PORTFOLIO - ELENA CAMUFFO

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Relevant Works

1. **CLAYCODE (2025)** [1] - *TOG, oral @ SIGGRAPH 2025, featured in technical papers' video* **[link]**

   - Stylable 2D scannable codes: Claycodes allow extensive visual customization (colour, shape, patterns) without compromising their machine-readability.
   - Topology-based encoding & decoding: Instead of a rigid grid, data is mapped into a tree-like structure of nested regions; decoding recovers shape and semantics from a single image.
   - High robustness to deformation: designed to work well on non-planar surfaces and under heavy visual distortion, Claycode outperforms QR/barcodes in challenging conditions.
   - **Project Page [link] | Paper [link]**

2. **SEMANTIC DRIVEN OPTIMIZATION IN 3D GAUSSIAN SPLATTING (2025)** [2]

   - Semantic-aware LOD adaptation: dynamically adjust level of detail per object in a scene using semantics in 3D Gaussian Splatting.
   - Balances memory and computational demands by reducing details on background while preserving target visual quality.
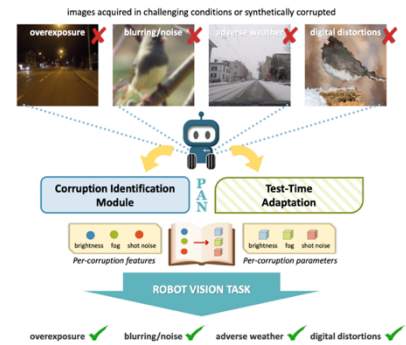   - **Paper [link]**
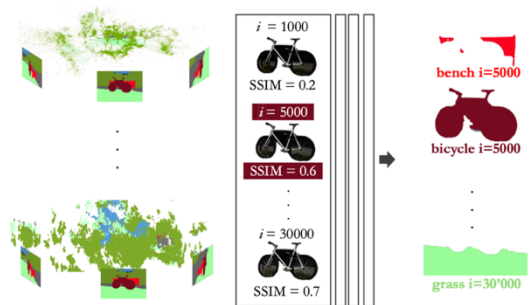
3. ROBUSTNESS TO INPUT CORRUPTIONS (2024) [3,4]

- Enhance robustness of vision systems by dynamically adjusting normalization layer statistics based on identified types of input corruption.
- Leading to improved performance across various robotic vision tasks.
- Research completed at **SAMSUNG UK**, resulting in 2 papers **[IROS | ICASSP]** + patent filing **[link]**.

4. SCAN-TO-BIM VIA FEW-SHOT SEGMENTATION (2023) [5]

- Fully automated pipeline for Scan-to-BIM (Building Information Modeling) workflows.
- Leveraging few-shot point cloud instance segmentation to efficiently convert raw 3D scans into structured BIM models for architectural and construction applications.
- Release of fully annotated point cloud dataset at instance level.
- **Project Page [link] | Paper [link]**
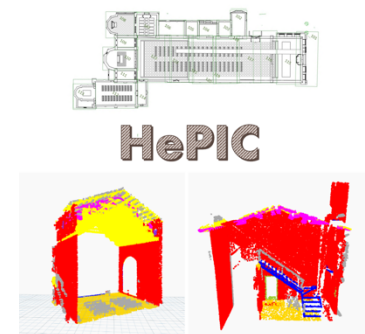
Research Summary

During my PhD my research has primarily focused on obtaining robust visual representation for various multimodal data in semantic scene understanding. My past work involved integrating different sensory inputs such as images and 3D data [5] and developing foundational learning strategies (such as continual learning, domain adaptation, model distillation, few-shot learning, etc.) to obtain robust, scalable and adaptable AI systems [3,4]. Particularly, during my internship at Samsung I worked on developing efficient and portable solutions that can be easily integrated on-device.

Currently, I am leading a research team working on 3D Gaussian Splatting. We are exploring scalable approaches to trade-off the quality and complexity of 3D visualizations in extended reality scenarios [2].

Side Work and Future Goals

I am deeply passionate about Research and 3D Computer Graphics. In the past year, I studied at the BigRock Institute of Magic Technologies and successfully completed the Master in Computer Graphics, learning the basics of 3D Art and related software. Also, I worked on a personal project on 2D Scannable Codes that resulted in a publication as a journal paper at SIGGRAPH 2025. I am eager to learn the most I can about 3D Graphics from both technical and artistic perspectives and I am motivated to continue developing my career in this direction.

References

[1] Maida M, Crescini A., Perronet M, & **Camuffo, E.**, (2025). *Claycode: Stylable and Deformable 2D Scannable Codes*. In ACM Transactions on Graphics (TOG). **[oral at SIGGRAPH 2025, featured in technical papers video]**

[2] Schiavo, C., **Camuffo, E.**, & Milani S. (2025). *SAGE: Semantic-Driven Adaptive Gaussian Splatting in Extended Reality*. In Proceedings of the European Signal Processing Conference (EUSIPCO).

[3] **Camuffo, E.**, Michieli, U., Milani, S., Moon, J. J., & Ozay, M. (2024). *Enhanced Model Robustness to Input Corruptions by Per-corruption Adaptation of Normalization Statistics*. In Proceedings of the IEEE/RSJ International Conference on Intelligent Robots and Systems (IROS).

[4] **Camuffo, E.**, Michieli, U., Moon, J. J., Kim, D., & Ozay, M. (2023). *FFT-based Selection and Optimization of Statistics for Robust Recognition of Severely Corrupted Images*. In Proceedings of the IEEE International Conference on Acoustics, Speech, and Signal Processing (ICASSP).

[5] Campagnolo, D., **Camuffo, E.**, Michieli, U., Milani, S., & Giordano, A. (2023). *Fully Automated Scan-to-BIM via Point Cloud Instance Segmentation*. In Proceedings of the IEEE International Conference on Image Processing (ICIP).