Editorial: Editor's challenge—image processing

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Editorial on the Research Topic
Editor's challenge—image processing

Nowadays, thanks to rapid technological progresses over the last decades, digital images and video sequences are ubiquitous in our daily personal and professional life, with many remarkable and successful applications and services. A key driver to research and development activities has been the objective to provide an ever-improving visual quality and user experience.

In particular, one of the next frontiers is to be able to deliver an immersive visual experience. More specifically, immersive applications aim at giving to the user the sense of being present and immersed in one location or environment, without being physically there. It often relies on technologies such as 360° omnidirectional video, multi-view video, volumetric video, or augmented/mixed/virtual reality. It is relevant in many compelling applications including entertainment, video conferencing, distance learning, healthcare and medicine, or cultural heritage. Note that it is also closely related to the notion of tele-presence.

In this context, related scientific challenges encompass a wide range of topics, including:

- Visual information processing, coding, denoising, enhancement, super-resolution
- Learning-based processing, coding, denoising, enhancement, super-resolution
- 360° videos, light fields, point clouds, volumetric imaging, holography
- High Dynamic Range, Wide Color Gamut
- Augmented Reality, Virtual Reality, metaverse
- Visual information transmission, low delay
- Immersive communications, interactivity
- Human perception and perceptually-inspired processing
- Visual quality assessment, aesthetic assessment
- Display technologies, head-mounted displays
- Video content management
- Multimedia security
- Low complexity implementations, energy efficiency, embedded solutions
- Datasets for new emerging modalities or specific application scenarios

This Research Topic includes three published articles.

Pérez et al., in their article entitled "*Emerging Immersive Communication Systems: Overview, Taxonomy, and Good Practices for QoE Assessment*", review existing immersive

communication systems and related user studies, with the goal of defining basic guidelines and testing methodologies for user studies. More specifically, the authors first introduce a new taxonomy to describe immersive communication systems. Next, a thorough analysis of QoE assessment methods is presented in the context of the proposed taxonomy. The authors find that most QoE methods follow a common structure, and then observe its effect on QoE features. Finally, best practices are proposed for assessing QoE in immersive communication systems, to contribute to future standardization efforts in this direction.

Isik et al., in the article "*LVAC: Learned volumetric attribute compression for point clouds using coordinate based networks*", consider the problem of point clouds compression. More specifically, the authors propose a new point cloud attribute compression framework, which exploits the decoded geometry as side information. For this purpose, point cloud attributes are compressed using Coordinate Based Networks (CBN), with an end-to-end optimization of a rate-distortion Lagrangian loss function. This approach allows for the interpolation of the reconstructed attributes continuously across space, and it leads to significant improvement in terms of fidelity reconstruction when compared to state-of-the-art baselines and the latest MPEG G-PCC standard. The authors also show the importance of properly normalizing the coefficients before quantization.

Allouche and Mitrea, in their article "*Video fingerprinting: Past, present, and future*", address a slightly different, but nonetheless very important Research Topic. Video fingerprinting, sometimes also referred to as content-based copy detection or near duplicate detection, addresses the problem of identifying duplicated and/or replicated versions of a given video sequence in a reference dataset. This Research Topic shares similarities with video indexing and video watermarking. The authors present an overview of the state-of-the-art in video fingerprinting, along with trends for future developments. They also discuss challenges brought by emerging video applications and the associated constraints in terms of content traceability.

I would like to extend my thanks to the authors who have contributed to this Research Topic, as well as to the reviewers for their invaluable evaluation of the submitted manuscripts in order to guarantee the highest scientific standard.

I am confident that this Research Topic on *Image Processing for Future Immersive Applications* will be of great interest to the image processing community and that it will inspire further advancement of this field, which still faces many scientific challenges, in order to bring exciting innovations and applications in the foreseeable future.

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