S. Melo
- M.Sc. Engineering Physics — 2013–2016
  Instituto Superior Técnico, University of Lisbon, Portugal
  - *Thesis Title*: 3D map of the Distribution of Metals in a Cell: Applications to the Toxicity of Nanoparticles
  - *Supervisors*: Prof. Teresa Pinheiro and Dr. Luís Alves

PUBLICATIONS

Note: The symbol † denotes shared first-authorship.

PEER-REVIEWED CONFERENCE PAPERS (14)

[C14] Farzaneh Taleb, Miguel Vasco, Antonio H. Ribeiro, Mårten Björkman, and Danica Kragic. *Can Transformers Smell Like Humans?* In: The Thirty-eighth Annual Conference on Neural Information Processing Systems. 2024 (**Spotlight)** [pdf]

[C13] Bernardo Esteves, Miguel Vasco, and Francisco S. Melo. *NeuralSolver: Learning Algorithms For Consistent and Efficient Extrapolation Across General Tasks*. In: The Thirty-eighth Annual Conference on Neural Information Processing Systems. 2024 [pdf]

[C12] Miguel Vasco†, Takuma Seno†, Kenta Kawamoto, Kaushik Subramanian, Peter R. Wurman, and Peter Stone. *A Super-human Vision-based Reinforcement Learning Agent for Autonomous Racing in Gran Turismo*. In: Proceedings of the First Reinforcement Learning Conference (RLC). vol. 1. 2024 (**Outstanding Paper Award**) [pdf]

[C11] Yuchong Zhang, Miguel Vasco, Mårten Björkman, and Danica Kragic. *Will You Participate? Exploring the Potential of Robotics Competitions on Human-Centric Topics*. In: International Conference on Human-Computer Interaction. Springer. 2024, pp. 240–255 [pdf]

[C10] Bernardo Esteves, Miguel Vasco, and Francisco S Melo. *Pre-training with Augmentations for Efficient Transfer in Model-Based Reinforcement Learning*. In: EPIA Conference on Artificial Intelligence. Springer. 2023, pp. 133–145 [pdf]

[C9] Nona Rajabi, Parag Khanna, Sumeyra U Demir Kanik, Elmira Yadollahi, Miguel Vasco, Mårten Björkman, Christian Smith, and Danica Kragic. *Detecting the Intention of Object Handover in Human-Robot Collaborations: An EEG Study*. In: 2023 32nd IEEE International Conference on Robot and Human Interactive Communication (RO-MAN). IEEE. 2023, pp. 549–555 [pdf] [video]

[C8] Nona Rajabi, Charles Chernik, Alfredo Reichlin, Farzaneh Taleb, Miguel Vasco, Ali Ghadirzadeh, Mårten Björkman, and Danica Kragic. *Mental Face Image Retrieval Based on a Closed-Loop Brain-Computer Interface*. In: International Conference on Human-Computer Interaction. Springer. 2023, pp. 26–45 [pdf]

[C7] Fábio Vital, Miguel Vasco, Alberto Sardinha, and Francisco Melo. *Perceive, Represent, Generate: Translating Multimodal Information to Robotic Motion Trajectories*. In: 2022 IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). IEEE. 2022, pp. 5855–5860 [pdf]

[C6] Petra Poklukar†, Miguel Vasco†, Hang Yin, Francisco S. Melo, Ana Paiva, and Danica Kragic. *Geometric Multimodal Contrastive Representation Learning*. In: Proceedings of the 39th International Conference on Machine Learning. 2022, pp. 17782–17800 (**CORE A***) [pdf]

[C5] Miguel Vasco, Hang Yin, Francisco S. Melo, and Ana Paiva. *How to Sense the World: Leveraging Hierarchy in Multimodal Perception for Robust Reinforcement Learning Agents*. In: 21st International Conference on Autonomous Agents and MultiAgent Systems (AAMAS). 2022, pp. 1301–1309 (**CORE A***) [pdf]

[C4] Pedro Ildefonso†, Pedro Remédios†, Rui Silva, Miguel Vasco, Francisco S. Melo, Ana Paiva, and Manuela Veloso. *Exploiting Symmetry in Human Robot-Assisted Dressing Using Reinforcement Learning*. In: EPIA Conference on Artificial Intelligence. Springer. 2021, pp. 405–417 [pdf]

[C3] Silvia Tulli, Marta Couto, Miguel Vasco, Elmira Yadollahi, Francisco S. Melo, and Ana Paiva. *Explainable Agency by Revealing Suboptimality in Child-Robot Learning Scenarios*. In: International Conference on Social Robotics (ICSR). Springer. 2020, pp. 23–35 (**Best Student Paper Award**) [pdf]

[C2] Rui Silva, Miguel Vasco, Francisco S. Melo, Ana Paiva, and Manuela Veloso. *Playing Games in the Dark: An Approach for Cross-Modality Transfer in Reinforcement Learning*. In: 19th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS). 2020, pp. 1260–1268 (**CORE A***) [pdf]

[C1] Miguel Vasco, Francisco S. Melo, David Martins de Matos, Ana Paiva, and Tetsunari Inamura. *Learning multimodal representations for sample-efficient recognition of human actions*. In: IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). IEEE. 2019, pp. 4288–4293 [pdf] [slides]

JOURNAL ARTICLES (4)

[J4] Alfredo Reichlin†, Gustaf Tegnér†, Miguel Vasco, Hang Yin, Mårten Björkman, and Danica Kragic. *Reducing Variance in Meta-Learning via Laplace Approximation for Regression Tasks*. In: Transactions on Machine Learning Research, 2024 [pdf]

[J3] Miguel Vasco, Hang Yin, Francisco S. Melo, and Ana Paiva. *Leveraging hierarchy in multimodal generative models for effective cross-modality inference*. In: Neural Networks (2021 Special Issue on AI and Brain Science: Brain-inspired AI) 146, 2022, pp. 238–255 (**Scimago Q1 in Artificial Intelligence**) [pdf]

[J2] Francisco S. Melo, Alberto Sardinha, David Belo, Marta Couto, Miguel Faria, Anabela Farias, Hugo Gamboa, Cátia Jesus, Mithun Kinarullathil, Pedro Lima, Luís Luz, André Mateus, Isabel Melo, Plinio Moreno, Daniel Osório, Ana Paiva, Jhielson Pimentel, João Rodrigues, Pedro Sequeira, Rubén Solera-Ureña, Miguel Vasco, Manuela Veloso, and Rodrigo Ventura. *Project INSIDE: towards autonomous semi-unstructured human–robot social interaction in autism therapy*. In: Artificial intelligence in medicine 96, 2019, pp. 198–216 (**Scimago Q1 in Artificial Intelligence**) [pdf]

[J1] Miguel Vasco, Luís Cerqueira Alves, Victoria Corregidor, Daniel Correia, Cláudia P. Godinho, Isabel Sá-Correia, Andrew Bettiol, Frank Watt, and Teresa Pinheiro. *3D map distribution of metallic nanoparticles in whole cells using MeV ion microscopy*. In: Journal of Microscopy 267.2, 2017, pp. 227–236 [pdf]

REFEREED EXTENDED ABSTRACTS/WORKSHOP PAPERS (5)

[W4] Farzaneh Taleb, Miguel Vasco, Nona Rajabi, Mårten Björkman, and Danica Kragic. *Do Foundation Models Smell Like Humans?* In: ICLR 2024 Workshop on Representational Alignment. 2024 (**CORE A***) [pdf]

[W3] Pedro P Santos, Diogo S Carvalho, Miguel Vasco, Alberto Sardinha, Pedro A Santos, Ana Paiva, and Francisco S Melo. *Centralized Training with Hybrid Execution in Multi-Agent Reinforcement Learning*. In: Proceedings of the 23rd International Conference on Autonomous Agents and Multiagent Systems. 2024, pp. 2453–2455 (**CORE A***) [pdf]

[W2] Miguel Vasco. *Multimodal Representation Learning for Robotic Cross-Modality Policy Transfer*. In: Proceedings of the 19th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS). 2020, pp. 2225–2227 (**CORE A***) [pdf] [slides] [video]

[W1] Miguel Vasco, Francisco S. Melo, David Martins de Matos, Ana Paiva, and Tetsunari Inamura. *Online Motion Concept Learning: A Novel Algorithm for Sample-Efficient Learning and Recognition of Human Actions*. In: Proceedings of the 18th International Conference on Autonomous Agents and MultiAgent Systems (AAMAS). 2019, pp. 2244–2246 (**CORE A***) [pdf] [poster]

PREPRINTS (3)

[P2] Alfredo Reichlin, Miguel Vasco, Hang Yin, and Danica Kragic. *Goal-Conditioned Offline Reinforcement Learning via Metric Learning*. In: arXiv preprint arXiv:2402.10820, 2024 [pdf]

[P1] Miguel Vasco, Francisco S. Melo, and Ana Paiva. *MHVAE: a Human-inspired Deep Hierarchical Generative Model for Multimodal Representation Learning*. In: arXiv preprint arXiv:2006.02991, 2020 [pdf]

RESEARCH PROJECTS

- ELSA (EU Horizon 2020) 2023–now
  Researcher
  - ELSA is a virtual center of excellence that will spearhead efforts in foundational safe and secure artificial intelligence (AI) methodology research. A large and growing network of top European experts in AI and machine learning is to promote the development and deployment of cutting-edge AI solutions in the future and make Europe the world's lighthouse of AI.
  - I am part of the KTH group, developing benchmarks for privacy-preserving learning and human-in-the-loop learning in robotics.
- TAILOR (EU Horizon 2020, GA. No.952215) 2021–2023
  Researcher
  - The purpose of TAILOR is to build a strong academic-public-industrial research network with the capacity of providing the scientific basis for Trustworthy AI leveraging and combining learning, optimization and reasoning for realizing AI systems that incorporate the safeguards that make them in the reliable, safe, transparent and respectful of human agency and expectations.
  - I was part of the research team of Técnico, and my research focused on the development of model-based RL agents in multimodal environments.

- RELEvaNT (Fundação para a Ciência e Tecnologia, ref. PTDC/CCI-COM/5060/2021) 2021–2023
  Researcher
  - RELEvaNT investigates new models and methods for efficient deep RL in non-stationary environments and the potential applications on several "human-centered" domains.
  - I was part of the research team of INESC-ID, and my research focused on the creation of the representation models for model-based RL agents in multimodal scenarios with partial-observability settings.
- INSIDE (CMU-Portugal Program, ref. CMUP-ERI/HCI/0051/2013) 2017–2018
  Researcher
  - INSIDE investigated the development of symbiotic human-robot interaction and its applications in the therapy of children with impaired development. The project included the deployment of actual robots in an hospital environment and its autonomous intervention in therapy sessions with children with autism spectrum disorders (ASD).
  - In this project I was part of the research team of INESC-ID, and my research focused on the creation of the computational framework for the decision-making and animation systems of an autonomous mobile robot.

INVITED TALKS AND CONSORTIA

- *Multimodal Representations for Perceiving and Acting* 2023
  Shizuoka University, Japan.
- *Multimodal Representation Learning for Agent Perception and Agency* 2021
  Robotics Perception Learning group, KTH Royal Institute of Technology.
- *Multimodal Representation Learning for Robot Perception and Agency* 2021
  RSS Pioneers – [poster]
- *Multimodal Representation Learning for Robotic Cross-Modality Policy Transfer* 2020
  AAMAS Doctoral Consortium – [slides] [video]

HONORS AND DISTINCTIONS

- Best PhD Thesis in AI in Portugal Award 2024
  Awarded by the Portuguese Association for Artificial Intelligence (APPIA).
- Best Paper Awards
  Reinforcement Learning Conference (RLC), 2024 – [C12],
  International Conference on Social Robotics (ICSR), 2020 – [C3].
- RSS Pioneer 2021
  Selective annual workshop in the "Robotics: Science and Systems" conference.
- Cohort of the AAMAS Doctoral Consortium 2020
  Selective annual workshop in the "International Conference on Autonomous Agents and Multiagent Systems".
- Excellence in Teaching Award, Instituto Superior Técnico, University of Lisbon 2020, 2021
  Annual award given to "teachers who stood out for their pedagogical excellence".
- Sony AI Scholarship 2022
  Awarded to attend the 4th International Summer School on Artificial Intelligence and Games
- Ph.D. Grant 2018
  Awarded by 'Fundação para a Ciência e Tecnologia", ref. SFRH/BD/139362/2018.
- Research Grant 2017, 2022
  Awarded in Project INSIDE and Project RELEvaNT by INESC-ID.

TEACHING AND SUPERVISION

COURSES

- FDD3359 Reinforcement Learning Spring 2024
  Doctoral Programme at the School of Electrical Engineering and Computer Science (EECS) *KTH Royal Institute of Technology*
  - *Role*: Teacher
  - Main lecturer, responsible for the organization and creation of contents for the course.
- DD2430 Project Course in Data Science Fall 2023
  Master Degree in Electrical Engineering and Computer Science *KTH Royal Institute of Technology*
  - *Role*: Teaching Assistant
  - Helping students develop their research projects in collaboration with industry partners.

- Planning, Learning and Intelligent Decision-Making 2021–2022
  Master Degree in Computer Science and Engineering, Master Degree in Data Science *Instituto Superior Técnico, University of Lisbon*
  - *Role*: Teaching Assistant
  - Supervising lab sessions, grading student labs
  - *Student Evaluation*: 9.0/9.0 (2021)
  - *Excellency in Teaching Award*: 2021
- Computation and Society (AI Ethics) 2019–2020
  Undergraduate Degree in Computer Science and Engineering *Instituto Superior Técnico, University of Lisbon*
  - *Role*: Teaching Assistant
  - Discussing current ethical issues in AI, grading student presentations;
  - *Student Evaluation*: 8.4/9.0 (2019), 9.0/9.0 (2020)
  - *Excellency in Teaching Award*: 2020

PH.D. STUDENTS

- Alfredo Reichlin, "*Interactive Representation Learning*" 2023-now
  Doctoral Programme at the School of Electrical Engineering and Computer Science, *KTH Royal Institute of Technology*
  Co-advised with Danica Kragic and Hang Yin
- Bernardo Esteves, "*Learning to Act at Scale: Algorithm Synthesis using Deep Neural Networks*" 2023-now
  Doctoral Programme in Computer Science, *Instituto Superior Técnico, University of Lisbon*
  Co-advised with Francisco S. Melo
- Farzaneh Taleb, "*Evaluating Representational Alignment in Natural and Artificial Intelligent Systems*" 2023-now
  Doctoral Programme at the School of Electrical Engineering and Computer Science, *KTH Royal Institute of Technology*
  Co-advised with Danica Kragic and Mårten Björkman
- Nona Rajabi, "*Extracting Human Intention and Perception from Physiological Signals using Data-driven Models*" 2023-now
  Doctoral Programme at the School of Electrical Engineering and Computer Science, *KTH Royal Institute of Technology*
  Co-advised with Danica Kragic and Mårten Björkman

M.SC. STUDENTS

- Afonso Fernandes, "*Using Multi-modal Generative Models against Adversarial Perceptual Attacks to RL Agents*" 2023
  M.Sc. Computer Science, *Instituto Superior Técnico, University of Lisbon*
- Bernardo Esteves, "*Efficient pre-training in model-based reinforcement learning*" 2021
  M.Sc. Computer Science, *Instituto Superior Técnico, University of Lisbon*
- Fábio Vital, "*Deep generative models for model-based reinforcement learning.*" 2021
  M.Sc. Computer Science, *Instituto Superior Técnico, University of Lisbon*

OTHER SUPERVISION ROLES

- Adriano Pacciarelli, Research Engineer 2024-now
  KTH Royal Institute of Technology
- Pedro Ildefonso, Summer internships of INESC-ID, 2019
  Instituto Superior Técnico, University of Lisbon
- Pedro Remédios, Summer Internships of INESC-ID 2019
  Instituto Superior Técnico, University of Lisbon

PROFESSIONAL SERVICE

ORGANIZATIONAL ROLES

- Multimodal Representation Learning: Perks and Pitfalls Workshop (ICLR) – Organizer [website] 2023
- RSS Pioneers Workshop – Faculty Chair [website] 2022

REVIEWER

Journals

- Entertainment Computing 2022
- Neural Computing and Applications 2020–2022

Conferences

- International Conference on Learning Representations (ICLR) 2025
- Artificial Intelligence and Statistics (AISTATS) 2025
- IEEE International Conference on Robotics and Automation (ICRA) 2025
- Neural Information Processing Systems (NeurIPS) 2024
- European Conference on Artificial Intelligence (ECAI) 2024
- International Joint Conference on Artificial Intelligence (IJCAI) 2022-2023
- International Symposium of Robotic Research (ISRR) 2022
- ACM International Conference on Intelligent Virtual Agents (IVA) 2022
- IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2020, 2022-2023
- AAAI Conference on Artificial Intelligence (AAAI) 2020–2024

Workshops

- HRI Pioneers Workshop (HRI) – [website] 2021–2023
- Adaptive and Learning Agents Workshop (AAMAS) – [website] 2020–2023

Other

- ELLIS Evaluator 2021, 2022

RESEARCH COMMUNITY SERVICE

- RPL Summer School on Robotics, Perception and Learning 2024
  Organiser of the RPL Summer School on Robotics, Perception and Learning at Stockholm, Sweden – [website]
- Talking Robotics 2020–2023
  Co-founder of the online bi-weekly virtual seminars about robotics and adjacent fields – [website] [twitter] [youtube]
  - *Goal*: Provide visibility and network opportunities for early-career researchers in AI and Robotics.
  - *Co-founders*: Patrícia Alves-Oliveira, Joana Campos and Silvia Tulli.
  - *Sponsors*: Semio and PAL Robotics.
- Robotics Reading Group 2019–2020
  Organizer of the Robotics Reading Group at Instituto Superior Técnico, University of Lisbon – [website]

MEDIA COVERAGE

- New Scientist – *online article about our super-human vision-based racing agent for Gran Turismo 7* [S1]. 2024
- Robohub – *online article featured multiple sessions of Talking Robotics*. 2021
- Synced Review – *online article about our AAMAS paper* [S4]; 2019
- Correio da Manhã – *TV report about the impact of robotics in therapy of children, referencing Project INSIDE*; 2018
- Diário de Notícias – *magazine article about recent developments in robotics, referencing Project INSIDE*. 2018

REFERENCES

- Danica Kragic, *KTH Royal Institute of Technology, Sweden* dani@kth.se
- Ana Paiva, *Instituto Superior Técnico, University of Lisbon, Portugal* ana.paiva@inesc-id.pt
- Francisco S. Melo, *Instituto Superior Técnico, University of Lisbon, Portugal* fmelo@inesc-id.pt