Marco Legittimo, PhD

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Skills

Research Topics: **Deep Learning, Computer Vision, Deep Reinforcement Learning, Robotics, Visual Odometry (VO), Simultaneous Localization And Mapping (SLAM), 3D Reconstruction with NeRF.**
Framework and Technologies: **PyTorch, Stable-Baseline3, PyTorch Geometric, Numpy, Pandas, OpenCV, Matplotlib, Scikit-learn, Scipy, TensorBoard, ROS, Docker, Git, Linux, Evo, NeRF Studio.**
Programming Languages: **Python (expert, 7 years), Bash scripting (proficient, 3 years), C++, and Java.**
Languages: **Italian (Native), English (Proficient), French (Basic), and Spanish (Basic).**

Work Experience

CeDiPa — **Postdoctoral Research Grant entitled:** Perugia (IT) | August 2024 — Now
"**Algorithms, models, and systems for digitization, exploitation, enhancement, and maintenance of artistic, cultural and environmental heritage**". Conducting research and developing objects novel view synthesis through Neural Radiance Fields (NeRF) and Gaussial Splatting (GS) techniques (ongoing) | PyTorch, Python, NeRF Studio.

University of Perugia — **PhD Research Grant entitled:** Perugia (IT) | September 2022 — July 2024
"**Visual odometry and obstacle avoidance approaches based on geometric and deep learning techniques for localization and navigation of MAV-class drones in unstructured environments**". A model was proposed that jointly avoids obstacles and follows a defined trajectory operating autonomously in never-seen environments during the training phase. Related result trajectories demonstrated the robustness of this approach compared to a modular SotA baseline by improving the success rate in 90% of test scenarios and getting closer to the ideal Dijkstra trajectory 60% of the time | PyTorch, Stable-Baseline3, Python.

University of Perugia — **PhD Research Grant entitled:** Perugia (IT) | July 2021 — June 2022
"**Development and testing of algorithms for localization, SLAM, and navigation of mobile robots: application in agricultural and urban contexts**". A model that performs the VO/SLAM task has been presented by leveraging the generalization capabilities of a deep learning feature extractor. It outperformed SotA SLAM approaches in challenging environments decreasing the tracking loss and the pose error by about 85% while remaining comparable in reference datasets | PyTorch, Python, ROS, C++, Docker.

University of Perugia — **Scholarship entitled:** Perugia (IT) | September 2020 — June 2021
"**Machine Learning tools and techniques for characterizing models for precision agriculture**". Benchmarking VO/VSLAM models (both geometric and data-driven) through extensive hyperparameters and scenario exploration by providing a comparison tool for the robotics research community | Bash, Docker, ROS, C++.

Publications

Marco Legittimo, Simone Felicioni, Fabio Bagni, Andrea Tagliavini, Alberto Dionigi, Francesco Gatti, Micaela Verucchi, Gabriele Costante, and Marko Bertogna. **A benchmark analysis of data-driven and geometric approaches for robot ego-motion estimation.** In *Journal of Field Robotics, volume 40, pages 626–654, 2023.*

Giuseppe Mollica, **Marco Legittimo**, Alberto Dionigi, Gabriele Costante, and Paolo Valigi.
Integrating Sparse Learning-Based Feature Detectors into Simultaneous Localization and Mapping—A Benchmark Study. In *Sensors, volume 23, 2023*.

Giuseppe Mollica, Simone Felicioni, **Marco Legittimo**, Leonardo Meli, Gabriele Costante, and Paolo Valigi. **MA-VIED: A Multisensor Automotive Visual Inertial Event Dataset.** In *Trans. Intell. Transport. Sys. 25, 1, 214–224*.

Marco Legittimo, Francesco Crocetti, Mario Luca Fravolini, Giuseppe Mollica, and Gabriele Costante. **LF^{2}SLAM: Learning-based Features For visual SLAM.** In *IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS). IEEE, 2024*

Raffaele Brilli, **Marco Legittimo**, Francesco Crocetti, Mirko Leomanni, Mario Luca Fravolini, and Gabriele Costante. **Monocular Reactive Collision Avoidance for MAV Teleoperation with Deep Reinforcement Learning.** In *2023 IEEE International Conference on Robotics and Automation (ICRA).*

Simone Felicioni, **Marco Legittimo**, Mario Luca Fravolini, and Gabriele Costante. **GOLN: Graph Object-based Localization Network.** In *2021 20th International Conference on Advanced Robotics (ICAR).*

Education

Doctor of Philosophy (PhD) — **University of Perugia** Perugia (IT) | November 2020 — April 2024
Computer Science & Engineering | Thesis: Exploring Deep Learning And Deep Reinforcement Learning For Pose Estimation And Collision Avoidance To Enhance Robot Navigation.

Master of Science (MSc) — **University of Perugia** Perugia (IT) | October 2017 — June 2020
Computer & Robotics Engineering | Thesis: A self-supervised approach for Visual Odometry estimation.

Bachelor of Science (BSc) — **University of Perugia** Perugia (IT) | October 2014 — October 2017
Computer & Electronic Engineering

Research Experience

Institut National des Sciences Appliquées de Lyon Lyon (FR) | June 2023 — October 2023
Next-Best View Planning for Aerial 3D Reconstruction of Unknown Environments. | Study and analysis of algorithms for autonomous exploration with aerial vehicles through Deep Learning methods.

Summer School Partecipation

IEEE RAS Summer School on Multi-Robot Systems Prague (CZ) | July 2022
International Computer Vision Summer School (ICVSS) Sicily (IT) | August 2023

Honours and Awards

Third prize Perugia (IT) | September 2020
Pegaso 2000 award for the best degree thesis related to computer engineering and digital technologies.