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Editorial

Cutting-Edge Advances in Image Information Processing

Pedro Couto [1,*] and Vítor Filipe [2,*]

[1] CITAB—Centre for the Research and Technology of Agro-Environmental and Biological Sciences, UTAD—University of Trás-os-Montes e Alto Douro, Quinta de Prados, 5001-801 Vila Real, Portugal
[2] INESC TEC—Institute for Systems and Computer Engineering Technology and Science, UTAD—University of Trás-os-Montes e Alto Douro, Quinta de Prados, 5001-801 Vila Real, Portugal
* Correspondence: pcouto@utad.pt (P.C.); vfilipe@utad.pt (V.F.)

Image information processing relates to a set of techniques with a diverse range of applications that have been developed over the last 30 years. They deal with the analysis, manipulation, and understanding of images and have many applications in a growing number of domains, such as medical imaging, industrial applications, security and surveillance solutions, social media and e-commerce applications, etc.

The field of image information processing has grown significantly in recent decades due to several factors, such as the availability of large volumes of data, the increase in computational power, the increasing adoption of cloud-based services and platforms, and the recent advances in artificial intelligence, machine learning, and deep learning technologies. These factors have enabled the establishment of more powerful and efficient image processing algorithms and models. The image information processing market is expected to grow substantially in the next few years.

This Special Issue showcases the latest advances in image information processing techniques and their contributions to a wide range of fields. It allows interested readers to foresee the future trends and challenges of the field and practice. This Special Issue features five articles that address object detection and tracking, feature extraction and classification, semantic segmentation, stereo matching, and image reconstruction in the fields of medical imaging, 3D image reconstruction, space surveillance, etc.

Cone Beam Computed Tomography (CBCT) is a technique that uses X-rays to create three-dimensional images of the prostate and surrounding tissues. CBCT Radiomics is a field of study that uses CBCT images to extract quantitative features that describe the characteristics of prostate cancer. These features can be used to classify, predict, and evaluate the prognosis and treatment response of prostate cancer patients [1]. Mendes et al. [1] showed that CBCT Radiomics features could distinguish between favorable and unfavorable prognosis groups with an area under the receiver operating characteristic curve (AUROC) of 0.791. CBCT Radiomics for prostate cancer is an emerging and promising field in medical imaging.

Zhu et al. [2] proposed a novel algorithm for stereo matching that can achieve similar or better performance than existing state-of-the-art methods while being faster and simpler. Stereo matching is a technique used to estimate the depth of a scene from two images taken from different viewpoints by finding corresponding pixels in the two images. This is commonly carried out by constructing a cost volume that is aggregated, which is a crucial step that smooths the cost values to reduce noise and preserve edges. The proposed algorithm is a simplified and efficient aggregation that does not depend on the texture or content of the images.

The rapid increase in space debris poses a risk to space activities, so it is vital to develop countermeasures in terms of space surveillance to prevent possible threats. Filho et al. [3] aimed to contribute to space surveillance by providing a novel and low-cost solution for detecting and tracking space debris. This work was part of the "Payload Camera Breadboard for Space Surveillance" research project that aimed to develop a low-cost camera device that could detect and track space debris from orbit. This work focused on defining the details of

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the camera device, such as the camera's optical design, image sensor characterization, and detectability performance.

Semantic segmentation is a technique that assigns a semantic category (e.g., person, tree, car, etc.) to each point in a point cloud, which is a 3D representation of the surface and structure of an object. Point clouds have many applications in fields such as autonomous driving and robot vision. Zhang et al. [4] propose a novel semi-supervised algorithm for the semantic segmentation of point clouds that can learn from both labeled and unlabeled data. The key feature of this algorithm is that it uses 3D shape information (e.g., size, orientation, curvature, topology, etc.) to segment the point clouds. The algorithm outperforms other state-of-the-art methods in terms of semantic segmentation quality by using 3D shapes as a key feature.

Computational ghost imaging is a technique that involves creating an image of an object by shining a series of random binary patterns on it and using a single-pixel detector. A new method for computational ghost imaging that uses sequenced random speckle patterns as the light source is proposed in [5]. Speckle patterns are patterns of bright and dark spots produced by laser light scattering from a rough surface. The authors of this study claim that using sequenced speckle patterns can improve image quality and more efficiently reduce computational time compared to conventional methods by exploiting the shape information of the object.

Image information processing has many applications in various fields and is expected to have a bright future with many challenges and opportunities. Some of the challenges and future directions of image information processing research are presented in the works featured in this Special Issue.

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