Davide Corsi

Postdoctoral Researcher

University of California: Irvine, Donald Bren Hall, Irvine, CA

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Research Experience

University of California: Irvine *Feb 2024 - current*

Postdoctoral Researcher

Developing methods and applications in Robot Learning. Including Safe Reinforcement Learning algorithms, implementations on simulated and physical robots, conducting experiments, and analyzing results (under the supervision of *Prof. Roy Fox*).

University of Verona *May 2023 - Jan 2024*

Postdoctoral Researcher

Development of AI techniques for robotic systems employed in water monitoring for sustainable tourism. Application of deep reinforcement learning techniques on safety-critical robotics problems (under the supervision of *Prof. Alessandro Farinelli*).

The Hebrew University of Jerusalem *Feb 2022 - Jul 2022*

Visiting Researcher

Development of techniques and algorithms for the formal verification of neural networks and integration with deep reinforcement learning and robotics applications (under the supervision of *Prof. Guy Katz*).

University of Verona *Oct 2018 - Oct 2019*

Research Fellowship

Development of aquatic drones for water monitoring, software, and hardware. Design the control software of the drone based on artificial intelligence techniques and deep learning for autonomous navigation, inside the European project INTCATCH2020.

Education

University of Verona *Oct 2019 - May 2023*

Ph.D. in Computer Science

- Thesis Title: "Safe Deep Reinforcement Learning: Enhancing the Reliability of Intelligent Systems"
- Advisor: Prof. Alessandro Farinelli

University of Verona *Oct 2016 - Jul 2018*

Master's Degree in Computer Science [110/110]

- Thesis Title: "Experimental evaluation of Reinforcement Learning approaches: application to a redundant 7DOF manipulator"
- Advisor: Prof. Alessandro Farinelli

Biosketch

I received my Master's degree in Computer Science from the University of Verona, where I developed my basic skills and a strong interest in the applications of Artificial Intelligence to robotic systems. Building on this foundation, I pursued my Ph.D. under the supervision of *Prof. Alessandro Farinelli* at the same institution, with a focus on deep reinforcement learning and, in particular, on the safety aspects that often prevent the adoption of these autonomous systems in a real-world context. During my Ph.D., I had the opportunity to have a research experience at the Hebrew University of Jerusalem under the supervision of *Prof. Guy Katz*. This experience broadened my perspective and exposed me to different methodologies in the field; collaborating with esteemed researchers at an international level significantly enriched my research acumen and expanded my network within the scientific community. From a more technical point of view, in the *Katz's lab* I had the opportunity to learn more about the concept of formal verification for neural networks, with the idea of integrating this knowledge with my previous experience in robotics.

My dissertation, entitled *"Safe Deep Reinforcement Learning: Enhancing the Reliability of Intelligent Systems"*, represents a significant contribution to the understanding of safety aspects in deep reinforcement learning. In particular, I have studied the problem of reliability of autonomous agents from two perspectives: (i) safe and constrained training, and (ii) providing formal guarantees about the behavior of deep neural network agents. This work has been published in prestigious machine learning and artificial intelligence conferences such as IJCAI, AAAI, ICLR, and TACAS. Moreover, as a fundamental aspect of my research, I have always tried to bridge the gap between theoretical research and real-world problems; in this direction, the application of these novel algorithms on the actual robotic platforms has led to publications in top-level robotics conferences such as IROS and ICRA.

Research Interests

My Research interests focus on developing novel Deep Reinforcement Learning (DRL) methods applied to robotics, with a particular emphasis on the generation of reliable systems in safety-critical contexts. I try to analyze this problem from two different perspectives: (i) safe training via constrained reinforcement learning, and (ii) validation via formal verification of neural networks. As an essential aspect of my work, I constantly try to merge theoretical research with practical application to real-world robotic problems.

Deep Reinforcement Learning for Robotics

Development of state-of-the algorithms and approaches for deep reinforcement learning, focusing on solving complex tasks for robotics applications. Development of techniques for robotics navigation based on neural network controllers.

Safe AI and Constrained Reinforcement Learning

Study of different methodologies to generate safe, predictable, and trustworthy intelligent agents via deep reinforcement learning. A particular focus is on constrained reinforcement learning approaches to inject prior knowledge into the training loop.

Formal Verification of Deep Neural Networks

Methodologies for the formal analysis and verification of neural networks, with a particular emphasis on robotic problems. Development of techniques to provide formal guarantees on the behavior of autonomous agents controlled by deep neural networks and trained via reinforcement learning.

Publications

Conference & Journal Publications:

[16] Verification-Guided Shielding for Deep Reinforcement Learning
D. Corsi, G. Amir, A. Rodriguez, C. Sanchez, G. Katz, R. Fox
Reinforcement Learning Conference (RLC), 2024.

[15] Aquatic Navigation: A Challenging Benchmark for Deep Reinforcement Learning
D. Corsi, D. Camponogara, A. Farinelli
Reinforcement Learning Conference (RLC), 2024.

[14] Enumerating Safe Regions in Deep Neural Networks with Provable Probabilistic Guarantees
L. Marzari, **D. Corsi**, E. Marchesini, A. Farinelli, F. Cicalese
Association for the Advancement of Artificial Intelligence (AAAI), 2024.

[13] Formally Explaining Neural Networks within Reactive Systems
S. Bassan, G. Amir, **D. Corsi**, I. Refaeli and G. Katz
Formal Methods in Computer-Aided Design (FMCAD), 2023

[12] Constrained Reinforcement Learning and Formal Verification for Safe Colonoscopy Navigation
D. Corsi*, L. Marzari*, A. Pore*, A. Farinelli, A. Casals, P. Fiorini, D. Dall'Alba
International Conference on Intelligent Robots and Systems (IROS), 2023.

[11] The #DNN-Verification problem: Counting Unsafe Inputs for Deep Neural Networks
L. Marzari*, **D. Corsi***, F. Cicalese, A. Farinelli
International Joint Conference on Artificial Intelligence (IJCAI), 2023.

[10] Verifying Learning-Based Robotic Navigation Systems
G. Amir*, **D. Corsi***, R. Yerushalmi, L. Marzari, D. Harel, A. Farinelli, G. Katz
International Conference on Tools and Algorithms for the Construction and Analysis of Systems (TACAS), 2023.

[9] Curriculum Learning for Safe Mapless Navigation
L. Marzari, **D. Corsi**, E. Marchesini, A. Farinelli
ACM/SIGAPP Symposium on Applied Computing (ACM SAC), 2022.

[8] Exploring Safer Behaviors for Deep Reinforcement Learning
E. Marchesini*, **D. Corsi***, A. Farinelli
Association for the Advancement of Artificial Intelligence (AAAI), 2022.

[7] Formal verification of Neural Networks for Safety-Critical Tasks in Deep Reinforcement Learning
D. Corsi, E. Marchesini, A. Farinelli
Conference on Uncertainty in Artificial Intelligence (UAI), 2021.

[6] Benchmarking Safe Deep Reinforcement Learning in Aquatic Navigation
D. Corsi, E. Marchesini, A. Farinelli
International Conference on Intelligent Robots and Systems (IROS), 2021.

[5] Safe Reinforcement Learning Using Formal Verification for Tissue Retraction in Autonomous Robotic-Assisted Surgery.
A. Pore*, **D. Corsi***, E. Marchesini*, D. Dall'Alba, A. Casals, A. Farinelli, P. Fiorini
International Conference on Intelligent Robots and Systems (IROS), 2021.

[4] Formal Verification for Safe Deep Reinforcement Learning in Trajectory Generation.
D. Corsi, E. Marchesini, A. Farinelli, P. Fiorini
International Conference on Robotic Computing (IRC), 2020.

[3] Genetic Soft Updates for Policy Evolution in Deep Reinforcement Learning.
E. Marchesini, **D. Corsi**, A. Farinelli
International Conference on Learning Representations (ICLR), 2020.

[2] Double Deep Q-Network for Trajectory Generation of a Commercial 7DOF Redundant Manipulator.
E. Marchesini, **D. Corsi**, A. Benfatti, A. Farinelli, P. Fiorini
International Conference on Robotic Computing (IRC), 2019.

[1] Gestural Interaction and Navigation Techniques for Virtual Museum Experiences.
F. M. Caputo, I. M. Ciortan, **D. Corsi**, M. De Stefani, A. Giachetti
Advanced Visual Interfaces and Interactions in Cultural Heritage (AVI CH), 2016.*

Submitted:

[3] Shields Modulo Theories
A. Rodriguez, G. Amir, **D. Corsi**, C. Sánchez. G. Katz
TBD, 2025.

[1] Constrained Reinforcement Learning for Robotics via Scenario-Based Programming
D. Corsi*, R. Yerushalmi*, G. Amir, A. Farinelli, D. Harel, G. Katz
TBD, 2025.

Teaching Experience

2023 **Reinforcement Learning**, Teaching Assistant, *University of Verona*
2022 **Foundations of Artificial Intelligence**, Teaching Assistant, *University of Verona*
2021 **Foundations of Artificial Intelligence**, Teaching Assistant, *University of Verona*
2020 **Artificial Intelligence**, Teaching Assistant, *University of Verona*

Academic Service

2025 **Programme Committee**, Thirty-Ninth AAAI Conference on Artificial Intelligence *AAAI 2025*
2024 **Programme Committee**, Thirty-Eighth AAAI Conference on Artificial Intelligence *AAAI 2024*
2023 **Programme Committee**, Thirty-Seventh AAAI Conference on Artificial Intelligence *AAAI 2023*
2023 **Reviewer**, International Joint Conference on Artificial Intelligence *IJCAI 2023*
2023 **Reviewer**, International Conference on Autonomous Agents and Multiagent Systems *AAMAS 2023*

Presentations and Invited Talks

2024 **The #DNN-Verification problem: Counting Unsafe Inputs for Deep Neural Networks**. *International Joint Conference on Artificial Intelligence*, Macau, Macau.

2021 **Formal verification of Neural Networks for Safety-Critical Tasks in Deep Reinforcement Learning**. *Conference on Uncertainty in Artificial Intelligence*, Virtual.

2020 **Formal Analysis of Decision-Making Models for Aquatic Navigation Using Deep Reinforcement Learning**. *AAAI Symposium Series: Machine Learning for Mobile Robot Navigation in the Wild*, Virtual.

2019 **Cloud-based data streaming from mobile sensors for water quality monitoring**. *International Conference Smarter Catchment Monitoring, Cleaner Waters*, London, UK.