Emanuele Caruso

PhD Student in Advanced-Systems Engineering

Computer Vision

Summary

I am a Computer Vision engineer and researcher. My academic background lies in robotics and artificial intelligence, with a particular focus on Computer Vision. I have explored a wide range of computer vision applications, including Visual SLAM, 3D Reconstruction, Differentiable Rendering, and Defect Segmentation. Additionally, I have hands-on experience in designing and implementing real multi-camera vision systems.

Education

Bachelor	Electronic Engineering			
	Grade: 105/110	**Date**: 10/2012 - 10/2017	**University:**	ROMA TRE UNIVERSITÀ DEGLI STUDI
Master	Artificial Intelligence and Robotics			
	Grade: 110/110 cum laude	**Date**: 10/2017 - 10/2022	**University:**	SAPIENZA UNIVERSITÀ DI ROMA
PhD	Advanced-Systems Engineering			
	Attending	**Date**: 11/2022 - 11/2025	**University:**	unibz

Experience

Computer Vision Engineer and Researcher	**Company**:	covision lab
Date: 06/2024 - ongoing		

Dissertations

Bachelor Thesis

Title: Implementation of chroma key with green screen in an augmented virtuality system with HTC Vive.

In a green screen room, the user is projected into a virtual world augmented with real objects coming from the front camera stream of the HTC Vive headset. The real images coming from the front-camera stream are overlyied on the virtual camera, filtering out the background with chroma key. The system has been implemented on the Unity game engine with C# scripts.

Keywords*:*
Computer Vision, Computer Graphics, Augmented Virtuality, Unity, Image Processing

Master Thesis

Title: Implementation of a direct Visual Odometry system.

A novel Visual Odometry system has been designed and implemented totally from scratch in C++ for Visual SLAM purposes. The method performs photometric bundle-adjustment in a sliding-window manner to preserve the real-time

capability. After a feature-based initialization, the optimization relies on photometric measurements, allowing an arbitrary dense point-cloud representation for the map. The method propose also a novel strategy to efficiently marginalize old variables and has been tested on a handmade synthetic dataset generated with Blender.

Keywords*:*
Computer Vision, Visual SLAM, Structure From Motion, Bundle Adjustment, Feature extraction, Pose Graph optimization

Research

I am currently enrolled in the PhD course on Advanced-Systems Engineering at the Free University of Bozen, with financial support from the Schaeffler Group company. My research focuses on utilizing Computer Vision techniques to generate Digital Twins of products within a production line, to the end of facilitating Quality Control.To this end, I employ differentiable rendering methods to reconstruct the intrinsic PBR materials of products.

Keywords:
Computer Vision, Computer Graphics, Deep Learning, 3D reconstruction, Neural rendering, Digital Twins, Phisically-based Rendering, Novel View Synthesis, NeRF

Academic Projects (Degree Course)

	Domain:	**Date:**
Video classification for activity recognition with CNNs and LSTMs	Computer Vision	10/2018
Development of an interactive graphic application on the web	Computer Graphics	01/2019
Implementation of a real-time path planner with RRT*	Robotics	02/2019
Implementation of a tracker with the Polaris Vicra system	Robotics	10/2019
Implementation of a path tracing renderer	Computer Graphics	06/2020
Text classification for compiler identification	Machine Learning	06/2020
Image classification for weather recognition with CNNs	Computer Vision	06/2020
Collision detection analysis for a manipulator with elastic joints in MATLAB	Robotics	09/2020
Implementation of iterative learning control in an under-actuated system	Robotics	09/2020
Implementation of a range only SLAM system	Robotics	01/2021
Design of a Quaternionic NN for 3D audio localization	Machine Learning	01/2021

Private Projects

- Development of a management software for aesthetic centers   Freelancer   from 03/2019 to 09/2019

Other educational experience

Conference-papers	Extended-abstract @ Ital-IA
	Digital twins and predictive AI-based inspections for quality control
	Date: 30/05/23
	Full-paper @ ICLR 2024, DMLR Workshop
	GRASP-GCN: Graph-Shape Prioritization for Neural Architecture Search under Distribution Shifts
	Date: 03/2024
	Full-paper @ ISIEA 2024, Main conference
	Automated visual inspection via differentiable physically-based rendering under unknown illumination
	Date: 06/2024
	Full-paper @ ECCV 2024, VISION Workshop
	Label Injection for Imbalanced Industrial Defect Segmentation
	Date: 09/2024

Journal @ Fractal and Fractional (MDPI)
Fractals as Pre-training Datasets for Anomaly Detection and Localization
Date: 11/2024

Teaching Assistant: 20 hours of Teaching Assistant for the course of "Algorithms ans Programming" at Unibz
Date: Oct-Jan 2023

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Date: Oct-Jan 2024

Scholarships

PhD Scholarship   **Call title**: AI and Computer Vision for automating visual inspection and creating parts' Digital Twins.

University: unibz   **Financier:** SCHAEFFLER

Skills

Languages

🇮🇹	Italian	Native
🇬🇧	English	C1
🇩🇪	German	A1

Technical

- **Programming languages**: C++, Python, C, C#, MATLAB, JavaScript, PROLOG, SQL, Lua, LaTeX
- **Operative Systems**: Linux, Windows
- **Tools**: CUDA Programming, Git, DL frameworks (Pytorch, Keras, Tensorflow, W&B, Optuna, Hydra), Game engines (Blender, Unity, Godot)
- **Hardware**: Basler Cameras, Gardasoft Light controller

Soft

- **Inter-personal**: Critical-thinking, Pro-active, Friendly
- **Organizational**: Punctuality, Sense of responsibility, Planning, Flexibility

Interests

- Videogame developing: 3D Modeling, Animations, Videogame programming
- Math and physics private lessons