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Research Interests

Artificial Intelligence (AI) is currently one of the fastest growing areas of computer science. In the past few years the interest in this field has transcended academic development, achieving a variety of applications, potentially influencing every modern economic activity. Much of this development is due to the recent availability of large data sets, as well as of computational resources, and is linked to a single field of AI, namely Machine Learning (ML). This fast development brought notoriety to the field, however, being confined to a single subarea of AI, it is deemed to achieve a standpoint, since the outputs of ML systems do not have explicit justifications that allow them to be audited. Therefore, machine learning algorithms cannot be fully trusted when dealing with human (sensitive) data. The key reason for the lack of justification for the ML outputs is that these algorithms have been largely developed independently from the AI subfield of Knowledge Representation and Reasoning. The future development of AI should consider the development of machine learning systems with knowledge representation capabilities allowing them to provide an explanation to their computed decisions. A large part of my current research has been devoted exactly at developing feasible and efficient combinations of machine learning algorithms (specially convolutional neural networks and reinforcement learning) with high-level ontologies capable of describing the outputs of ML algorithms. This facilitates reasoning about ML decisions and the inference of new facts about the underlying domain. In particular, I have been investigating how the output of a convolutional neural network, that associates visual scenes to English sentences, could be explained by means of a spatial ontology representing the domain objects and their attributes.

Qualifications

PhD, Spatial Reasoning and Abductive Interpretation of Sensor Data Obtained by a Mobile Robot in Dynamic Environment, Imperial College London

Award Date: 20 Nov 2003

Master of Science, Formalising the Common Sense of a Mobile Robot, University of Amsterdam

Award Date: 8 Oct 1998

Master of Science, The Equivalence between Transaction Logic Semantics and the Semantics of its PROLOG implementation, Universidade de Sao Paulo

Award Date: 10 Jul 1995

Bachelor (Honours), The effect of thermal treatment on LiF dosimeters, Universidade de Sao Paulo

Award Date: 30 Nov 1993

Employment

Associate Professor in Artificial Intelligence and Robotics

College of Science and Engineering

Flinders University

8 Oct 2019 → 31 Dec 2099

Research outputs

DRL-Based Thruster Fault Recovery for Unmanned Underwater Vehicles

Lagattu, K., Le Chenadec, G., Artusi, E., Santos, P. E., Sammut, K. & Clement, B., 20 Feb 2024, 2024 Australian and New Zealand Control Conference, ANZCC 2024. Institute of Electrical and Electronics Engineers Inc., p. 25-30 6 p. (2024 Australian and New Zealand Control Conference, ANZCC 2024).

Multimodal Speech Emotion Recognition Using Modality-Specific Self-Supervised Frameworks

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Hybrid Navigation Acceptability and Safety

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Cortes, H. M., Santos, P. E. & da Silva Filho, J. I., 15 Nov 2023, In: *Expert Systems with Applications*. 230, 16 p., 120536.

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Neau, M., Santos, P. E., Bosser, A-G. & Buche, C., Oct 2023, *Proceedings - 2023 IEEE/CVF International Conference on Computer Vision Workshops, ICCVW 2023*. Institute of Electrical and Electronics Engineers Inc., p. 11-20 10 p. (Proceedings - 2023 IEEE/CVF International Conference on Computer Vision Workshops, ICCVW 2023).

Payload Bay Berthing of Underwater Vehicles with a Larger XLUUV

Cooper-Baldock, Z. L., Santos, P. E., Brinkworth, R. & Sammut, K., 18 Sept 2023, *7th Submarine Science Technology and Engineering Conference 2023 - Proceedings SubSTEC7*. Submarine Institute of Australia, p. 97-104 7 p.

A Semantics of Spatial Expressions for interacting with unmanned aerial vehicles

Domingos, L. C. F. & Santos, P. E., Dec 2022, p. 156-163. 8 p.

Contrastive Visual and Language Learning for Visual Relationship Detection

Tran, T., Neau, M., Santos, P. E. & Powers, D., Dec 2022. 8 p.

An investigation of preprocessing filters and deep learning methods for vessel type classification with underwater acoustic data

Domingos, L. C. F., Santos, P. E., Skelton, P. S. M., Brinkworth, R. S. A. & Sammut, K., 7 Nov 2022, In: *IEEE Access*. 10, p. 117582-117596 15 p.

CAPTION: Caption Analysis with Proposed Terms, Image of Objects, and Natural Language Processing

Ferreira, L. A., De Rizzo Meneghetti, D., Lopes, M. & Santos, P. E., 23 Jul 2022, In: *SN Computer Science*. 3, 16 p., 390.

Collaborative Mission Planning for Autonomous Maritime Vehicles

Santos, P. E. & Sammut, K., Apr 2022, p. 40-41. 2 p.

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Domingos, L. C. F., Santos, P. E., Skelton, P. S. M., Brinkworth, R. S. A. & Sammut, K., 2 Mar 2022, In: *Sensors*. 22, 6, 30 p., 2181.

Commonsense Reasoning for Identifying and Understanding the Implicit Need of Help and Synthesizing Assistive Actions

Neau, M., Santos, P., Bosser, A. G., Beu, N. & Buche, C., Mar 2022, In: *CEUR Workshop Proceedings*. 3121, 9 p.

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Heuristics, Answer Set Programming and Markov Decision Process for Solving a Set of Spatial Puzzles*
dos Santos, T. F., Santos, P. E., Ferreira, L. A., Bianchi, R. A. C. & Cabalar, P., Mar 2022, In: Applied Intelligence. 52, 4, p. 4488-4510 23 p.

Monitoring electrical systems data-network equipment by means of Fuzzy and Paraconsistent Annotated Logic
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Rodrigues, E. J., Santos, P. E., Lopes, M., Bennett, B. & Oppenheimer, P. E., Mar 2020, In: Journal of Logic and Computation. 30, 2, p. 635-661 27 p.

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The knowledge of knots: an interdisciplinary literature review
Santos, P. E., Cabalar, P. & Casati, R., 30 Sept 2019, In: Spatial Cognition and Computation. 19, 4, p. 334-358 25 p.

Representation and retrieval of images by means of spatial relations between objects
Nunes, D., Ferreira, L. A., Santos, P. E. & Pease, A., 1 Jan 2019, In: CEUR Workshop Proceedings. 2350

Solving Safety Problems with Ensemble Reinforcement Learning
Ferreira, L. A., dos Santos, T. F., Bianchi, R. A. C. & Santos, P. E., 2019, AI 2019: Advances in Artificial Intelligence - 32nd Australasian Joint Conference, 2019, Proceedings. Liu, J. & Bailey, J. (eds.). Cham, Switzerland: Springer , p. 203-214 12 p. (Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics); vol. 11919 LNAI).

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Bianchi, R. A. C., Santos, P. E., da Silva, I. J., Celiberto, L. A. & Lopez de Mantaras, R., Aug 2018, In: Journal of Intelligent and Robotic Systems: Theory and Applications. 91, 2, p. 301-312 12 p.

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Improving reinforcement learning results with qualitative spatial representation

Homem, T. P. D., Perico, D. H., Santos, P. E., Costa, A. H. R. & Da Costa Bianchi, R. A., 28 Jun 2017, *Proceedings - 2017 Brazilian Conference on Intelligent Systems, BRACIS 2017.* Institute of Electrical and Electronics Engineers Inc., p. 151-156 6 p. (Proceedings - 2017 Brazilian Conference on Intelligent Systems, BRACIS 2017; vol. 2018-January).

Consistency check in a multiple viewpoint system for reasoning about occlusion

Martin, A. P., Santos, P. E. & Safi-Samghabadi, M., 4 Jun 2017, *Advances in Artificial Intelligence: From Theory to Practice - 30th International Conference on Industrial Engineering and Other Applications of Applied Intelligent Systems, IEA/AIE 2017, Proceedings.* Ali, M., Benferhat, S. & Tabia, K. (eds.). Springer-Verlag, Vol. 10350. p. 523-532 10 p. (Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics); vol. 10350 LNCS).

Pinning down polysemy: A formalisation for a Brazilian Portuguese preposition

Rodrigues, E., Santos, P. E. & Lopes, M., Mar 2017, In: *Cognitive Systems Research.* 41, p. 84-92 9 p.

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João, K-J. & Santos, P. E., 2017, *Cognitive Science: : Recent Advances and Recurring Problems.* Adams, F., Pessoa Jr, O. & Kogler Jr, J. E. (eds.). United States of America: Vernon Press, p. 179-196 17 p.

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Celiberto, L. A., Bianchi, R. A. C. & Santos, P. E., 15 Dec 2016, *Proceedings - 13th Latin American Robotics Symposium and 4th Brazilian Symposium on Robotics, LARS/SBR 2016.* Cavalcante, S. V. & Tonidandel, F. (eds.). Institute of Electrical and Electronics Engineers Inc., p. 311-316 6 p. 7783545. (Proceedings - 13th Latin American Robotics Symposium and 4th Brazilian Symposium on Robotics, LARS/SBR 2016).

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Cabalar, P. & Santos, P. E., Sept 2016, In: Artificial Intelligence. 238, p. 1-10 10 p.

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Santos, P. E., 2 Mar 2016, In: Bulletin of the Atomic Scientists. 72, 2, p. 117-119 3 p.

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Perico, D. H., Santos, P. E. & Bianchi, R. A. C., 11 Feb 2016, *Proceedings - 12th LARS Latin American Robotics Symposium and 3rd SBR Brazilian Robotics Symposium, LARS-SBR 2015 - Part of the Robotics Conferences 2015*. Goncalves, R. S., Macharet, D. G., Osorio, F. S., Campos, M. F. M. & Carvalho, J. C. M. (eds.). Institute of Electrical and Electronics Engineers Inc., p. 216-221 6 p. 7402168. (Proceedings - 12th LARS Latin American Robotics Symposium and 3rd SBR Brazilian Robotics Symposium, LARS-SBR 2015 - Part of the Robotics Conferences 2015).

Framing holes within a loop hierarchy
Santos, P. E. & Cabalar, P., 11 Jan 2016, In: Spatial Cognition and Computation. 16, 1, p. 54-95 42 p.

Probabilistic self-localisation on a qualitative map based on occlusions
Santos, P. E., Martins, M. F., Fenelon, V., Cozman, F. G. & Dee, H. M., 10 Jan 2016, In: Journal of Experimental and Theoretical Artificial Intelligence. 28, 5, p. 781-799 19 p.

Transferring knowledge as heuristics in reinforcement learning: A case-based approach
Bianchi, R. A. C., Celiberto, L. A., Santos, P. E., Matsuura, J. P. & Lopez De Mantaras, R., Sept 2015, In: Artificial Intelligence. 226, p. 102-121 20 p.

Perceptual narratives of space and motion for semantic interpretation of visual data
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- An investigation of actions, change and space
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- Probabilistic logic for multi-robot event recognition
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- Formalising the fisherman's folly puzzle
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Holes, knots and shapes: A spatial ontology of a puzzle

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