Claudio Coppola

PhD in Robotics, Machine Learning Expert

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London, UK

London, UK

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Robotics AI researcher. Experienced in Robot Manipulation and Machine Learning.

Experience

Machine Learning Applied Scientist

Amazon

Jul 2022 - Aug 2024

- Developed and deployed Deep Learning solutions for demand forecasting and Cost Estimation.
- Deployed Machine Learning solutions using the AWS cloud infrastructure.
- Led a product team in project scoping, data engineering, and software architecture design.

Scientific Advisor

Queen Mary University of London

Jul 2022 - Present

- Collaborated on a teleoperation system having a VR headset and exoskeleton leader reconstructing object shape from tactile information of a multi-fingered robot manipulator follower.
- Collaborated on deep-learning model for haptic robot primitives segmentation and a controller reproducing multi-fingered robot demonstrations.
- Developed a machine-learning model for contact localisation and pressure estimation for a soft tactile sensor.

Postdoctoral Researcher

Queen Mary University of London

May 2019 - Jun 2022

- Developed a *teleoperation platform* for a dexterous manipulator using the real-time robot middleware ROS tested on Mujoco simulations and a real robot
- Developed a supervised Machine Learning system to segment robot grasp and manipulation skills from long-horizon robot demonstrations based on robot state and tactile perception.
- Developed a robust robot grasp exploration system based on Bayesian Optimization and contributed to the open-source library scikit-optimize.
- Published articles in multiple top-level robotics conferences.

Research Associate

University of Lincoln

May 2017 - May 2018

- Developed state-of-the-art Machine Learning Ensemble for Human Activity Recognition and Re-identification systems for mobile assistive robots used in the EU H2020 research projects ENRICHME and FLOBOT.
- Conducted demonstrations for AI and Mobile Robotics courses.

Other Experiences

- BrainStation Instructor (Nov 2023 Present): Lead Instructor for the Data Science & Gen AI courses.
- 2Watch Data Scientist Contractor (Jan Dec 2020): Developed an OCR system extracting information from gaming dashboards.
- Entrepreneur First LD11 Cohort Member (Oct 2018 Jan 2019) CTO in a startup ideation.
- Buzzoole Lead Data Scientist (May 2018 Oct 2018) Trained InceptionNet model and sequence-to-sequence models to support product development.
- KPMG Business Intelligence Consultant (Jan Jun 2014): Developed Data warehouse logic for business intelligence applications.

Education

PhD in Robotic Perception

University of Lincoln

Jul 2014 - Aug 2018

Lincoln, UK

• Developed a Machine Learning workflow for Human Social Activity Segmentation using real-world RGB-D data for assistive robotics.

MSc cum Laude in Computer Science Engineering

University Federico II of Napoli

Oct 2011 - Dec 2013

- Napoli, Italy
- Top 5% Student
- Focus: Computer Vision, Machine Learning, Signal Processing.
- Thesis: Iris Liveness detection for authentication systems based on Iris Recognition

BSc in Computer Science Engineering

University Federico II of Napoli

Oct 2011 - Dec 2013

Napoli, Italy

- Top 5% Student
- Focus: Software Engineering, Artificial Intelligence, Control Theory.
- Thesis: Algorithm and systems for voice recognition.

Technical Skills

- Machine Learning & AI Deep Learning, Bayesian Optimization, Ensemble Learning, Supervised/Unsupervised Learning, Reinforcement Learning.
- Frameworks ROS, Pytorch, Scikit-learn, Lightning, Mujoco, Pandas, Streamlit, Docker, AWS, Kinect SDK2, OpenCV.
- Methodological Robot Manipulation, Machine Learning, Time-Series Forecasting, Computer Vision, Mobile Robotics, Optimization, Scientific writing, Software Engineering.

Programming Skills

Proficient: Python, Matlab, SQL. Experienced: C, C++, C#, Java

Lincoln, UK

London, UK

Certifications

- $\rightarrow~$ Machine Learning Stanford University on Coursera
- \rightarrow Deep Learning Specialization deeplearning.ai on Coursera
- → Deep Reinforcement Learning Nanodegree Udacity
- → Fundamentals of Reinforcement Learning University of Alberta on Coursera
- → BMVA Computer Vision Summer School 2015 Swansea University.

Awards

2022 <u>PD Enrichment Awards</u> - <u>Alan Turing Institute</u>
2022 <u>AI-Net PostDoc Awards</u> - <u>DAAD</u>
2020 Hult regionals winner - <u>Hult Foundation</u>
2016 Research Travel Award - Santander
2016 Research Travel Awards - EURAI

Projects

ZeroShot Forecasting initiative

Amazon - Led a team to innovate the deployed forecasting models with zero-shot forecasting foundation models to replace the ad-hoc trained models in production.

- Performed research on zero-shot forecasting models based on meta-learning (e.g. N-beats, N-Hits) and LLM-based models (e.g. Chronos).
- Implemented experiments to compare the performance of zero-shot models with models in deployment for multiple businesses.
- Organised an internal hackathon to adopt the Chronos foundational forecasting model in existing business solutions.

Skill Segmentation for Long-Horizon Robot Task Learning

Queen Mary University of London - Developed methods to automatically segment robot dexterous manipulation skills from long-horizon demonstration videos enabling the learning of complex tasks.

- Designed and implemented features capturing robot proprioception and tactile data for skill segmentation.
- Built and compared machine learning models (Random Forests and Deep Learning) using scikit-learn and PyTorch for robust skill segmentation.
- Enabled robots to learn complex skills from long demonstrations, improving automation capabilities in manufacturing.
- Released a dataset of robot teleoperation data to facilitate further research in robot learning from demonstrations.

The early version of the approach used *Random Forests*, but in the recent formulation, it uses a custom Deep-Learning model. The data collected has been made available here.

RoboPuppetteer: Dexterous robot teleoperation system

Queen Mary University of London - Developed a low-cost (£200) teleoperation system for an UR5 robot with Allegro hand, enabling real-time control with vision-based hand tracking and haptic feedback using a custom vibrotactile glove.

- Utilized ROS for system communication and implemented inverse kinematics for accurate robot pose control.
- Integrated a custom haptic glove for tactile feedback, enhancing user control during manipulation using Arduino.
- Validated finger mapping logic rigorous testing in Mujoco simulations and live robot demonstrations.

Source code & videos available here.

Human Social Activity Recognition for assistive robotics

University of Lincoln - Developed a novel occlusion-resistant social activity detection and recognition system from long RGB-D videos.

- Developed a sequential Machine Learning model based on a multi-modal probabilistic mixture of learners for social activity recognition.
- Developed a continuously learning model that estimates spatio-temporal priors of human habits and uses them to improve activity classification performance.
- Created three public datasets for human social activity recognition combining RGB-D data and the pose of individuals.

The code of the algorithm is implemented in Matlab.

Other Projects

Details of other projects can be found here

Publications & Invited Talks

Invited Talks

- "How to Train your Robot: Teaching Robot Behaviour Using Teleoperation". Where Is My Robot Butler? Future House London, UK 2024
- "Human Activity Recognition and Monitoring" Symposium of the British Machine Vision Association 2017 (BMVA), London, UK.
- Learning Human Actions: from Perception to Robot Learning, University of Leeds, UK
- Learning Human Actions: from Perception to Robot Learning, University of Lincoln, UK

Journals

- [1] Xompero, A., Donaher, S., Iashin, V., Palermo, F., Solak, G., Coppola, C., ... & Cavallaro, A. (2022). The CORSMAL benchmark for the prediction of the properties of containers. IEEE Access.
- [2] Siddiqui, M. S., Coppola, C., Solak, G., & Jamone, L. (2021). Grasp Stability Prediction for a Dexterous Robotic Hand Combining Depth Vision and Haptic Bayesian Exploration. Frontiers in Robotics and AI, 237.
- [3] Coppola, C., Cosar, S., Faria, D., & Bellotto, N. (2019). Social Activity Recognition on Continuous RGB-D Video Sequences. International Journal of Social Robotics, 1–15.

Conferences & Workshops

- [4] Giudici G., Bonzini Aramis A., Coppola C., Althoefer K., Farkhatdinov I. & Jamone L. (2024). "Leveraging Tactile Sensing to Render both Haptic Feedback and Virtual Reality 3D Object Reconstruction in Robotic Telemanipulation", *Submitted to* IEEE Robotics and Automation Letters
- [5] Mao X., Giudici G., Coppola C., ..., Zhibin Li & Lorenzo Jamone(2024). Segmenting long-horizon teleoperated robot manipulation demonstrations using multi-modal single-skill data for flexible robot learning. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2024
- [6] Dawood A. B., Coppola C. & Althoefer K. Learning Decoupled Multi-touch Force Estimation, Localization and Stretch for Soft Capacitive E-skin. IEEE International Conference of Robotics and Automation (ICRA) 2023
- [7] Coppola C., & Jamone L.(2022). Master of Puppets: Multi-modal Robot Activity Segmentation from Teleoperated Demonstrations. In 2022 IEEE Conference on Development and Learning (ICDL).
- [8] Coppola C., Solak G. & Jamone L.(2022). A portable and affordable system for the teleoperation of dexterous robotic hands using Leap Motion hand tracking and vibrotactile feedback. In 2022 31st IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN).
- [9] Zenha R., Denoun B., Coppola C. & Jamone L. (2021). Tactile Slip Detection in the Wild Leveraging Distributed Sensing of both Normal and Shear Forces. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2021
- [10] Xompero, A., Donaher, S., Iashin, V., Palermo, F., Solak, G., Coppola, C., ... & Cavallaro, A. (2021). Multi-modal estimation of the properties of containers and their content: survey and evaluation. arXiv preprint arXiv:2107.12719.
- [11] Siddiqui, M. S., Coppola, C., Solak, G., & Jamone, L. (2021, September). Discovering Stable Robot Grasps for Unknown Objects in Presence of Uncertainty Using Bayesian Models. In Annual Conference Towards Autonomous Robotic Systems (pp. 46-55). Springer
- [12] Iashin V. and Palermo F. and Solak G. and Coppola C. (2020). Filling Mass Estimation Using Multi-modal Observations of Human-robot Handovers. CoRR, abs/2012.01311.
- [13] Coppola, C., Cosar, S., Faria, D., & Bellotto, N. (2017). Automatic detection of human interactions from RGB-D data for social activity classification. In 2017 26th IEEE International Symposium on Robot and Human Interactive Communication (RO-MAN) (pp. 871-876).
- [14] Fernandez-Carmona, M., Cosar, S., Coppola, C., & Bellotto, N. (2017). Entropy-based abnormal activity detection fusing RGB-D and domotic sensors. In 2017 IEEE International Conference on Multisensor Fusion and Integration for Intelligent Systems (MFI) (pp. 42-48).
- [15] Coppola, C., Faria, D., Nunes, U., & Bellotto, N. (2016). Social activity recognition based on probabilistic merging of skeleton features with proximity priors from RGB-D data. IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS) 2021.
- [16] Cosar, S., Coppola, C. & Bellotto, N. (2017). Volume-based Human Re-identification with RGB-D Cameras. In VISIGRAPP (4: VISAPP).
- [17] Coppola, C., Krajnik, T., Duckett, T., & Bellotto, N. (2016). Learning temporal context for activity recognition. In European Conference on Artificial Intelligence (ECAI2016).
- [18] Coppola, C., Mozos, O., Bellotto, N.(2015). Applying a 3d qualitative trajectory calculus to human action recognition using depth cameras. In IEEE/RSJ IROS Workshop on Assistance and Service Robotics in a Human Environment.

Peer-Review Work

Actively contributed to the academic community through peer review for the following conferences and Journals on Robotic perception, Robot Learning and Machine Learning:

Conferences: IROS; ICRA; ICAR; ICDL; IJCNN; ROMAN;

Journals: Nature Machine Intelligence; Transaction of Robotics; Cognitive Systems Research; IEEE Transactions on Haptics; IEEE RA-L; MDPI Applied Sciences;