Point Cloud Processing and Compression

A point cloud is a set of 3D points that can be used to represent a 3D surface. Each point has a spatial position (x, y, z) and a vector of attributes, such as colors, material reflection, or normal. As point clouds are capable of reconstructing 3D objects or scenes, they have the potential to be widely used in various applications such as auto-driving and 6-degree virtual reality. The following properties of point cloud make the point cloud compression and processing become rather challenging. 1) Unstructured. The point cloud is a series of non-uniform sampled points. On the one hand, it makes the correlations among various points difficult to be utilized for compression. On the other hand, the convolutional neural network that is widely used in image/video processing cannot be applied to the point cloud processing. 2) Unordered. Unlike images and videos, point cloud is a set of points without specific order. Therefore, both the point cloud processing and compression algorithms need to be invariant to any permutations of the input point cloud. Recent years have witnessed considerable research efforts in point cloud processing and compression. Hence, the state-of-the-art in point cloud processing and compression is getting redefined. Yet, many research challenges still remain to be addressed. 1) Efficient compression framework to compress the point cloud especially the sparse point cloud is still an open problem. Both the traditional compression framework from MPEG and the end-to-end point cloud compression schemes are competing to be the state-of-the-art. 2) Simple yet efficient quality metrics to balance the trade-off between the geometry and the attribute that can reflect human perception are needed. Point cloud has two kinds of information: geometry and attribute. They have their own quality metrics individually. However, how do the qualities of geometry and attribute influence the overall quality of a point cloud is still unknown. A good quality metric is also important to guide the processing and compression algorithms. To have a better quality metric to the overall quality of point cloud needs more attention.3) Efficient deep learning network structures for point cloud object detection and segmentation are anticipated. The development of point cloud object detection and segmentation is still in an initial stage. More sophisticated and efficient algorithms are to be developed. 4) Large scale point cloud data set is limited for various point cloud tasks. The differences between point clouds captured by various equipment are larger than the images/videos. There is an urgent need to have some well captured and organized dataset to promote the development in this field. This special issue will provide a forum for the latest developments, innovations, and applications of point cloud processing and compression. Prospective authors are invited to submit original manuscripts on topics including, but not limited to:

- Novel 3D sensing and Point cloud capturing
- Novel point cloud compression framework
- New point cloud compression methods based on graph signal processing
- Learning-based point cloud compression scheme in traditional pipeline
- End-to-end point cloud compression scheme
- Perceptual friendly point cloud quality metrics

- Novel point cloud processing and compression algorithms based on perceptual friendly point cloud quality metric
- New network architectures for point cloud processing
- Novel loss function designs for point cloud processing
- Well captured large scale point cloud data set

Prospective authors should submit their manuscripts following the IEEE T-CSVT guidelines at https://ieee-cas.org/pubs/tcsvt/submit-manuscript. Authors should submit a PDF version of their complete manuscript to https://mc.manuscriptcentral.com/tcsvt according to the following schedule:

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Biography of Guest Editors:

Zhu Li is now an Associate Professor with the Dept of Computer Science & Electrical Engineering (CSEE), University of Missouri, Kansas City, and director of the NSF I/UCRC Center for Big Learning (CBL) at UMKC. He received his PhD in Electrical & Computer Engineering from Northwestern University, Evanston in 2004. He was AFOSR SFFP summer visiting faculty at the US Air Force Academy (USAFA), 2016, 2017, 2018 and 2020, with the UAV Research Center. He was Sr. Staff Researcher/Sr. Manager with Samsung Research America's Multimedia Standards Research Lab in Richardson, TX, 2012-2015, Sr. Staff Researcher/Media Analytics Lead with FutureWei (Huawei) Technology's Media Lab in Bridgewater, NJ, 2010~2012, an Assistant Professor with the Dept of Computing, The Hong Kong Polytechnic University from 2008 to 2010, and a Principal Staff Research Engineer with the Multimedia Research Lab (MRL), Motorola Labs, from 2000 to 2008. His research interests include point cloud and light field compression, graph signal processing and deep learning in the next gen visual compression, image processing and understanding. He has 47 issued or pending patents, 100+ publications in book chapters, journals, and conferences in these areas. He is an IEEE senior member, associate Editor-in-Chief for I*EEE Trans on Circuits & System for Video Tech*, associated editor for *IEEE Trans on Image Processing*(2020~), *IEEE Trans. on Multimedia* (2015-18), *IEEE Trans on Circuits & System for Video Technology* (2016-19). He serves on the steering committee member of IEEE ICME (2015-18), he is an elected member of the IEEE Multimedia Signal Processing (MMSP), IEEE Image, Video, and Multidimensional Signal

Processing (IVMSP), and IEEE Visual Signal Processing & Communication (VSPC) Tech Committees. He is program co-chair for IEEE Int'l Conf on Multimedia & Expo (ICME) 2019, and co-chaired the IEEE Visual Communication & Image Processing (VCIP) 2017. He received the Best Paper Award at IEEE Int'l Conf on Multimedia & Expo (ICME), Toronto, 2006, the Best Paper Award (DoCoMo Labs Innovative Paper) at IEEE Int'l Conf on Image Processing (ICIP), San Antonio, 2007.

Shan Liu (Senior Member, IEEE) received the B.Eng. degree in electronic engineering from Tsinghua University, and the M.S. and Ph.D. degrees in electrical engineering from the University of Southern California.

She was the Director of the Media Technology Division, MediaTek USA. She was with MERL, Sony, and IBM. She has been actively contributing to international standards over the last decade. She is currently a Tencent Distinguished Scientist and the General Manager of Tencent Media Lab. She has served as a Co-Editor for HEVC SCC and the emerging VVC. She had numerous technical contributions adopted into various standards, such as HEVC, VVC, OMAF, DASH, and PCC. At the same time, technologies and products developed by her and under her leadership are serving over 100 million daily active users. She has published more than 80 journal and conference papers. She holds more than 150 granted U.S. and global patents. Her research interests include audiovisual, high volume, immersive and emerging media compression, intelligence, transport, and systems. She served on the Industrial Relations Committee of the IEEE Signal Processing Society from 2014 to 2015. She is serving on the Editorial Board of the IEEE TRANSACTIONS ON CIRCUITS AND SYSTEMS FOR VIDEO TECHNOLOGY for the period of 2018–2021. She was the Vice President of the Industrial Relations and Development of the Asia–Pacific Signal and Information Processing Association from 2016 to 2017. She was named the APSIPA Industrial Distinguished Leader in 2018. She was appointed as the Vice Chair for the IEEE Data Compression Standards Committee in 2019.

Frederic Dufaux is a CNRS Research Director at Université Paris-Saclay, CNRS, CentraleSupélec, Laboratoire des Signaux et Systèmes (L2S, UMR 8506), where he is head of the Telecom and Networking hub.

Frédéric received his M.Sc. in physics and Ph.D. in electrical engineering from EPFL in 1990 and 1994 respectively. He has over 20 years of experience in research, previously holding positions at EPFL, Emitall Surveillance, Genimedia, Compaq, Digital Equipment, and MIT. He was also Editor-in-Chief of Signal Processing: Image Communication from 2010 until 2019.

Frederic is a Fellow of IEEE. He was Chair of the IEEE SPS Multimedia Signal Processing (MMSP) Technical Committee in 2018 and 2019. He is a member of the IEEE SPS Technical Directions Board. He was Vice General Chair of ICIP 2014, General Chair of MMSP 2018, and Technical Program Co-Chair of ICIP 2019. He will be Technical Program Co-Chair of ICIP 2021. He is also a founding member and the Chair of the EURASIP Technical Area Committee on Visual Information Processing.

Frederic has been involved in the standardization of digital video and imaging technologies for more than 15 years, participating both in the MPEG and JPEG committees. He was co-chairman of JPEG 2000 over wireless (JPWL) and co-chairman of JPSearch. He is the recipient of two ISO awards for these contributions.

His research interests include image and video coding, 3D video, high dynamic range imaging, visual quality assessment, video surveillance, privacy protection, image and video analysis, multimedia content search and retrieval, and video transmission over wireless network. He is author or co-author of 3 books, more than 200 research publications and 20 patents issued or pending.

Li Li (Member IEEE) received the B.S. and Ph.D. degrees in electronic engineering from the University of Science and Technology of China (USTC), Hefei, Anhui, China, in 2011 and 2016, respectively. He is currently an associate professor in the University of Science and Technology of China. He was a visiting assistant professor in University of Missouri-Kansas City from 2016 to 2020.

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Dr. C.-C. Jay Kuo is Director of the Multimedia Communication Lab. and Distinguished Professor of Electrical Engineering and Computer Science at USC. His research interests are in the areas of multimedia compression and communication, multimedia content analysis and computer vision. He has guided 155 students to their PhD degrees and supervised 30 postdoctoral research fellows. He is a co-author of about 300 journal papers, 950 conference papers, 30 patents, and 14 books. He delivered 750 invited lectures in conferences, research institutes, universities and companies. Dr. Kuo was Editor-in-Chief for the IEEE Transactions on Information Forensics and Security (2012-2014) and the Journal of Visual Communication and

Image Representation (1997-2011). He was on the Editorial Board of the IEEE Signal Processing Magazine (2003-2004), IEEE Transactions on Speech and Audio Processing (2001-2003), IEEE Transactions on Image Processing (1995-98) and IEEE Transactions on Circuits and Systems for Video Technology (1995-1997). He was an IEEE Signal Processing Society Distinguished Lecturer (2006-2007). He was President of Asia-Pacific Signal and Information Processing Association (APSIPA) in 2013-2014. Dr. Kuo received recognitions and awards for his outstanding research and education contributions, including the 2010 Electronic Imaging Scientist of the Year Award, the 2010-11 Fulbright-Nokia Distinguished Chair in Information and Communications Technologies,the 2016 IEEE Computer Society Taylor L. Booth Education Award, the 2016 IEEE Circuits and Systems Society John Choma Education Award, the 2016 IS&T Raymond C. Bowman Award, the 2017 IEEE Leon K. Kirchmayer Graduate Teaching Award, the 2017 IEEE Signal Processing Society Carl Friedrich Gauss Education Award, the 2019 IEEE Computer Society Edward J. McCluskey Technical Achievement Award, the 2019 IEEE Signal Processing Society Claude Shannon-Harry Nyquist Technical Achievement Award and the 2020 IEEE TCMC Impact Award. Dr. Kuo is a Fellow of AAAS, IEEE and SPIE.