FINAL EXAM
IMAGE PROCESSING AND PATTERN RECOGNITION

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Design of Pixel-Based Machine Learning Image Processing Architectures

Machine learning (ML) plays an important role in several areas of imaging. Pixel/voxel-based machine learning (PML) uses pixel/voxel values in images directly, instead of features calculated from segmented objects as input information. As result, it yields both to an accurate description of objects and to a better performance, since it bypasses feature calculation inaccuracies or segmentation.

Project: Introduce the design of one or more than one (fusion) of pixel-based machine learning algorithms aimed at enhanced detection and characterization of complex or subtle structures.

Describe in detail the following:

- Design aspects and principles of the proposed algorithm (s)
- Why Machine Learning using pixel values?
- Applied scenarios, domain of applicability.
- Figure-of-Merits (FOM)s, with emphasis on the following:
    - imaging performance parameters
    - speed
    - cost
    - power
    - computational efficiency
- Discuss advantages and limitations.
- Perform a comparison with its peers.
- Identify more than one technical, commercial sector where your design would apply. Typical areas would be the following:

Medical Imaging / Visualization: Help medical professionals interpret medical imaging and diagnose anomalies faster, computer-aided diagnosis.

- Law Enforcement & Security: Aid in surveillance & biometric authentication.
- Object recognition and classification: Space, Defense.
- Space Debris detection and assessment.

- Self-Driving Technology: Assist in detecting objects and mimicking human visual cues & interactions. Cars, drones, satellites.
- Gaming: Improving augmented reality and virtual reality gaming experiences.
- Image Restoration & Sharpening: Improve the quality of images or add popular filters etc.
- Pattern Recognition: Classify and recognize objects/patterns in images and understand contextual information.
- Image Retrieval

How could such systems/architectures enhance or disrupt the computer visualization and image processes?

Carefully summarized your findings.

Comments

You should follow the project guidelines report.

Next to each student name, his (her) contribution into the exam should be clearly stated. The exam grade consists of the following components:

1. Individual student contribution (not in width but in depth)

2. Integration of all student contributions into the project. A student may get involved in more than one area. In addition:

3. Technical merit.

4. Originality (not a criterion, but highly desirable).
5. Literature search.

REPORT/PROJECT GUIDELINES

Please, follow the Report Guidelines shown below, <u>when applicable.</u>

Report Guidelines: IEEE Format

Abstract: 50-100 Words *(in italic)*

I. Introduction
Literature Search (main body of references)

II. Problem Definition
Definition of an Area of Interest/Address Problems/needs/demand

III. Applied Methodology
Present Design Principles
Material Characterization
Systems Analysis/Procedures/Techniques

IV. Discussion
Advantages Disadvantages
Comparison with peers
Applications/Potential

V. Conclusion

VI. Acknowledgement

VII. Reference List (IEEE Format)
Examples

[1] Richard G. Priest and Steven R. Meier, "Polarimetric microfacet scattering theory with applications to absorptive and reflective surfaces" Optical Engineering, vol. 41, pp. 988– 993, May 2002.

[2] G. C. Giakos, "Multifusion Multispectral Lightwave Polarimetric Detection Principles and Systems", IEEE Transactions on Instrumentation and Measurement, vol. 55, no. 6, pp. 1904-1912, 2006.

Please, use figures and diagrams widely. Please, quote reporting information (reference) next to each figure (if applicable).