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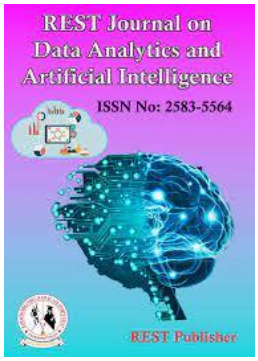

Survey On Parameters of Data Compression

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Abstract: *The rapid development in the hardware and the software gives rise to data growth. This data growth has numerous impacts, including the need for a larger storage capacity for storing and transmitting. Data compression is needed in today's world because it helps to minimize the amount of storage space required to store and transmit data. Performance measures in data compression are used to evaluate the efficiency and effectiveness of data compression algorithms. In recent times, numerous data compression algorithms are developed to reduce data storage and increase transmission speed in this internet era. In order to analyses how data compression performance is measured in terms of text, image, audio, and video compressions. This survey presents discussion made for important data compression parameters according to their data types.*

Key words: *Compression ratio, Data, Text, Image, Audio & Video*.

1. INTRODUCTION

Compression is the procedure of using encoding techniques to minimize the volume of data required for the storage or transmission of a specific piece of information (text, image, audio, or video). In a computer system, data compression is employed for storing data in a format that uses minimal storage space than the original version. Data compression requires the use of specialized software programmers that compress the data and restore it to its original size. Lossy or lossless data compression is the two main types. If the recovered data are taken to be identical to the source, the compression technique is said to be lossless; otherwise, it is said to be energy inefficient. For applications requiring textual data, lossless compression techniques are essential because, in the most extreme case scenario, losing a single character can cause the text to become dangerously false [1]. There are many ways to analyse how data compression methods function. We can gauge the algorithmic difficulty, computational memory usage, processing speed, level of data compression, and reconstruction quality. Compression Ratio (CR) is the formula used the most frequently to determine how effective a compression technique is and it described as the proportion of the total number of bits needed to store compressed data to uncompressed data [1]. The technique of encoding information with lesser details than the original version is known as data compression. It is used to minimize the file size, allowing them to be transmitted or stored more efficiently. There are various types of data that can be compressed, including text, images, audio, and video. Different data compression algorithms are used for different types of data, and the specific algorithm used will depend on the characteristics of the data being compressed and the specific application for which the compressed data will be used. Data compression algorithms typically operate by identifying and exploiting redundancy or patterns in the data. For instance, a text compression algorithm may find and encode frequently occurring words or phrases more efficiently, while an image compression algorithm might identify and encode patterns of pixels that are similar to each other [2].

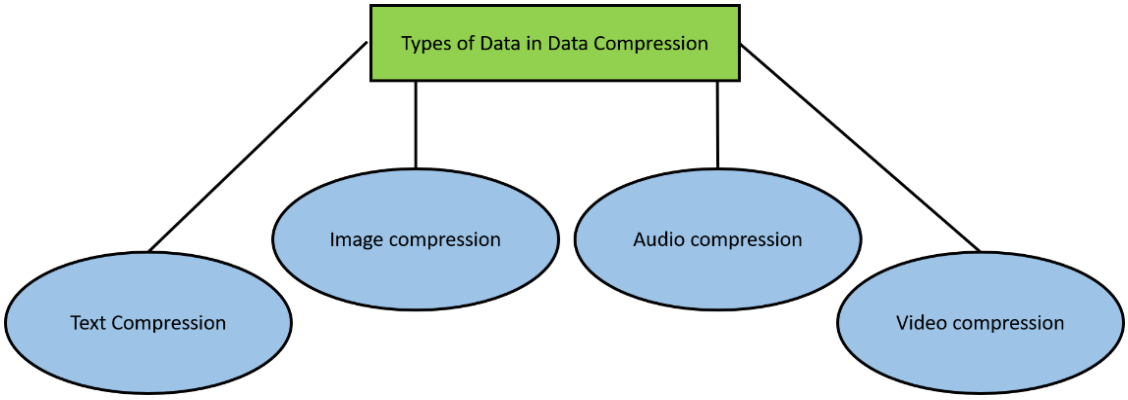

FIGURE 1. Data compression data types

2. RELATED WORKS

One of the most important areas of research is text compression, and many text compression methods have already been created. Given how much more bandwidth is being used online, this is a serious problem. In order to obtain an outstanding compression ratio, in this work Burrows-Wheeler transform approach and pattern matching-based lossless text compression technique using Huffman coding is suggested [4]. In many pipelines for image processing and computer vision, picture compression is a crucial step. Sometimes, the purpose of compression is to deliver visuals that, given a certain compression ratio, a human observer would consider as having excellent quality [5]. Since the human eye cannot distinguish these variations, the process enhances the compression ratio while keeping significant data that is roughly equivalent to the original data [6]. Mean Square Error (MSE), Peak Signal to Noise Ratio (PSNR) and Bits Per Pixel (BPP), and are a few parameters used to gauge the quality of an image [7]. Uses the MSE, PSNR, and correlation coefficient (CC) metrics to assess the quality of the decrypted image in each situation [8]. Performance data is presented using quantitative measurements in the form of numbers. To evaluate the effectiveness of compression techniques statistical measures or tools are used [3]. To assess the audio compression performance measurements like Signal-to-noise ratio (SNR) and Bits Per Second (BPS) were used [10]. CR and PSNR are employed to contrast the compression quality. The audio samples outcome proves that the suggested algorithm performs well. By altering various system settings, the compression ratio can be increased [11]. This is resource-intensive but direct and meaningful. In the compression community, objective techniques like MSE and PSNR are frequently employed as practical substitutes for subjective assessment [12]. We will utilise parameters to compare different video standards. We compare the size of the file after compression and compression time utilizing the generic compression standards [13]. PSNR and MS-SSIM metrics are employed to quantify the distortion of the reconstructed frames. Compared to PSNR, MS-SSIM has a stronger correlation with how humans perceive distortion. BPP is used to represent the necessary bits for each pixel in the current frame to compute the total bits required for encoding the representations [14].

3. PARAMETERS IN DATA COMPRESSION ACCORDING TO THEIR DATA TYPES

Data compression parameters are used to compute the effectiveness of the compression algorithms. There are different types of parameters in data compression according to their data types. They are text, image, audio and video compression parameters.

Text Compression: Text compression is the technique of encoding details utilizing lesser bits than the source version. It can be used to minimize the storage and transmission needs of text data. There are a variety of methods for text compression, including lossless and lossy methods. Lossless text compression methods allow you to reconstruct the original data exactly, while lossy methods allow for some loss of information in order to achieve a higher level of compression. Some common text compression algorithms include Huffman coding, Lempel-Ziv-Welch (LZW), and run-length encoding. Parameters in text compression algorithms are values that control the behavior of the compression process. These parameters can affect the efficiency of the compression, as well as the speed at which the compression and decompression process occurs. Some of the commonly used text compression parameters are Compression Ratio (CR), Compression Speed (CS), Decompression Speed (DS), Compression Percentage (CP) and Execution Time (ET) [4].

Compression Ratio: Compression algorithm efficiency is calculated using CR, it is the ratio of the source text size against the compressed text size. CR is calculated using Equation (1) [5].

$$\text{Compression Ratio} = \frac{\text{Original text size}}{\text{Compressed text size}} \quad (1)$$

Compression and Decompression Speed: The speed of compression and decompression (also known as encoding and decoding) in data compression refers to the time it takes to convert data from its original form into a compressed form, and vice versa. The speed of these operations altered by a number of parameters such as the data size, the compression algorithm complexity, and the implementation optimization. In general, compression tends to be faster than decompression, since it is a one-way process and does not need to reconstruct the original data. However, the relative speed of compression and decompression can vary depending on the specific algorithm and implementation. Some algorithms may be optimized for faster compression at the expense of slower decompression, while others may be optimized for faster decompression at the expense of slower compression [6].

Compression Percentage: Compression percentage is computed by removing the compressed bits size from the source bit size, and then dividing the result by the before compression file size, its formula for computation is given in equation (2) [17].

$$\text{Percentage of Compression} = \frac{\text{Bits before compresion} - \text{Bits after compression}}{\text{Bits before compression}} * 100 \qquad (2)$$

Execution Time: The execution time in text compression mentions the time taken to complete the process of compression and decompression (also known as encoding and decoding text). The execution time is modified by the number of parameters such as text size, the compression algorithm complexity and implementation optimization [7].

Image compression: Image compression is a common method in practice to reduce the image file size. It is typically used to save storage space, reduce the time required to transmit images over the internet or other networks. Image compression works by identifying patterns in the image data and replacing them with smaller representations. Parameters are used in image compression to control the difference between image quality and file size. Various image compression algorithms and formats have different parameters that can be adjusted to achieve different levels of compression. Some of the commonly used image compression parameters are CR, CP and PSNR [8].

Pixel-to-noise ratio (**PSNR**): PSNR metric represents the quality of a reconstructed image while comparing with actual image that is commonly used in image processing to measure the image performance and compression algorithms, as well as other image processing techniques. PSNR is calculated by taking the proportion of the original signal's maximum possible power to the power of the distortion (difference between the actual and reconstructed signals). The high PSNR intimates the improved quality of the reconstructed signal [9]. PSNR is typically calculated as given in equation (3).

$$PSNR = 10 * \log10(MAX^2 / MSE) \qquad (3)$$

Audio compression: Audio compression is a method to reduce the digital audio file size, typically in order to save storage space, minimize the time required to transmit audio over the internet or other networks, or to reduce the cost of storing and distributing audio. Audio compression works by identifying patterns in the audio data and replacing them with smaller representations. Parameters that are commonly used in audio compression to control the trade-offs between file size and quality are compression ratio and SNR [10].

Signal-to-Noise ratio SNR: A higher SNR indicates a better quality signal with less noise, while a lower SNR indicates a poorer quality signal with more noise. Formula for calculating SNR is given in equation (4) [10].

$$SNR = 10 \times \log (signal / noise) \qquad (4)$$

Video compression: Video compression is the process of reducing the size of a video file, while maintaining as much of the original video quality as possible. This is done by eliminating redundant or unnecessary data and reducing the complexity of the data that needs to be stored. There are many different video compression algorithms and standards, each with its own trade-offs in terms of file size, quality, and computational complexity. Some popular video compression standards include H.264, H.265, and VP9. Some of the commonly used parameters for video compression are PSNR, SSIM , AVM and MS-SSIM [11].

Structural Similarity Index (SSIM): SSIM metric compares the originality of two images, checks the quality of the desired video compression algorithm by comparing the compressed video frames to the original video frames. The SSIM is calculated using the luminance, contrast, and structure of the images, and it is typically ranged from -1 to 1. In which the maximum value indicates the higher similarity among the images. SSIM is often used as a benchmark for evaluating the quality of video compression algorithms because it well compared with image quality in terms of human perception [12].

Multi-Scale Structural Similarity Index (MS-SSIM): An addition to the SSI, MS-SSIM for Motion Detection quality metric computes these metrics at different scales and associate them by equation 5 [40].

$$SSIM(x, y) = [lM(x, y)]\alpha M \cdot YM\, j=1\, [cj\ (x, y)]\beta j\ [sj\ (x, y)]\gamma j \qquad (5)$$

Artefact-based Video Metric (AVM): An artefact-based video quality metric AVM to estimate the reconstructed video quality. Formula for calculate AVM is given in equation (6) [11].

$$AVM\ (x,y) = \theta_1 A_b(x,y) + \theta_2 A_s(x,y) + \theta_3 A_e(x,y) \quad (6)$$

4. COMPARISON OF PARAMETERS FROM RECENT RESEARCH ARTICLES

TABLE 1. Parameter comparison of Text compression.

	Compression ratio	Compression Factor	Compression Percentage	BPP	RMSE	PSNR	Compression Time	Decompression Time	MSSIM
[13]	Yes	Yes	Yes						
[9]				Yes	Yes	Yes			
[14]	Yes					Yes	Yes		
[15]						Yes			
[16]						Yes			Yes
[17]	Yes								
[18]	Yes					Yes			
[19]					Yes	Yes			
[20]				Yes		Yes	Yes	Yes	Yes
[21]	Yes					Yes			
[22]	Yes								
[23]				Yes		Yes			

From the table 1, by comparing the parameters used in recent text compression research paper compression ratio and compression percentage are the most commonly used parameters.

TABLE 2. Parameter comparison of Image compression.

	Compression Ratio	Compression Speed	Decompression Speed	Compression Percentage	Execution time	Compression time	Decompression time	Compression Factor
[6]	Yes	Yes	Yes					
[24]				Yes				
[7]	Yes				Yes			
[5]	Yes					Yes	Yes	
[25]				Yes				
[26]	Yes							
[27]				Yes				
[28]	Yes							
[29]	Yes	Yes	Yes					
[30]	Yes			Yes		Yes	Yes	Yes
[31]	Yes	Yes	Yes	Yes				Yes

From the table 2, by comparing the parameters used in recent image compression research paper compression ratio and PSNR are the most commonly used parameters.

TABLE 3. Parameter comparison of Audio compression.

	SNR	CR	PSNR	Decoding Speed
[32]	Yes			
[33]		Yes	Yes	
[34]		Yes		Yes
[35]		Yes		
[36]	Yes			
[37]	Yes			
[38]	Yes			

From the table 3, by comparing the parameters used in recent audio compression research paper compression ratio, PSNR and SNR are the most commonly used parameters.

Table 4. Parameter comparison of Video compression.

	PSNR	SSIM	AVM	MS-SSIM	Compression ratio
[11]	Yes	Yes	Yes		
[39]	Yes	Yes			
[40]				Yes	
[41]	Yes			Yes	
[12]	Yes	Yes			
[42]	Yes	Yes			
[43]	Yes				Yes

From the table 4, by comparing the parameters used in recent video compression research paper PSNR and SSIM are the most commonly used parameters.

5. CONCLUSION

Data Compression (DC) approaches are crucial to manage the enormous volume of data generated in diverse structures in the digital world, still, now there is no proper universal DC strategy for efficiently compressing the multiple data formats in various applications. In order to compress different kinds of data, including textual, audio, video, and photos, a number of DC techniques are proposed. DC algorithm performance are explored in different perspectives. The algorithmic difficulty, computational memory usage, processing speed, level of data compression, and reconstruction quality can be measured. Compression ratio is the frequently used formula to determine the effectiveness of compression technique. This study describes and evaluates the most recent DC performance measures in text, image, audio, and video compression algorithms.

REFERENCES

[1]. U. Jayasankar, V. Thirumal, and D. Ponnurangam, "A survey on data compression techniques: From the perspective of data quality, coding schemes, data type and applications," *Journal of King Saud University - Computer and Information Sciences*, vol. 33, no. 2, pp. 119–140, Feb. 2021, doi: 10.1016/j.jksuci.2018.05.006.

[2]. M. Hosseini, "A Survey of Data Compression Algorithms and their Applications," 2012, doi: 10.13140/2.1.4360.9924.

[3]. S. Boopathiraja, V. Punitha, P. Kalavathi, and V. B. S. Prasath, "Computational 2D and 3D Medical Image Data Compression Models," *Arch Computat Methods Eng*, vol. 29, no. 2, pp. 975–1007, Mar. 2022, doi: 10.1007/s11831-021-09602-w.

[4]. Tanvi Patel, Judith Angela, Poonam Choudhary, Kruti Dangarwala, and Sad Vidhya Mandal Institue of Technology, "Survey of Text Compression Algorithms," *IJERT*, vol. V4, no. 03, p. IJERTV4IS030932, Mar. 2015, doi: 10.17577/IJERTV4IS030932.

[5]. Md. A. Rahman and M. Hamada, "Burrows–Wheeler Transform Based Lossless Text Compression Using Keys and Huffman Coding," *Symmetry*, vol. 12, no. 10, p. 1654, Oct. 2020, doi: 10.3390/sym12101654.

[6]. A. Habib, M. J. Islam, and M. S. Rahman, "A dictionary-based text compression technique using quaternary code," *Iran J Comput Sci*, vol. 3, no. 3, pp. 127–136, Sep. 2020, doi: 10.1007/s42044-019-00047-w.

[7]. C. Oswald and B. Sivaselvan, "An optimal text compression algorithm based on frequent pattern mining," *J Ambient Intell Human Comput*, vol. 9, no. 3, pp. 803–822, Jun. 2018, doi: 10.1007/s12652-017-0540-2.

[8]. M. Rehman, M. Sharif, and M. Raza, "Image Compression: A Survey," *RJASET*, vol. 7, no. 4, pp. 656–672, Jan. 2014, doi: 10.19026/rjaset.7.303.

[9]. M. H. Rasheed, O. M. Salih, M. M. Siddeq, and M. A. Rodrigues, "Image compression based on 2D Discrete Fourier Transform and matrix minimization algorithm," *Array*, vol. 6, p. 100024, Jul. 2020, doi: 10.1016/j.array.2020.100024.
[10]. U. Kr. Mondal and A. Debnath, "Developing a Dynamic Cluster Quantization based Lossless Audio Compression (DCQLAC)," *Multimed Tools Appl*, vol. 80, no. 6, pp. 8257–8280, Mar. 2021, doi: 10.1007/s11042-020-09886-3.
[11]. F. Zhang and D. R. Bull, "A Parametric Framework for Video Compression Using Region-Based Texture Models," *IEEE J. Sel. Top. Signal Process.*, vol. 5, no. 7, pp. 1378–1392, Nov. 2011, doi: 10.1109/JSTSP.2011.2165201.
[12]. J. W. Soh *et al.*, "Reduction of Video Compression Artifacts Based on Deep Temporal Networks," *IEEE Access*, vol. 6, pp. 63094–63106, 2018, doi: 10.1109/ACCESS.2018.2876864.
[13]. V. Koval, V. Yatskiv, I. Yakymenko, and D. Zahorodnia, "A Lossless Image Compression Algorithm Based On Group Encoding," in *2020 10th International Conference on Advanced Computer Information Technologies (ACIT)*, Deggendorf, Germany, Sep. 2020, pp. 871–874. doi: 10.1109/ACIT49673.2020.9208909.
[14]. C. T. Selvi, J. Amudha, and R. Sudhakar, "Medical image encryption and compression by adaptive sigma filterized synorr certificateless signcryptive Levenshtein entropy-coding-based deep neural learning," *Multimedia Systems*, vol. 27, no. 6, pp. 1059–1074, Dec. 2021, doi: 10.1007/s00530-021-00764-y.
[15]. H. M. Yasin and A. M. Abdulazeez, "Image Compression Based on Deep Learning: A Review," *AJRCoS*, pp. 62–76, May 2021, doi: 10.9734/ajrcos/2021/v8i130193.
[16]. J. Xu, J. Mou, J. Liu, and J. Hao, "The image compression–encryption algorithm based on the compression sensing and fractional-order chaotic system," *Vis Comput*, vol. 38, no. 5, pp. 1509–1526, May 2022, doi: 10.1007/s00371-021-02085-7.
[17]. A. Golts and Y. Y. Schechner, "Image compression optimized for 3D reconstruction by utilizing deep neural networks," *Journal of Visual Communication and Image Representation*, vol. 79, p. 103208, Aug. 2021, doi: 10.1016/j.jvcir.2021.103208.
[18]. K. Datta, B. Jana, and M. D. Chakraborty, "Two-layers robust data hiding scheme for highly compressed image exploiting AMBTC with difference expansion," *Journal of King Saud University - Computer and Information Sciences*, vol. 34, no. 8, pp. 5240–5260, Sep. 2022, doi: 10.1016/j.jksuci.2022.05.013.
[19]. O. M. Salih, M. H. Rasheed, M. M. Siddeq, and M. A. Rodrigues, "Image compression for quality 3D reconstruction," *Journal of King Saud University - Computer and Information Sciences*, vol. 34, no. 5, pp. 2271–2287, May 2022, doi: 10.1016/j.jksuci.2020.07.012.
[20]. D. Mishra, S. K. Singh, and R. K. Singh, "Wavelet-Based Deep Auto Encoder-Decoder (WDAED)-Based Image Compression," *IEEE Trans. Circuits Syst. Video Technol.*, vol. 31, no. 4, pp. 1452–1462, Apr. 2021, doi: 10.1109/TCSVT.2020.3010627.
[21]. K. Dimililer, "DCT-based medical image compression using machine learning," *SIViP*, vol. 16, no. 1, pp. 55–62, Feb. 2022, doi: 10.1007/s11760-021-01951-0.
[22]. G. Patidar, S. Kumar, and D. Kumar, "A Review on Medical Image Data Compression Techniques," in *2nd International Conference on Data, Engineering and Applications (IDEA)*, Bhopal, India, Feb. 2020, pp. 1–6. doi: 10.1109/IDEA49133.2020.9170679.
[23]. R. Krishnaswamy and S. NirmalaDevi, "EFFICIENT MEDICAL IMAGE COMPRESSION BASED ON INTEGER WAVELET TRANSFORM," in *2020 Sixth International Conference on Bio Signals, Images, and Instrumentation (ICBSII)*, Chennai, India, Feb. 2020, pp. 1–5. doi: 10.1109/ICBSII49132.2020.9167597.
[24]. T. A. Hilal and H. A. Hilal, "Arabic Text Lossless Compression by Characters Encoding," *Procedia Computer Science*, vol. 155, pp. 618–623, 2019, doi: 10.1016/j.procs.2019.08.087.
[25]. T. A. Hilal and H. A. Hilal, "Turkish Text Compression via Characters Encoding," *Procedia Computer Science*, vol. 175, pp. 286–291, 2020, doi: 10.1016/j.procs.2020.07.042.
[26]. F. Zhang *et al.*, "TADOC: Text analytics directly on compression," *The VLDB Journal*, vol. 30, no. 2, pp. 163–188, Mar. 2021, doi: 10.1007/s00778-020-00636-3.
[27]. B. Vijayalakshmi, "Lossless Text Compression Technique Based on Static Dictionary for Unicode Tamil Document".
[28]. T. Abu Hilal, H. Abu Hilal, and A. Abu Hilal, "Multistage Arabic and Turkish Text Compression via Characters Encoding and 7-Zip," *JUSPN*, vol. 15, no. 01, pp. 11–15, Mar. 2021, doi: 10.5383/JUSPN.15.01.002.
[29]. N. Jacob, P. Somvanshi, and R. Tornekar, "Comparative Analysis of Lossless Text Compression Techniques," *IJCA*, vol. 56, no. 3, pp. 17–21, Oct. 2012, doi: 10.5120/8871-2850.
[30]. Ph.D. Research Scholar, Department of Computer Science, Vidyasagar College of Arts and Science, Udumalpet, Tamilnadu, India., B. Vijayalakshmi*, Dr. N. Sasirekha, and Associate Professor, Department of Computer Science, Vidyasagar College of Arts and Science, Udumalpet, Tamilnadu, India., "Lossless Tamil Compression using ASCII Substitution and Modified Huffman Encoding Technique," *IJRTE*, vol. 8, no. 6, pp. 2900–2906, Mar. 2020, doi: 10.35940/ijrte.F8177.038620.
[31]. B. Vijayalakshmi and D. N. Sasirekha, "Comparative Analysis of Lossless Text Compression Methods with Novel Tamil Compression Technique".
[32]. S. Kim, D. Jun, B.-G. Kim, S. Beack, M. Lee, and T. Lee, "Two-Dimensional Audio Compression Method Using Video Coding Schemes," *Electronics*, vol. 10, no. 9, p. 1094, May 2021, doi: 10.3390/electronics10091094.
[33]. S. Shukla, M. Ahirwar, R. Gupta, S. Jain, and D. S. Rajput, "Audio Compression Algorithm using Discrete Cosine Transform (DCT) and Lempel-Ziv-Welch (LZW) Encoding Method," in *2019 International Conference on Machine Learning, Big Data, Cloud and Parallel Computing (COMITCon)*, Faridabad, India, Feb. 2019, pp. 476–480. doi: 10.1109/COMITCon.2019.8862228.
[34]. T. Mineo and H. Shouno, "Improving sign-algorithm convergence rate using natural gradient for lossless audio compression," *J AUDIO SPEECH MUSIC PROC.*, vol. 2022, no. 1, p. 12, Dec. 2022, doi: 10.1186/s13636-022-00243-w.
[35]. G. C. da Silva Stanisce Corrêa, R. Pirk, and M. da Silva Pinho, "Lossy Audio Compression Applied to Launch Vehicle Acoustic Data," *J Astronaut Sci*, vol. 68, no. 2, pp. 535–548, Jun. 2021, doi: 10.1007/s40295-021-00257-0.
[36]. W. Tu, Y. Yang, B. Du, W. Yang, X. Zhang, and J. Zheng, "RNN-based signal classification for hybrid audio data compression," *Computing*, vol. 102, no. 3, pp. 813–827, Mar. 2020, doi: 10.1007/s00607-019-00713-8.

[37]. R. Banerjee, S. Chatterjee, and S. Das Bit, "An energy saving audio compression scheme for wireless multimedia sensor networks using spatio-temporal partial discrete wavelet transform," *Computers & Electrical Engineering*, vol. 48, pp. 389–404, Nov. 2015, doi: 10.1016/j.compeleceng.2015.09.009.
[38]. M. Sablatash and T. Cooklev, "Compression of High-Quality Audio Signals, Including Recent Methods Using Wavelet Packets," *Digital Signal Processing*, vol. 6, no. 2, pp. 96–107, Apr. 1996, doi: 10.1006/dspr.1996.0010.
[39]. S. Chen, Q. Liu, and Y. Yang, "Adaptive Multi-Modality Residual Network for Compression Distorted Multi-View Depth Video Enhancement," *IEEE Access*, vol. 8, pp. 97072–97081, 2020, doi: 10.1109/ACCESS.2020.2996258.
[40]. W. Park and M. Kim, "Deep Predictive Video Compression Using Mode-Selective Uni- and Bi-Directional Predictions Based on Multi-Frame Hypothesis," *IEEE Access*, vol. 9, pp. 72–85, 2021, doi: 10.1109/ACCESS.2020.3046040.
[41]. G. Lu, X. Zhang, W. Ouyang, L. Chen, Z. Gao, and D. Xu, "An End-to-End Learning Framework for Video Compression," *IEEE Trans. Pattern Anal. Mach. Intell.*, vol. 43, no. 10, pp. 3292–3308, Oct. 2021, doi: 10.1109/TPAMI.2020.2988453.
[42]. B. Wang, Q. Peng, E. Wang, K. Han, and W. Xiang, "Region-of-Interest Compression and View Synthesis for Light Field Video Streaming," *IEEE Access*, vol. 7, pp. 41183–41192, 2019, doi: 10.1109/ACCESS.2019.2907572.
[43]. H. Kim and H.-J. Lee, "A low-power surveillance video coding system with early background subtraction and adaptive frame memory compression," *IEEE Trans. Consumer Electron.*, vol. 63, no. 4, pp. 359–367, Nov. 2017, doi: 10.1109/TCE.2017.015073.

