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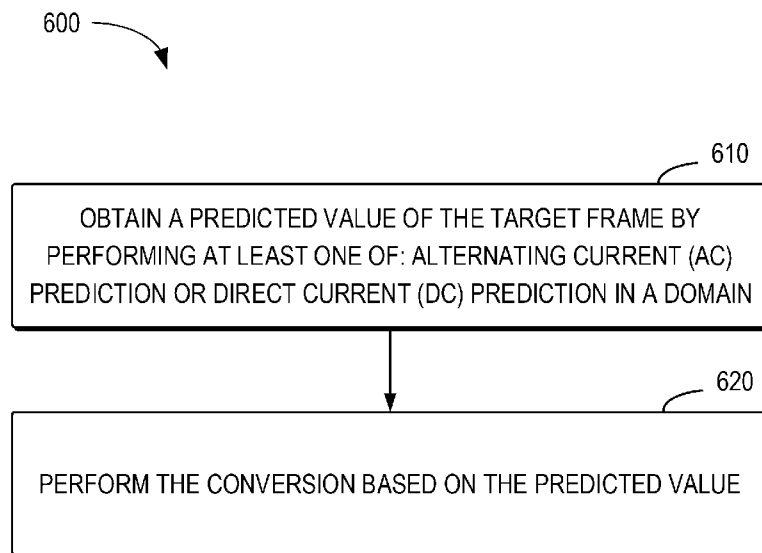


Fig. 6

(57) Abstract: Embodiments of the present disclosure provide a solution for video processing. A method for video processing is proposed. The method comprises: obtaining, for a conversion between a target frame of a point cloud sequence and a bitstream of the pointcloud sequence, a predicted value of the target frame by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain; and performing the conversion based on the predicted value.

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METHOD, APPARATUS, AND MEDIUM FOR VIDEO PROCESSING

FIELDS

[0001] Embodiments of the present disclosure relates generally to video processing techniques, and more particularly, to attribute prediction based on region-adaptive hierarchical transform (RAHT).

BACKGROUND

[0002] A point cloud is a collection of individual data points in a three-dimensional (3D) plane with each point having a set coordinate on the X, Y, and Z axes. Thus, a point cloud may be used to represent the physical content of the three-dimensional space. Point clouds have shown to be a promising way to represent 3D visual data for a wide range of immersive applications, from augmented reality to autonomous cars.

[0003] Point cloud coding standards have evolved primarily through the development of the well-known MPEG organization. MPEG, short for Moving Picture Experts Group, is one of the main standardization groups dealing with multimedia. In 2017, the MPEG 3D Graphics Coding group (3DG) published a call for proposals (CFP) document to start to develop point cloud coding standard. The final standard will consist in two classes of solutions. Video-based Point Cloud Compression (V-PCC or VPCC) is appropriate for point sets with a relatively uniform distribution of points. Geometry-based Point Cloud Compression (G-PCC or GPCC) is appropriate for more sparse distributions. However, coding efficiency of conventional point cloud coding techniques is generally expected to be further improved.

SUMMARY

[0004] Embodiments of the present disclosure provide a solution for video processing.

[0005] In a first aspect, a method for video processing is proposed. The method comprises: obtaining, for a conversion between a target frame of a point cloud sequence and a bitstream of the point cloud sequence, a predicted value of the target frame by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain; and performing the conversion based on the predicted value. In this way, it can improve accuracy of the prediction value and improve prediction efficiency.

[0006] In a second aspect, an apparatus for video processing is proposed. The apparatus comprises a processor and a non-transitory memory with instructions thereon. The instructions upon execution by the processor, cause the processor to perform a method in accordance with the first aspect of the present disclosure.

5 [0007] In a third aspect, a non-transitory computer-readable storage medium is proposed. The non-transitory computer-readable storage medium stores instructions that cause a processor to perform a method in accordance with the first aspect of the present disclosure.

[0008] In a fourth aspect, another non-transitory computer-readable recording medium
10 is proposed. The non-transitory computer-readable recording medium stores a bitstream of a video which is generated by a method performed by an apparatus for video processing. The method comprises: obtaining a predicted value of a target frame of a point cloud sequence by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain; and generating the bitstream based on the predicted
15 value.

[0009] In a fifth aspect, a method for storing a bitstream of a video is proposed. The method comprises: obtaining a predicted value of a target frame of a point cloud sequence by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain; generating the bitstream based on the predicted value; and storing
20 the bitstream in a non-transitory computer-readable recording medium.

[0010] This Summary is provided to introduce a selection of concepts in a simplified form that are further described below in the Detailed Description. This Summary is not intended to identify key features or essential features of the claimed subject matter, nor is it intended to be used to limit the scope of the claimed subject matter.

25 BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Through the following detailed description with reference to the accompanying drawings, the above and other objectives, features, and advantages of example embodiments of the present disclosure will become more apparent. In the example embodiments of the present disclosure, the same reference numerals usually refer to the
30 same components.

[0012] Fig. 1 illustrates a block diagram that illustrates an example video coding system,

in accordance with some embodiments of the present disclosure;

[0013] Fig. 2 illustrates a block diagram that illustrates a first example video encoder, in accordance with some embodiments of the present disclosure;

[0014] Fig. 3 illustrates a block diagram that illustrates an example video decoder, in accordance with some embodiments of the present disclosure;

[0015] Fig. 4 shows 7 parent-level nodes for each sub-node of transform unit node;

[0016] Fig. 5 shows an example of the coding flow for the improved inter prediction of AC coefficients;

[0017] Fig. 6 illustrates a flowchart of a method for video processing in accordance with embodiments of the present disclosure; and

[0018] Fig. 7 illustrates a block diagram of a computing device in which various embodiments of the present disclosure can be implemented.

[0019] Throughout the drawings, the same or similar reference numerals usually refer to the same or similar elements.

15 DETAILED DESCRIPTION

[0020] Principle of the present disclosure will now be described with reference to some embodiments. It is to be understood that these embodiments are described only for the purpose of illustration and help those skilled in the art to understand and implement the present disclosure, without suggesting any limitation as to the scope of the disclosure.

20 The disclosure described herein can be implemented in various manners other than the ones described below.

[0021] In the following description and claims, unless defined otherwise, all technical and scientific terms used herein have the same meaning as commonly understood by one of ordinary skills in the art to which this disclosure belongs.

25 [0022] References in the present disclosure to “one embodiment,” “an embodiment,” “an example embodiment,” and the like indicate that the embodiment described may include a particular feature, structure, or characteristic, but it is not necessary that every embodiment includes the particular feature, structure, or characteristic. Moreover, such phrases are not necessarily referring to the same embodiment. Further, when a particular
30 feature, structure, or characteristic is described in connection with an example

embodiment, it is submitted that it is within the knowledge of one skilled in the art to affect such feature, structure, or characteristic in connection with other embodiments whether or not explicitly described.

[0023] It shall be understood that although the terms “first” and “second” etc. may be used herein to describe various elements, these elements should not be limited by these terms. These terms are only used to distinguish one element from another. For example, a first element could be termed a second element, and similarly, a second element could be termed a first element, without departing from the scope of example embodiments. As used herein, the term “and/or” includes any and all combinations of one or more of the listed terms.

[0024] The terminology used herein is for the purpose of describing particular embodiments only and is not intended to be limiting of example embodiments. As used herein, the singular forms “a”, “an” and “the” are intended to include the plural forms as well, unless the context clearly indicates otherwise. It will be further understood that the terms “comprises”, “comprising”, “has”, “having”, “includes” and/or “including”, when used herein, specify the presence of stated features, elements, and/or components etc., but do not preclude the presence or addition of one or more other features, elements, components and/or combinations thereof.

Example Environment

[0025] Fig. 1 is a block diagram that illustrates an example point cloud coding system 100 that may utilize the techniques of the present disclosure. As shown, the point cloud coding system 100 may include a source device 110 and a destination device 120. The source device 110 can be also referred to as a point cloud encoding device, and the destination device 120 can be also referred to as a point cloud decoding device. In operation, the source device 110 can be configured to generate encoded point cloud data and the destination device 120 can be configured to decode the encoded point cloud data generated by the source device 110. The techniques of this disclosure are generally directed to coding (encoding and/or decoding) point cloud data, i.e., to support point cloud compression. The coding may be effective in compressing and/or decompressing point cloud data.

[0026] Source device 100 and destination device 120 may comprise any of a wide range of devices, including desktop computers, notebook (i.e., laptop) computers, tablet

computers, set-top boxes, telephone handsets such as smartphones and mobile phones, televisions, cameras, display devices, digital media players, video gaming consoles, video streaming devices, vehicles (e.g., terrestrial or marine vehicles, spacecraft, aircraft, etc.), robots, LIDAR devices, satellites, extended reality devices, or the like. In some cases, source device 100 and destination device 120 may be equipped for wireless communication.

[0027] The source device 100 may include a data source 112, a memory 114, a GPCC encoder 116, and an input/output (I/O) interface 118. The destination device 120 may include an input/output (I/O) interface 128, a GPCC decoder 126, a memory 124, and a data consumer 122. In accordance with this disclosure, GPCC encoder 116 of source device 100 and GPCC decoder 126 of destination device 120 may be configured to apply the techniques of this disclosure related to point cloud coding. Thus, source device 100 represents an example of an encoding device, while destination device 120 represents an example of a decoding device. In other examples, source device 100 and destination device 120 may include other components or arrangements. For example, source device 100 may receive data (e.g., point cloud data) from an internal or external source. Likewise, destination device 120 may interface with an external data consumer, rather than include a data consumer in the same device.

[0028] In general, data source 112 represents a source of point cloud data (i.e., raw, unencoded point cloud data) and may provide a sequential series of “frames” of the point cloud data to GPCC encoder 116, which encodes point cloud data for the frames. In some examples, data source 112 generates the point cloud data. Data source 112 of source device 100 may include a point cloud capture device, such as any of a variety of cameras or sensors, e.g., one or more video cameras, an archive containing previously captured point cloud data, a 3D scanner or a light detection and ranging (LIDAR) device, and/or a data feed interface to receive point cloud data from a data content provider. Thus, in some examples, data source 112 may generate the point cloud data based on signals from a LIDAR apparatus. Alternatively or additionally, point cloud data may be computer-generated from scanner, camera, sensor or other data. For example, data source 112 may generate the point cloud data, or produce a combination of live point cloud data, archived point cloud data, and computer-generated point cloud data. In each case, GPCC encoder 116 encodes the captured, pre-captured, or computer-generated point cloud data. GPCC encoder 116 may rearrange frames of the point cloud data from the received order

(sometimes referred to as “display order”) into a coding order for coding. GPCC encoder 116 may generate one or more bitstreams including encoded point cloud data. Source device 100 may then output the encoded point cloud data via I/O interface 118 for reception and/or retrieval by, e.g., I/O interface 128 of destination device 120. The encoded point cloud data may be transmitted directly to destination device 120 via the I/O interface 118 through the network 130A. The encoded point cloud data may also be stored onto a storage medium/server 130B for access by destination device 120.

[0029] Memory 114 of source device 100 and memory 124 of destination device 120 may represent general purpose memories. In some examples, memory 114 and memory 124 may store raw point cloud data, e.g., raw point cloud data from data source 112 and raw, decoded point cloud data from GPCC decoder 126. Additionally or alternatively, memory 114 and memory 124 may store software instructions executable by, e.g., GPCC encoder 116 and GPCC decoder 126, respectively. Although memory 114 and memory 124 are shown separately from GPCC encoder 116 and GPCC decoder 126 in this example, it should be understood that GPCC encoder 116 and GPCC decoder 126 may also include internal memories for functionally similar or equivalent purposes. Furthermore, memory 114 and memory 124 may store encoded point cloud data, e.g., output from GPCC encoder 116 and input to GPCC decoder 126. In some examples, portions of memory 114 and memory 124 may be allocated as one or more buffers, e.g., to store raw, decoded, and/or encoded point cloud data. For instance, memory 114 and memory 124 may store point cloud data.

[0030] I/O interface 118 and I/O interface 128 may represent wireless transmitters/receivers, modems, wired networking components (e.g., Ethernet cards), wireless communication components that operate according to any of a variety of IEEE 802.11 standards, or other physical components. In examples where I/O interface 118 and I/O interface 128 comprise wireless components, I/O interface 118 and I/O interface 128 may be configured to transfer data, such as encoded point cloud data, according to a cellular communication standard, such as 4G, 4G-LTE (Long-Term Evolution), LTE Advanced, 5G, or the like. In some examples where I/O interface 118 comprises a wireless transmitter, I/O interface 118 and I/O interface 128 may be configured to transfer data, such as encoded point cloud data, according to other wireless standards, such as an IEEE 802.11 specification. In some examples, source device 100 and/or destination device 120 may include respective system-on-a-chip (SoC) devices. For example, source device 100

may include an SoC device to perform the functionality attributed to GPCC encoder 116 and/or I/O interface 118, and destination device 120 may include an SoC device to perform the functionality attributed to GPCC decoder 126 and/or I/O interface 128.

[0031] The techniques of this disclosure may be applied to encoding and decoding in support of any of a variety of applications, such as communication between autonomous vehicles, communication between scanners, cameras, sensors and processing devices such as local or remote servers, geographic mapping, or other applications.

[0032] I/O interface 128 of destination device 120 receives an encoded bitstream from source device 110. The encoded bitstream may include signaling information defined by GPCC encoder 116, which is also used by GPCC decoder 126, such as syntax elements having values that represent a point cloud. Data consumer 122 uses the decoded data. For example, data consumer 122 may use the decoded point cloud data to determine the locations of physical objects. In some examples, data consumer 122 may comprise a display to present imagery based on the point cloud data.

[0033] GPCC encoder 116 and GPCC decoder 126 each may be implemented as any of a variety of suitable encoder and/or decoder circuitry, such as one or more microprocessors, digital signal processors (DSPs), application specific integrated circuits (ASICs), field programmable gate arrays (FPGAs), discrete logic, software, hardware, firmware or any combinations thereof. When the techniques are implemented partially in software, a device may store instructions for the software in a suitable, non-transitory computer-readable medium and execute the instructions in hardware using one or more processors to perform the techniques of this disclosure. Each of GPCC encoder 116 and GPCC decoder 126 may be included in one or more encoders or decoders, either of which may be integrated as part of a combined encoder/decoder (CODEC) in a respective device. A device including GPCC encoder 116 and/or GPCC decoder 126 may comprise one or more integrated circuits, microprocessors, and/or other types of devices.

[0034] GPCC encoder 116 and GPCC decoder 126 may operate according to a coding standard, such as video point cloud compression (VPCC) standard or a geometry point cloud compression (GPCC) standard. This disclosure may generally refer to coding (e.g., encoding and decoding) of frames to include the process of encoding or decoding data. An encoded bitstream generally includes a series of values for syntax elements representative of coding decisions (e.g., coding modes).

[0035] A point cloud may contain a set of points in a 3D space, and may have attributes associated with the point. The attributes may be color information such as R, G, B or Y, Cb, Cr, or reflectance information, or other attributes. Point clouds may be captured by a variety of cameras or sensors such as LIDAR sensors and 3D scanners and may also be computer-generated. Point cloud data are used in a variety of applications including, but not limited to, construction (modeling), graphics (3D models for visualizing and animation), and the automotive industry (LIDAR sensors used to help in navigation).

[0036] Fig. 2 is a block diagram illustrating an example of a GPCC encoder 200, which may be an example of the GPCC encoder 116 in the system 100 illustrated in Fig. 1, in accordance with some embodiments of the present disclosure. Fig. 3 is a block diagram illustrating an example of a GPCC decoder 300, which may be an example of the GPCC decoder 126 in the system 100 illustrated in Fig. 1, in accordance with some embodiments of the present disclosure.

[0037] In both GPCC encoder 200 and GPCC decoder 300, point cloud positions are coded first. Attribute coding depends on the decoded geometry. In Fig. 2 and Fig. 3, the region adaptive hierarchical transform (RAHT) unit 218, surface approximation analysis unit 212, RAHT unit 314 and surface approximation synthesis unit 310 are options typically used for Category 1 data. The level-of-detail (LOD) generation unit 220, lifting unit 222, LOD generation unit 316 and inverse lifting unit 318 are options typically used for Category 3 data. All the other units are common between Categories 1 and 3.

[0038] For Category 3 data, the compressed geometry is typically represented as an octree from the root all the way down to a leaf level of individual voxels. For Category 1 data, the compressed geometry is typically represented by a pruned octree (i.e., an octree from the root down to a leaf level of blocks larger than voxels) plus a model that approximates the surface within each leaf of the pruned octree. In this way, both Category 1 and 3 data share the octree coding mechanism, while Category 1 data may in addition approximate the voxels within each leaf with a surface model. The surface model used is a triangulation comprising 1-10 triangles per block, resulting in a triangle soup. The Category 1 geometry codec is therefore known as the Trisoup geometry codec, while the Category 3 geometry codec is known as the Octree geometry codec.

[0039] In the example of Fig. 2, GPCC encoder 200 may include a coordinate transform unit 202, a color transform unit 204, a voxelization unit 206, an attribute transfer unit 208,

an octree analysis unit 210, a surface approximation analysis unit 212, an arithmetic encoding unit 214, a geometry reconstruction unit 216, an RAHT unit 218, a LOD generation unit 220, a lifting unit 222, a coefficient quantization unit 224, and an arithmetic encoding unit 226.

5 [0040] As shown in the example of Fig. 2, GPCC encoder 200 may receive a set of positions and a set of attributes. The positions may include coordinates of points in a point cloud. The attributes may include information about points in the point cloud, such as colors associated with points in the point cloud.

10 [0041] Coordinate transform unit 202 may apply a transform to the coordinates of the points to transform the coordinates from an initial domain to a transform domain. This disclosure may refer to the transformed coordinates as transform coordinates. Color transform unit 204 may apply a transform to convert color information of the attributes to a different domain. For example, color transform unit 204 may convert color information from an RGB color space to a YCbCr color space.

15 [0042] Furthermore, in the example of Fig. 2, voxelization unit 206 may voxelize the transform coordinates. Voxelization of the transform coordinates may include quantizing and removing some points of the point cloud. In other words, multiple points of the point cloud may be subsumed within a single “voxel,” which may thereafter be treated in some respects as one point. Furthermore, octree analysis unit 210 may generate an octree based on the voxelized transform coordinates. Additionally, in the example of Fig. 2, surface approximation analysis unit 212 may analyze the points to potentially determine a surface representation of sets of the points. Arithmetic encoding unit 214 may perform arithmetic encoding on syntax elements representing the information of the octree and/or surfaces determined by surface approximation analysis unit 212. GPCC encoder 200 may output
25 these syntax elements in a geometry bitstream.

[0043] Geometry reconstruction unit 216 may reconstruct transform coordinates of points in the point cloud based on the octree, data indicating the surfaces determined by surface approximation analysis unit 212, and/or other information. The number of transform coordinates reconstructed by geometry reconstruction unit 216 may be different
30 from the original number of points of the point cloud because of voxelization and surface approximation. This disclosure may refer to the resulting points as reconstructed points. Attribute transfer unit 208 may transfer attributes of the original points of the point cloud

to reconstructed points of the point cloud data.

[0044] Furthermore, RAHT unit 218 may apply RAHT coding to the attributes of the reconstructed points. Alternatively, or additionally, LOD generation unit 220 and lifting unit 222 may apply LOD processing and lifting, respectively, to the attributes of the reconstructed points. RAHT unit 218 and lifting unit 222 may generate coefficients based on the attributes. Coefficient quantization unit 224 may quantize the coefficients generated by RAHT unit 218 or lifting unit 222. Arithmetic encoding unit 226 may apply arithmetic coding to syntax elements representing the quantized coefficients. GPCC encoder 200 may output these syntax elements in an attribute bitstream.

[0045] In the example of Fig. 3, GPCC decoder 300 may include a geometry arithmetic decoding unit 302, an attribute arithmetic decoding unit 304, an octree synthesis unit 306, an inverse quantization unit 308, a surface approximation synthesis unit 310, a geometry reconstruction unit 312, a RAHT unit 314, a LOD generation unit 316, an inverse lifting unit 318, a coordinate inverse transform unit 320, and a color inverse transform unit 322.

[0046] GPCC decoder 300 may obtain a geometry bitstream and an attribute bitstream. Geometry arithmetic decoding unit 302 of decoder 300 may apply arithmetic decoding (e.g., CABAC or other type of arithmetic decoding) to syntax elements in the geometry bitstream. Similarly, attribute arithmetic decoding unit 304 may apply arithmetic decoding to syntax elements in attribute bitstream.

[0047] Octree synthesis unit 306 may synthesize an octree based on syntax elements parsed from geometry bitstream. In instances where surface approximation is used in geometry bitstream, surface approximation synthesis unit 310 may determine a surface model based on syntax elements parsed from geometry bitstream and based on the octree.

[0048] Furthermore, geometry reconstruction unit 312 may perform a reconstruction to determine coordinates of points in a point cloud. Coordinate inverse transform unit 320 may apply an inverse transform to the reconstructed coordinates to convert the reconstructed coordinates (positions) of the points in the point cloud from a transform domain back into an initial domain.

[0049] Additionally, in the example of Fig. 3, inverse quantization unit 308 may inverse quantize attribute values. The attribute values may be based on syntax elements obtained from attribute bitstream (e.g., including syntax elements decoded by attribute arithmetic

decoding unit 304).

[0050] Depending on how the attribute values are encoded, RAHT unit 314 may perform RAHT coding to determine, based on the inverse quantized attribute values, color values for points of the point cloud. Alternatively, LOD generation unit 316 and inverse
5 lifting unit 318 may determine color values for points of the point cloud using a level of detail-based technique.

[0051] Furthermore, in the example of Fig. 3, color inverse transform unit 322 may apply an inverse color transform to the color values. The inverse color transform may be an inverse of a color transform applied by color transform unit 204 of encoder 200. For
10 example, color transform unit 204 may transform color information from an RGB color space to a YCbCr color space. Accordingly, color inverse transform unit 322 may transform color information from the YCbCr color space to the RGB color space.

[0052] The various units of Fig. 2 and Fig. 3 are illustrated to assist with understanding the operations performed by encoder 200 and decoder 300. The units may be implemented
15 as fixed-function circuits, programmable circuits, or a combination thereof. Fixed-function circuits refer to circuits that provide particular functionality and are preset on the operations that can be performed. Programmable circuits refer to circuits that can be programmed to perform various tasks and provide flexible functionality in the operations that can be performed. For instance, programmable circuits may execute software or
20 firmware that cause the programmable circuits to operate in the manner defined by instructions of the software or firmware. Fixed-function circuits may execute software instructions (e.g., to receive parameters or output parameters), but the types of operations that the fixed-function circuits perform are generally immutable. In some examples, one or more of the units may be distinct circuit blocks (fixed-function or programmable), and
25 in some examples, one or more of the units may be integrated circuits.

[0053] Some exemplary embodiments of the present disclosure will be described in detailed hereinafter. It should be understood that section headings are used in the present document to facilitate ease of understanding and do not limit the embodiments disclosed in a section to only that section. Furthermore, while certain embodiments are described
30 with reference to GPCC or other specific point cloud codecs, the disclosed techniques are applicable to other point cloud coding technologies also. Furthermore, while some embodiments describe point cloud coding steps in detail, it will be understood that

corresponding steps decoding that undo the coding will be implemented by a decoder.

1. Brief Summary

The present disclosure is related to point cloud coding technologies. Specifically, it is related to point cloud attribute inter prediction in region-adaptive hierarchical transform. The ideas may be applied individually or in various combination, to any point cloud coding standard or non-standard point cloud codec, e.g., the being-developed Geometry based Point Cloud Compression (G-PCC).

2. Abbreviations

G-PCC	Geometry based Point Cloud Compression
MPEG	Moving Picture Experts Group
3DG	3D Graphics Coding Group
CFP	Call For Proposal
V-PCC	Video-based Point Cloud Compression
RAHT	Region-Adaptive Hierarchical Transform

3. Introduction

MPEG, short for Moving Picture Experts Group, is one of the main standardization groups dealing with multimedia. In 2017, the MPEG 3D Graphics Coding group (3DG) published a call for proposals (CFP) document to start to develop point cloud coding standard (MPEG 3DG and Requirements, “Call for Proposals for Point Cloud Compression V2”, ISO/IEC JTC1/SC29 WG11 N16763). The final standard will consist in two classes of solutions. Video-based Point Cloud Compression (V-PCC) is appropriate for point sets with a relatively uniform distribution of points (ISO/IEC JTC 1/SC 29/WG 07, “Information technology — Coded Representation of Immersive Media — Part 5: Visual Volumetric Video-based Coding (V3C) and Video-based Point Cloud Compression (V-PCC)”, ISO/IEC 23090-5). Geometry-based Point Cloud Compression (G-PCC) is appropriate for more sparse distributions (ISO/IEC JTC 1/SC 29/WG 11, “Information technology — MPEG-I (Coded Representation of Immersive Media) — Part 9: Geometry-based Point Cloud Compression”, ISO/IEC 23090-9:2020(E)). Both V-PCC and G-PCC support the coding and decoding for single point cloud and point cloud sequence.

In one point cloud, there may be geometry information and attribute information. Geometry information is used to describe the geometry locations of the data points. Attribute information is used to record some details of the data points, such as textures, normal vectors, reflections

and so on.

3.1 Region-Adaptive Hierarchical Transform

In G-PCC, one of important point cloud attribute coding tools is the Region-Adaptive Hierarchical Transform (RAHT). It is a transform that uses the attributes associated with a node in a lower level of the octree to predict the attributes of the nodes in the next level (Ricardo L. De Queiroz and Philip A. Chou, “Compression of 3D Point Clouds Using a Region-Adaptive Hierarchical Transform”, IEEE Transactions on Image Processing). It assumes that the positions of the points are given at both the encoder and decoder. RAHT follows the octree scan backwards, from leaf nodes to root node, at each step recombining nodes into larger ones until reaching the root node. At each level of octree, the nodes are processed in the Morton order. At each decomposition, instead of grouping eight nodes at a time, RAHT does it in three steps along each dimension, (e.g., along z, then y then x). If there are L levels in octree, RAHT takes $3L$ levels to traverse the tree backwards.

Let the nodes at level l be $g_{l,x,y,z}$, for x, y, z integers. $g_{l,x,y,z}$ was obtained by grouping $g_{l+1,2x,y,z}$ and $g_{l+1,2x+1,y,z}$, where the grouping along the first dimension was an example. RAHT only process occupied nodes. If one of the nodes in the pair is unoccupied, the other one is promoted to the next level, unprocessed, i.e., $g_{l-1,x,y,z} = g_{l,2x,y,z}$ if the latter is the occupied node of the pair. The grouping process is repeated until getting to the root. Note that the grouping process generates nodes at lower levels that are the result of grouping different numbers of voxels along the way. The number of nodes grouped to generate node $g_{l,x,y,z}$ is the weight $\omega_{l,x,y,z}$ of that node.

At every grouping of two nodes, say $g_{l,2x,y,z}$ and $g_{l,2x+1,y,z}$, with their respective weights, $\omega_{l,2x,y,z}$ and $\omega_{l,2x+1,y,z}$, RAHT apply the following transform:

$$\begin{bmatrix} g_{l-1,x,y,z} \\ h_{l-1,x,y,z} \end{bmatrix} = T_{\omega_1\omega_2} \begin{bmatrix} g_{l,2x,y,z} \\ h_{l,2x+1,y,z} \end{bmatrix},$$

where $\omega_1 = \omega_{l,2x,y,z}$ and $\omega_2 = \omega_{l,2x+1,y,z}$ and

$$T_{\omega_1\omega_2} = \frac{1}{\sqrt{\omega_1+\omega_2}} \begin{bmatrix} \sqrt{\omega_1} & \sqrt{\omega_2} \\ -\sqrt{\omega_2} & \sqrt{\omega_1} \end{bmatrix}.$$

Note that the transform matrix changes at all times, adapting to the weights, i.e., adapting to the number of leaf nodes that each $g_{l,x,y,z}$ actually represents. The quantities $g_{l,x,y,z}$ are used to group and compose further nodes at a lower level. $h_{l,x,y,z}$ are the actual high-pass coefficients generated by the transform to be encoded and transmitted. Furthermore, weights accumulate for the level above. In the above example,

$$\omega_{l-1,2,y,z} = \omega_{l,2x,y,z} + \omega_{l,2x+1,y,z}.$$

In the last stage, the tree root, the remaining two voxels $g_{1,0,0,0}$ and $g_{1,1,0,0}$ are transformed into the final two coefficients as:

$$\begin{bmatrix} g_{DC} \\ h_{0,0,0,0} \end{bmatrix} = T_{\omega_{1,0,0,0}\omega_{1,1,0,0}} \begin{bmatrix} g_{1,0,0,0} \\ g_{1,1,0,0} \end{bmatrix}$$

where $g_{DC} = g_{0,0,0,0}$.

3.3 Upsampled transform domain prediction in RAHT

The transform domain prediction is introduced to improve coding efficiency on RAHT (S. Lasserre, D. Flynn, “On an improvement of RAHT to exploit attribute correlation”, ISO/IEC JTC1/SC29/WG11 M47378). It is formed of two parts.

- 5 Firstly, the RAHT tree traversal is changed to be descent based from the previous ascent approach, i.e., a tree of attribute and weight sums is constructed and then RAHT is performed from the root of the tree to the leaves for both the encoder and the decoder. The transform is also performed in octree node transform unit that has $2 \times 2 \times 2$ sub-nodes. Within the node, the encoder transform order is from leaves to the root.
- 10 Secondly, for each sub-node of transform unit, a corresponding predicted sub-node is produced by upsampling the previous transform level. Actually, only sub-node that contains at last one point will produce a corresponding predicted sub-node. The transform unit that contains $2 \times 2 \times 2$ predicted sub-nodes is transformed and subtracted from the transformed attributes at the encoder side.
- 15 Each sub-node of transform unit node is predicted by 7 parent-level nodes where 3 coline parent-level neighbour nodes, 3 coplane parent-level neighbour nodes and 1 parent node. Coplane and coline neighbours are the neighbours that share a face and an edge with current transform unit node, respectively. Fig. 4 shows 7 parent-level nodes for each sub-node of transform unit node.
- 20 The attribute a_{up} of each sub-node is predicted depending on the distance between it and its parent-level node as follows.

$$a_{up} = \sum \omega_k a_k / \sum \omega_k$$

a_k is the attribute of its one parent-level node and ω_k is weight depending on the distance. In G-PCC, $\omega_{parent} : \omega_{coplane} : \omega_{coline} = 4 : 2 : 1$.

- 25 For AC coefficient, the prediction residual will be signalled.
For DC coefficient, the coefficients are inherited from the previous level, which means that the DC coefficient is signalled without prediction.

3.4 Attribute inter prediction in RAHT

The attribute inter prediction in RAHT was proposed and researched in Y.-Z. Xu, W. Wang, K. Zhang, L. Zhang, [G-PCC][EE13.2 related][New proposal] Inter-Prediction for RAHT Attribute Coding, ISO/IEC JTC1/SC29/WG7 m61083, October 2022. It is proposed to apply inter-prediction to DC and AC coefficients in RAHT. The same octree decomposition is performed on the current frame and the reference frame.

- 35 For the first 5 layers, the same scan of the octree is performed on the two frames. Before performing the octree scan backwards, a point-to-point matching process needs to be performed to ensure that the node of the reference frame can establish a corresponding one-to-one relationship with the node of the current frame. For each point in the reference frame, it will be matched to one point in the current frame in a “upper matching” method. The Morton value of

the matched point is the smallest Morton value greater than the Morton value of the current point.

For DC coefficients, the residual between the DC coefficient for the root node of the current frame and the DC coefficient for the root node of the reference frame is calculated as:

$$5 \quad DC_{residual} = DC_{current} - DC_{reference}.$$

The $DC_{residual}$ is signaled to the decoder in place of $DC_{current}$.

For each node in the first 5 layers, the average attribute of the node in the same octree location in the reference frame is calculated as $Attr_{predicted_inter}$ and the corresponding AC coefficients are calculated as $AC_{predicted_inter}$.

10

For AC coefficients, the prediction residual is signalled as:

$$AC_{residual} = AC_{current} - AC_{predicted},$$

$$AC_{predicted} = AC_{predicted_inter} ? AC_{predicted_inter} : AC_{predicted_intra}.$$

If the $AC_{predicted_inter}$ is equal to zero, the $AC_{predicted_intra}$ is applied as the original transform

15 domain prediction.

4. Problems

The existing designs for point cloud attribute prediction in RAHT have the following problems:

1. In current design, the prediction result is either inter prediction value or intra prediction value. However, for some nodes, neither the inter prediction value nor intra prediction value is the optimal prediction value. For example, for some nodes, the mean value of inter and intra prediction value may outperform the other prediction values.
2. In current design, a point-to-point “up-matching” process needs to be performed to ensure that the node in the reference frame can establish a corresponding one-to-one relationship with the node in the current frame. However, for some nodes in the current frame, the matched nodes in the reference frame may be empty. In this case, the prediction efficiency may be limited.

5. Detailed solutions

To solve the above problems and some other problems not mentioned, methods as summarized below are disclosed. The solutions should be considered as examples to explain the general concepts and should not be interpreted in a narrow way. Furthermore, these solutions can be applied individually or combined in any manner.

It should be noticed that in the following discussions, the term RAHT may represent the current RAHT design or any variance of the current RAHT design.

- 1) It is proposed to perform the AC prediction (inter- and/or intra- prediction) in one specific domain.

- a. In one example, the specific domain may be transform domain.
 - a) In one example, the predicted value and the current value may be in the form of AC coefficients.
- b. In one example, the specific domain may be attribute domain.
 - a) In one example, the predicted value and the current value may be in the form of average attribute value/whole attribute value, and so on.
 - b) In one example, the predicted value and the current value may be in the form of conversion of average attribute value/whole attribute value, and so on. For example, the conversion may be normalization.
- c. In one example, there may be one indication to indicate which domain the prediction is performed.
 - a) In one example, the prediction may be performed in transform domain if the indication is equal to one value; otherwise, the prediction may be performed in attribute domain.
 - b) In one example, the prediction may be performed in transform domain if the indication is not equal to one value; otherwise, the prediction may be performed in attribute domain.
 - c) In one example, the indication may be signalled.
 - d) In one example, the indication may be pre-defined.
- d. In one example, the prediction value of AC (e.g., the $AC_{predicted}$ in section 3.4) may be calculated from the AC inter prediction (e.g., the $AC_{predicted_inter}$ in section 3.4) and/or the AC intra prediction (e.g., the $AC_{predicted_intra}$ in section 3.4).
 - a) In one example, the prediction value may be set to the mean or max or min of the AC inter and intra prediction.
- e. In one example, it is proposed to perform the AC inter prediction in transform domain.
 - a) In one example, the prediction residual of transform results (e.g., AC coefficients) may be signaled.
 - b) In one example, the prediction residual of transform results (e.g., AC coefficients) may be processed before being signaled.
 - 1. In one example, the processing may be quantization.
- f. In one example, $AC_{predicted_inter}$ may be the transform results of the predicted attributes of the reference node in the reference frame.
 - a) In one example, the predicted attributes of the reference node may be derived based on the reconstructed attributes and reconstructed geometry of the reference frame.
- g. Alternatively, $AC_{predicted_inter}$ may be the reconstructed AC coefficients of the reference node in the reference frame.
- h. In one example, $AC_{predicted}$ may be processed before being used as a prediction.
 - a) In one example, the processing may be dequantization.

2) It is proposed to perform the DC prediction (inter- and/or intra- prediction) in one specific domain.

a. In one example, the specific domain may be transform domain.

a) In one example, the predicted value and the current value may be in the form of DC coefficients.

b. In one example, the specific domain may be attribute domain.

a) In one example, the predicted value and the current value may be in the form of average attribute value/whole attribute value, and so on.

b) In one example, the predicted value and the current value may be in the form of conversion of average attribute value/whole attribute value, and so on. For example, the conversion may be normalization.

c. In one example, there may be one indication to indicate which domain the prediction is performed.

a) In one example, the prediction may be performed in transform domain if the indication is equal to one value; otherwise, the prediction may be performed in attribute domain.

b) In one example, the prediction may be performed in transform domain if the indication is not equal to one value; otherwise, the prediction may be performed in attribute domain.

c) In one example, the indication may be signalled.

d) In one example, the indication may be pre-defined.

d. In one example, the prediction value of DC coefficients of all nodes in the current octree may be calculated from the DC inter prediction value.

e. In one example, the prediction value of DC coefficients of partial nodes in the current octree may be calculated from the DC inter prediction value.

f. In one example, the prediction value of DC coefficients of the first node in the current octree may be calculated from the DC inter prediction value.

g. In one example, it is proposed to perform the DC inter prediction in transform domain.

a) In one example, the prediction residual of transform results (e.g., DC coefficients) may be signaled.

b) In one example, the prediction residual of transform results (e.g., DC coefficients) may be processed before being signaled.

1. In one example, the processing may be quantization.

h. In one example, the DC inter prediction value may be the transform results of the predicted attributes of the reference node in the reference frame.

a) In one example, the predicted attributes of the reference node may be derived based on the reconstructed attributes and reconstructed geometry of the reference frame.

- i. Alternatively, the DC inter prediction value may be the reconstructed DC coefficients of the reference node in the reference frame.
- j. In one example, the DC inter prediction value may be processed before being used as a prediction.

5 a) In one example, the processing may be dequantization.

3) It is proposed to apply different octree decomposition to the current frame and the reference frame.

a. In one example, how to do the octree decomposition of a frame may be signaled to the decoder.

10 a) In one example, there may be one indication to indicate whether the same octree decomposition is applied to the current frame and the reference frame.

b) In one example, the indication may be signaled.

c) In one example, the indication may be pre-defined.

15 b. In one example, the octree decomposition of the current frame may be determined by the geometry information of the current frame.

c. In one example, the octree decomposition of the reference frame may be determined by the geometry information of the reference frame.

d. In one example, for each node in the current frame, there may be at most one reference node is the reference frame.

20 a) In one example, there may be one reference node if the reference node and the current node share the same octree location and the reference node is not empty; otherwise, there is no reference nodes for the current node.

b) Alternatively, there may be one reference node if the reference node and the current node share the same octree location; otherwise, there is no reference nodes for the current node.

25

4) It is proposed to apply the AC and/or DC inter prediction conditionally for one node in the current frame.

a. In one example, the inter prediction may be applied to the current node when there is one reference node in the reference frame.

30 b. In one example, the inter prediction may be applied to the current node when more than of one of the sub nodes of the current node are occupied.

a) In one example, one sub-node may be occupied if there are at least one points in the sub-node.

35 c. In one example, the inter prediction may be applied to the current node when the intra prediction is enabled for the current node.

d. In one example, the inter prediction may be applied to the current node when the inter prediction is enabled for the octree layer that the current node belongs to.

e. In one example, the inter prediction may be applied to the current node when all or partial of the above conditions are met.

5) It is proposed to apply the AC and/or DC intra prediction conditionally for one node in the current frame.

a. In one example, the intra prediction may be applied to the current node when the intra prediction is enabled for the current node.

5 b. In one example, the intra prediction may be applied to the current node when the inter prediction is not applied to the current node.

c. In one example, the intra prediction may be applied to the current node when the octree occupancy code of the reference node is not equal to the octree occupancy code of the current node.

10 d. In one example, the intra prediction may be applied to the current node when all or partial of the above conditions are met.

6) It is proposed to apply the prediction conditionally for one sub node of the current node.

15 a. In one example, the inter prediction may be applied to one sub node of the current node if the inter prediction is applied to the current node and there is reference sub node in the reference frame.

b. In one example, the intra prediction may be applied to one sub node of the current node when the intra prediction is applied to the current node and the inter prediction is not applied to the current sub node.

20 c. In one example, the intra prediction may be applied to one sub node of the current node when the intra prediction is applied to the current node.

7) It is proposed to generate the predicted value based on the inter prediction value and/or the intra prediction in RAHT on sets of layers of the octree scan.

25 a. In one example, the AC and/or DC predicted value may be generated based on the intra prediction value if there is no reference node in the reference frame for the current node. The reference node and the current node share the same octree location.

b. In one example, the AC and/or DC predicted value may be generated based on the intra prediction value on a set of layers of the octree scan.

30 a) In one example, the set of layers may be the last M layers of the octree scan.

1. In one example, M may be signalled to the decoder.

a. In one example, M may be coded with fixed-length coding, unary coding, truncated unary coding, etc. al.

b. In one example, M may be coded in a predictive way.

35 2. Alternatively, M may be pre-defined.

b) Alternatively, the set of layers may be all layers except the first M layers of the octree scan.

1. In one example, M may be signalled to the decoder.

40 a. In one example, M may be coded with fixed-length coding, unary coding, truncated unary coding, etc. al.

- b. In one example, M may be coded in a predictive way.
 - 2. Alternatively, M may be pre-defined.
 - c. In one example, the AC and/or DC predicted value may be generated based on the inter prediction and the intra prediction value on a set of layers of the octree scan.
 - 5 a) In one example, the set of layers may be the first N layers of the octree scan.
 - 1. In one example, N may be signalled to the decoder.
 - a. In one example, N may be coded with fixed-length coding, unary coding, truncated unary coding, etc. al.
 - 10 b. In one example, N may be coded in a predictive way.
 - 2. Alternatively, N may be pre-defined.
 - b) In one example, the AC and/or DC predicted value may be the transform results of the predicted attributes.
 - 15 1. In one example, the predicted attributes may be indicated by the predicted attribute of each sub node of the current node.
 - 2. In one example, the predicted attribute of one sub node may be the intra prediction value.
 - 3. Alternatively, the predicted attribute of one sub node may be the inter prediction value.
 - 20 4. In one example, the predicted attribute of one sub node may be the inter prediction value of the sub node, if the inter prediction value of the sub node is not equal to zero; otherwise, the predicted attribute of the sub node may be the intra prediction value of the sub node.
 - 25 5. In one example, the predicted attributes of all sub nodes may be the inter prediction values of all sub nodes, if there is reference node; otherwise, the predicted attributes of all sub nodes may be the intra prediction values of all sub nodes.
 - c) In one example, the AC predicted value may be the reconstructed AC coefficients of the reference node in the reference frame, if there is reference node; otherwise, the AC predicted value may be the transform results of the intra predicted attributes.
 - 30 d) In one example, the DC predicted value may be the reconstructed DC coefficients of the reference node in the reference frame, if there is reference node; otherwise, the DC predicted value may be the transform results of the intra predicted attributes.
 - 35
 - d. In one example, the AC and/or DC predicted value may be generated based on a combination of the inter prediction and the intra prediction value.
 - a) In one example, the AC and/or DC predicted value may be the weighted average value of the inter prediction and the intra prediction value on a set of layers of the octree scan.
 - 40

b) In one example, the set of layers may be from the $N+1^{\text{th}}$ layer to the M^{th} layer of the octree scan.

1. In one example, N and M may be signalled to the decoder.

a. In one example, N and M may be coded with fixed-length coding, unary coding, truncated unary coding, etc. al.

b. In one example, N and M may be coded in a predictive way.

2. Alternatively, N and M may be pre-defined.

c) In one example, the AC and/or DC predicted value may be the transform results of the predicted attributes.

1. In one example, the predicted attributes may be indicated by the predicted attribute of each sub node of the current node.

2. In one example, the predicted attribute of one sub node may be the intra prediction value.

3. Alternatively, the predicted attribute of one sub node may be the weighted average value of inter prediction value and intra prediction value.

4. In one example, the predicted attribute of one sub node may be weighted average value of inter prediction value and intra prediction value of the sub node, if the inter prediction value of the sub node is not equal to zero; otherwise, the predicted attribute of the sub node may be the intra prediction value of the sub node.

5. In one example, for all sub nodes, the predicted attributes may be the weighted average value of inter prediction value and intra prediction value, if there is reference node; otherwise, the predicted attributes of all sub nodes may be the intra prediction values of all sub nodes.

d) In one example, the AC predicted value may be the weighted average value of the reconstructed AC coefficients of the reference node in the reference frame and the transform results of the intra predicted attributes, if there is reference node; otherwise, the AC predicted value may be the transform results of the intra predicted attributes.

e) In one example, the DC predicted value may be the weighted average value of the reconstructed DC coefficients of the reference node in the reference frame and the transform results of the intra predicted attributes, if there is reference node; otherwise, the DC predicted value may be the transform results of the intra predicted attributes.

f) In one example, the weighted average of A and B may be calculated as:

$$Average_{weight} = \frac{W_{inter} \times A + W_{intra} \times B}{W_{inter} + W_{intra}}.$$

1. In one example, A may be the inter prediction value of one sub node and B may be the intra prediction of the sub node.

2. In one example, A may be the reconstructed AC and/or DC coefficients of the reference node in the reference frame and B may be the transform results of the intra predicted attributes.

- g) In one example, the weights of inter prediction and intra prediction may be derived at the encoder.
- h) In one example, the weights of inter prediction and intra prediction may be derived at the decoder.
- 5 i) In one example, the weights of inter prediction and intra prediction may be determined by the current layer L where the current node is in.
1. In one example, the weight of inter prediction is higher and the weight of intra prediction is lower when the current node is in a lower layer of the octree.
 - 10 2. In one example, the weight of inter prediction may be calculated as:

$$W_{inter} = M - L + 1.$$
 3. In one example, the weight of intra prediction may be calculated as:

$$W_{intra} = L - N.$$
- 15 j) In one example, the weights of inter prediction and intra prediction may be signalled to the decoder.
1. In one example, the weights of inter prediction and intra prediction of each layer maybe signalled to the decoder.
 2. In one example, the weights of inter prediction and intra prediction may be coded with fixed-length coding, unary coding, truncated unary coding, etc. al.
 - 20 3. In one example, the weights of inter prediction and intra prediction may be coded in a predictive way.
- e. In one example, multiple ways of using inter and intra prediction results and/or multiple ways of layers to be utilized may be enabled.
- 25 a) Alternatively, furthermore, which way (e.g., which layers, weights) to be applied may be pre-defined.
 - b) Alternatively, furthermore, which way (e.g., which layers, weights) to be applied may be signalled.
 - 30 c) Alternatively, furthermore, which way (e.g., which layers, weights) to be applied may be derived on-the-fly.
- 8) It is proposed to store the reconstructed coefficients when the transform is performed.
- a. In one example, for each node, there may be at least one indication to indicate the node location.
 - 35 a) In one example, there may be one indication to indicate the octree location of the node.
 - b) In one example, there may be one indication to indicate the octree layer of the node.
 - b. In one example, the indication may be derived at the encoder.
 - 40 c. In one example, the indication may be derived at the decoder.

- d. In one example, the indication may be corresponding to the reconstructed coefficients of each node.
 - e. In one example, the indication and the corresponding reconstructed coefficients may be stored in one list.
 - 5 f. In one example, the reconstructed coefficients may be selected based on the indication from the list when the inter prediction is enabled.
- 9) It is proposed to signal the method to determine the inter prediction value.
- a. In one example, there may be multiple methods to determine the inter prediction value.
 - 10 a) In one example, there may be multiple methods to determine the inter prediction value in transform domain.
 - 1. In one example, the inter prediction value in transform domain may be derived from the reconstructed coefficients of the reference node.
 - 2. In one example, the inter prediction value in transform domain may be derived from the transform result of the inter predicted attribute.
 - 15 b. In one example, there may be one indication to indicate the method to determine the inter prediction value.
 - a) In one example, there may be one specific value of indication, for each method to determine the inter prediction value.
 - 20 c. In one example, the indication may be derived at the encoder.
 - d. In one example, the indication may be signalled to the decoder.
 - a) In one example, the indication may be coded with fixed-length coding, unary coding, truncated unary coding, etc. al.
 - b) In one example, the indication may be coded in a predictive way.
 - 25 10) Whether to and/or how to apply a method disclosed above may be signaled from encoder to decoder in a bitstream/frame/tile/slice/octree/etc.
 - 11) Whether to and/or how to apply the disclosed methods above may be dependent on coded information, such as dimensions, colour format, colour component, slice/picture type.

6. Embodiments

- 30 An example of the coding flow for the improved inter prediction of AC coefficients is depicted in Fig. 5.

[0054] Fig. 6 illustrates a flowchart of a method 600 for video processing in accordance with embodiments of the present disclosure. The method 600 is implemented during a conversion between a target frame of a point cloud sequence and a bitstream of the point cloud sequence. In some embodiments, the conversion may include encoding the target frame into the bitstream. In some other embodiments, the conversion includes decoding

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the target frame from the bitstream. It is noted that embodiments can be implemented independently or can be combined in any suitable manner.

[0055] At block 610, for a conversion between a target frame of a point cloud sequence and a bitstream of the point cloud sequence, a predicted value of the target frame is obtained by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain. In some embodiments, the AC prediction comprises at least one of: an AC inter prediction or an AC intra prediction. Alternatively, or in addition, the DC prediction comprises at least one of: a DC inter prediction or a DC intra prediction.

[0056] At block 620, the conversion is performed based on the predicted value. In this way, it can improve the accuracy of the predicted value. Further, it can also improve the coding efficiency.

[0057] In some embodiments, the domain is a transform domain. For example, the predicted value and a current value are in form of AC coefficients. Alternatively, or in addition, the predicted value and the current value are in form of DC coefficients.

[0058] In some embodiments, the domain is an attribute domain. For example, the predicted value and a current value are in form of average attribute value or whole attribute value. Alternatively, the predicted value and the current value are in form of conversion of average attribute value or conversion of whole attribute value.

[0059] In some embodiments, an indication is used to indicate which domain where the AC prediction and/or DC prediction is performed. In some embodiments, if the indication is equal to a value, the AC prediction and/or DC prediction is performed in transform domain. Alternatively, or in addition, if the indication is not equal to the value, the AC prediction and/or DC prediction is performed in attribute domain.

[0060] In some embodiments, if the indication is not equal to a value, the AC prediction and/or DC prediction is performed in transform domain. Alternatively, or in addition, if the indication is equal to the value, the AC prediction and/or DC prediction is performed in attribute domain.

[0061] In some embodiments, the indication is signaled. Alternatively, the indication may be pre-defined.

[0062] In some embodiments, the predicted value is calculated from at least one of: an

AC inter prediction or an AC intra prediction. For example, the predicted value is set to a mean value of the AC inter prediction and the AC intra prediction. In some other embodiments, the predicted value is set to a maximum value of the AC inter prediction and the AC intra prediction. In some other embodiments, the predicted value is set to a minimum of the AC inter and intra prediction.

[0063] In some embodiments, an AC inter prediction is performed in transform domain. Alternatively, or in addition, a DCI inter prediction is performed in transform domain.

[0064] In some embodiments, a prediction residual of transform results is signalled. For example, the prediction residual of AC coefficients may be signaled. In some other embodiments, the prediction residual of DC coefficients may be signaled.

[0065] In some embodiments, a processing is applied to a prediction residual of transform results before being signalled. In some embodiments, the processing is quantization. For example, the transform results may be AC coefficients and/or DC coefficients.

[0066] In some embodiments, an AC inter prediction is transform results of predicted attributes of a reference node in a reference frame. Alternatively, or in addition, a DC inter prediction is transform results of predicted attributes of a reference node in a reference frame. For example, the predicted attributes of the reference node is derived based on reconstructed attributes and reconstructed geometry of the reference frame.

[0067] In some embodiments, an AC inter prediction is reconstructed AC coefficients of a reference node in a reference frame, and/or wherein a DC inter prediction is reconstructed AC coefficients of a reference node in a reference frame. In some embodiments, the predicted values is processed before being used as a prediction. For example, the processing is dequantization.

[0068] In some embodiments, a prediction value of DC coefficients of all nodes in a current octree is calculated from a DC inter prediction value. In some other embodiments, a prediction value of DC coefficients of partial nodes in a current octree is calculated from a DC inter prediction value. In some further embodiments, a prediction value of DC coefficients of a first node in a current octree is calculated from a DC inter prediction value.

[0069] In some embodiments, different octree decompositions are applied to a current

frame and a reference frame. In some embodiments, a way to do an octree decomposition of a frame is signaled to a decoder. For example, an indication is used to indicate whether a same octree decomposition is applied to the current frame and the reference frame. In some embodiments, the indication is signalled. Alternatively, the indication is pre-defined.

5 [0070] In some embodiments, an octree decomposition of the current frame is determined by geometry information of the current frame. In some other embodiments, an octree decomposition of the reference frame is determined by geometry information of the reference frame.

[0071] In some embodiments, for each node in the current frame, at most one reference
10 node is in the reference frame. In some embodiments, there is one reference node for a current node, if the reference node and the current node share a same octree location and the reference node is not empty. In some other embodiments, there is no reference nodes for a current node, if a reference node and the current node do not share a same octree location and/or the reference node is empty.

15 [0072] In some embodiments, there is one reference node for a current node, if the reference node and a current node share a same octree location. In some other embodiments, there is no reference node for a current node, if the reference node and a current node do not share a same octree location.

[0073] In some embodiments, at least one of: an AC inter prediction or a DC inter
20 prediction is applied for one node in a current frame based on a condition being met. For example, at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if the condition where there is one reference node in a reference frame is met. In some embodiments, at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if the condition where more than of one of sub
25 nodes of the current node are occupied is met. In some embodiments, a sub-node is occupied if there are at least one points in the sub-node.

[0074] In some embodiments, at least one of: the AC inter prediction or the DC inter
prediction is applied to the current node, if the condition where an intra prediction is enabled for the current node is met. For example, at least one of: the AC inter prediction
30 or the DC inter prediction is applied to the current node, if the condition where an AC and/or DC intra prediction is enabled for the current node is met. In some other embodiments, at least one of: the AC inter prediction or the DC inter prediction is applied

to the current node, if the condition where the least one of: the AC inter prediction or the DC inter prediction is enabled for an octree layer to which the current node belongs is met. In some embodiments, at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if all or partial of the conditions are met.

- 5 [0075] In some embodiments, at least one of: an AC intra prediction or a DC intra prediction is applied for one node in a current frame based on a condition being met. In some embodiments, at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if the condition where at least one of: the AC intra prediction or the DC intra prediction is enabled for the current node is met. In some other
10 embodiments, at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if the condition where an inter prediction is not applied to the current node is met. In some embodiments, at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if the condition where an octree occupancy code of a reference node is not equal to an octree occupancy code of a current node is met. In
15 some other embodiments, at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if all or partial of the conditions are met.

- [0076] In some embodiments, the prediction is applied for a sub-node of a current node based on a condition being met. In some embodiments, an inter prediction is applied to one sub-node of the current node, if the inter prediction is applied to the current node and
20 there is a reference sub node in a reference frame. In some other embodiments, an intra prediction is applied to one sub node of the current node, if the intra prediction is applied to the current node and an inter prediction is not applied to the current sub node. In some embodiments, an intra prediction is applied to one sub node of the current node, if the intra prediction is applied to the current node.

- 25 [0077] In some embodiments, the predicted value is generated based on at least one of: an inter prediction value and/or an intra prediction in Region-Adaptive Hierarchical Transform (RAHT) on sets of layers of an octree scan. In some embodiments, if there is no reference node in a reference frame for a current node, at least one of: AC predicted value or DC predicted value is generated based on the intra prediction value, wherein the
30 reference node and the current node share a same octree location.

[0078] In some embodiments, at least one of: AC or DC predicted value is generated based on an intra prediction value on a set of layers of the octree scan. For example, the

set of layers comprises last M layers of the octree scan. Alternatively, the set of layers comprises all layers except first M layers of the octree scan.

[0079] In some embodiments, M is signalled to a decoder. Alternatively, M is pre-defined. In some embodiments, M is coded with at least one of: fixed-length coding, unary coding, or truncated unary coding. Alternatively, M is coded in a predictive way.

[0080] In some embodiments, at least one of: AC or DC predicted value is generated based on an inter prediction value and an intra prediction value on a set of layers of the octree scan. For example, the set of layers comprises first N layers of the octree scan.

[0081] In some embodiments, N is signalled to a decoder. Alternatively, N is pre-defined. In some embodiments, N is coded with at least one of: fixed-length coding, unary coding, or truncated unary coding. Alternatively, N is coded in a predictive way.

[0082] In some embodiments, the at least one of: AC predicted value or DC predicted value is transform results of predicted attributes. In some embodiments, the predicted attributes are indicated by a predicted attribute of each sub node of a current node.

[0083] In some embodiments, a predicted attribute of one sub node is an intra prediction value. In some other embodiments, a predicted attribute of one sub node is an inter prediction value.

[0084] In some embodiments, a predicted attribute of a sub node is an inter prediction value of the sub node, if the inter prediction value of the sub node is not equal to zero. In some other embodiments, a predicted attribute of a sub node is an intra prediction value of the sub node if the inter prediction value of the sub node is equal to zero.

[0085] In some embodiments, predicted attributes of all sub nodes are inter prediction values of all sub nodes, if there is a reference node. In some other embodiments, predicted attributes of all sub nodes are intra prediction values of all sub nodes, if there is no reference node.

[0086] In some embodiments, the AC predicted value is reconstructed AC coefficients of a reference node in a reference frame, if there is a reference node. In some other embodiments, the AC predicted value is transform results of intra predicted attributes, if there is no reference node.

[0087] In some embodiments, the DC predicted value is reconstructed DC coefficients

of a reference node in a reference frame, if there is a reference node. In some other embodiments, the DC predicted value is transform results of intra predicted attributes, if there is no reference node.

[0088] In some embodiments, at least one of: AC predicted value or DC predicted value is generated based on a combination of an inter prediction and an intra prediction value. In some embodiments, at least one of the AC predicted value or DC predicted value is a weighted average value of the inter prediction and the intra prediction value on a set of layers of an octree scan. In some embodiments, the set of layers is from (N+1)-th layer to M-th layer of the octree scan, where M and N are integer numbers.

[0089] In some embodiments, N and M are signalled to a decoder. Alternatively, N and M are pre-defined.

[0090] In some embodiments, N and M are coded with at least one of: fixed-length coding, unary coding, or truncated unary coding. Alternatively, N and M are coded in a predictive way.

[0091] In some embodiments, at least one of: AC predicted value or DC predicted value is transform results of predicted attributes. In some embodiments, the predicted attributes are indicated by a predicted attribute of each sub node of a current node.

[0092] In some embodiments, a predicted attribute of a sub node is an intra prediction value. In some other embodiments, a predicted attribute of a sub node is a weighted average value of inter prediction value and intra prediction value.

[0093] In some embodiments, a predicted attribute of a sub node is weighted average value of inter prediction value and intra prediction value of the sub node, if the inter prediction value of the sub node is not equal to zero. In some other embodiments, a predicted attribute of a sub node is an intra prediction value of a sub node, if the inter prediction value of the sub node is equal to zero.

[0094] In some embodiments, a predicted attribute of each sub node is a weighted average value of inter prediction value and intra prediction value, if there is a reference node. In some other embodiments, predicted attributes of all sub nodes are intra prediction values of all sub nodes, if there is no reference node.

[0095] In some embodiments, the AC predicted value is a weighted average value of reconstructed AC coefficients of a reference node in a reference frame and transform

results of intra predicted attributes, if there is a reference node. In some other embodiments, the AC predicted value is transform results of intra predicted attributes, if there is no reference node.

[0096] In some embodiments, the DC predicted value is a weighted average value of reconstructed DC coefficients of a reference node in a reference frame and transform results of intra predicted attributes, if there is a reference node. In some other embodiments, the DC predicted value is transform results of intra predicted attributes, if there is no reference node.

[0097] In some embodiments, a weighted average of A and B is calculated as:

$$Average_{weight} = \frac{W_{inter} \times A + W_{intra} \times B}{W_{inter} + W_{intra}}, \text{ and where } W_{inter} \text{ and } W_{intra} \text{ are weighting factors.}$$

In some embodiments, A represents an inter prediction value of a sub node and B represents an intra prediction of the sub node. Alternatively, A represents reconstructed AC and/or DC coefficients of a reference node in a reference frame, and B represents transform results of the intra predicted attributes.

[0098] In some embodiments, weights of inter prediction and intra prediction are derived at an encoder. Alternatively, or in addition, the weights of inter prediction and intra prediction are derived at a decoder.

[0099] In some embodiments, weights of inter prediction and intra prediction are determined by a current layer L where a current node is in. In some embodiments, a weight of inter prediction is higher and a weight of intra prediction is lower, if the the current node is in a lower layer of the octree. In some other embodiments, a weight of inter prediction is calculated as: $W_{inter} = M - L + 1$, where M and L are numbers. In some further embodiments, a weight of intra prediction is calculated as: $W_{intra} = L - N$, where M and L are numbers.

[0100] In some embodiments, weights of inter prediction and intra prediction are signalled to a decoder. For example, the weights of inter prediction and intra prediction of each layer are signalled to the decoder. In some embodiments, the weights of inter prediction and intra prediction are coded with at least one of: fixed-length coding, unary coding, or truncated unary coding. Alternatively, the weights of inter prediction and intra prediction are coded in a predictive way.

[0101] In some embodiments, a plurality of ways of using inter and intra prediction

results and/or a plurality of ways of layers to be utilized are enabled. In some embodiments, which way to be applied is pre-defined. Alternatively, which way to be applied is signalled, or wherein which way to be applied is derived on-the-fly.

[0102] In some embodiments, reconstructed coefficients are stored, if a transform is performed. In some embodiments, for each node, there is at least one indication to indicate a node location.

[0103] In some embodiments, there is an indication to indicate an octree location of a node. Alternatively, there is an indication to indicate an octree layer of the node.

[0104] In some embodiments, the indication is derived at an encoder. Alternatively, the indication is derived at a decoder. In some embodiments, the indication is corresponding to reconstructed coefficients of each node.

[0105] In some embodiments, the indication and the corresponding reconstructed coefficients are stored in one list. In some embodiments, reconstructed coefficients are selected based on the indication from the list, if the inter prediction is enabled.

[0106] In some embodiments, an approach is signaled to determine an inter prediction value. In some embodiments, there is a plurality of approaches to determine the inter prediction value. In some other embodiments, there is a plurality of approaches to determine the inter prediction value in transform domain.

[0107] In some embodiments, the inter prediction value in transform domain is derived from reconstructed coefficients of a reference node. In some other embodiments, the inter prediction value in transform domain is derived from transform result of an inter predicted attribute.

[0108] In some embodiments, there is an indication to indicate the approach to determine the inter prediction value. In some other embodiments, there is a specific value of indication, for each approach to determine the inter prediction value.

[0109] In some embodiments, the indication is derived at an encoder. Alternatively, the indication is signaled to a decoder.

[0110] In some embodiments, the indication is coded with at least one of: fixed-length coding, unary coding, or truncated unary coding. Alternatively, the indication is coded in a predictive way.

[0111] In some embodiments, whether to and/or how to obtain the predicted value by performing at least one of the AC prediction or the DCI prediction is indicated from an encoder to a decoder in one of: a bitstream, a frame, a tile, a slice, or a octree. In some other embodiments, whether to and/or how to obtain the predicted value by performing at least one of the AC prediction or the DCI prediction is dependent on coding information, wherein the coding information comprises at least one of: dimensions, colour format, colour component, slice type, or picture type.

[0112] According to further embodiments of the present disclosure, a non-transitory computer-readable recording medium is provided. The non-transitory computer-readable recording medium stores a bitstream of a video which is generated by a method performed by an apparatus for video processing. The method comprises: obtaining a predicted value of a target frame of a point cloud sequence by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain; and generating the bitstream based on the predicted value.

[0113] According to still further embodiments of the present disclosure, a method for storing bitstream of a video is provided. The method comprises: obtaining a predicted value of a target frame of a point cloud sequence by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain; generating the bitstream based on the predicted value; and storing the bitstream in a non-transitory computer-readable recording medium.

[0114] Implementations of the present disclosure can be described in view of the following clauses, the features of which can be combined in any reasonable manner.

[0115] Clause 1. A method of video processing, comprising: obtaining, for a conversion between a target frame of a point cloud sequence and a bitstream of the point cloud sequence, a predicted value of the target frame by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain; and performing the conversion based on the predicted value.

[0116] Clause 2. The method of clause 1, wherein the AC prediction comprises at least one of: an AC inter prediction or an AC intra prediction, and/or wherein the DC prediction comprises at least one of: a DC inter prediction or a DC intra prediction.

[0117] Clause 3. The method of clause 1, wherein the domain is a transform domain.

[0118] Clause 4. The method of clause 3, wherein the predicted value and a current value are in form of AC coefficients, and/or wherein the predicted value and the current value are in form of DC coefficients.

[0119] Clause 5. The method of clause 1, wherein the domain is an attribute domain.

5 [0120] Clause 6. The method of clause 5, wherein the predicted value and a current value are in form of average attribute value or whole attribute value, or wherein the predicted value and the current value are in form of conversion of average attribute value or conversion of whole attribute value.

[0121] Clause 7. The method of clause 1, wherein an indication is used to indicate which
10 domain where the AC prediction and/or DC prediction is performed.

[0122] Clause 8. The method of clause 7, wherein if the indication is equal to a value, the AC prediction and/or DC prediction is performed in transform domain, and/or wherein if the indication is not equal to the value, the AC prediction and/or DC prediction is performed in attribute domain.

15 [0123] Clause 9. The method of clause 7, wherein if the indication is not equal to a value, the AC prediction and/or DC prediction is performed in transform domain, and/or wherein if the indication is equal to the value, the AC prediction and/or DC prediction is performed in attribute domain.

[0124] Clause 10. The method of clause 7, wherein the indication is signaled or pre-
20 defined.

[0125] Clause 11. The method of clause 1, wherein the predicted value is calculated from at least one of: an AC inter prediction or an AC intra prediction.

[0126] Clause 12. The method of clause 11, wherein the predicted value is set to a mean value of the AC inter prediction and the AC intra prediction, or wherein the predicted
25 value is set to a maximum value of the AC inter prediction and the AC intra prediction, or wherein the predicted value is set to a minimum of the AC inter and intra prediction.

[0127] Clause 13. The method of clause 1, wherein an AC inter prediction is performed in transform domain, and/or wherein a DCI inter prediction is performed in transform domain.

30 [0128] Clause 14. The method of clause 13, wherein a prediction residual of transform

results is signalled.

[0129] Clause 15. The method of clause 13, wherein a processing is applied to a prediction residual of transform results before being signalled.

[0130] Clause 16. The method of clause 15, wherein the processing is quantization.

5 [0131] Clause 17. The method of clause 1, wherein an AC inter prediction is transform results of predicted attributes of a reference node in a reference frame, and/or wherein an DC inter prediction is transform results of predicted attributes of a reference node in a reference frame.

10 [0132] Clause 18. The method of clause 17, wherein the predicted attributes of the reference node is derived based on reconstructed attributes and reconstructed geometry of the reference frame.

15 [0133] Clause 19. The method of clause 1, wherein an AC inter predictoin is reconstructed AC coefficients of a reference node in a reference frame, and/or wherein a DC inter predictoin is reconstructed AC coefficients of a reference node in a reference frame.

[0134] Clause 20. The method of clause 1, wherein the predicted values is processed before being used as a prediction.

[0135] Clause 21. The method of clause 20, wherein the processing is dequantization.

20 [0136] Clause 22. The method of clause 1, wherein a prediction value of DC coefficients of all nodes in a current octree is calculated from a DC inter prediction value.

[0137] Clause 23. The method of clause 1, wherein a prediction value of DC coefficients of partial nodes in a current octree is calculated from a DC inter prediction value.

[0138] Clause 24. The method of clause 1, wherein a prediction value of DC coefficients of a first node in a current octree is calculated from a DC inter prediction value.

25 [0139] Clause 25. The method of calim 1, wherein different octree decompositions are applied to a current frame and a reference frame.

[0140] Clause 26. The method of clause 25, wherein a way to do an octree decomposition of a frame is signaled to a decoder.

[0141] Clause 27. The method of clause 26, wherein an indication is used to indicate

whether a same octree decomposition is applied to the current frame and the reference frame.

[0142] Clause 28. The method of clause 27, wherein the indication is signalled, or wherein the indication is pre-defined.

5 [0143] Clause 29. The method of clause 25, wherein an octree decomposition of the current frame is determined by geometry information of the current frame.

[0144] Clause 30. The method of clause 25, wherein an octree decomposition of the reference frame is determined by geometry information of the reference frame.

10 [0145] Clause 31. The method of clause 25, wherein for each node in the current frame, at most one reference node is in the reference frame.

[0146] Clause 32. The method of clause 31, wherein there is one reference node for a current node, if the reference node and the current node share a same octree location and the reference node is not empty.

15 [0147] Clause 33. The method of clause 31, wherein there is no reference nodes for a current node, if a reference node and the current node do not share a same octree location and/or the reference node is empty.

[0148] Clause 34. The method of clause 31, wherein there is one reference node for a current node, if the reference node and a current node share a same octree location.

20 [0149] Clause 35. The method of clause 31, wherein there is no reference node for a current node, if the reference node and a current node do not share a same octree location.

[0150] Clause 36. The method of clause 1, wherein at least one of: an AC inter prediction or a DC inter prediction is applied for one node in a current frame based on a condition being met.

25 [0151] Clause 37. The method of clause 36, wherein at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if the condition where there is one reference node in a reference frame is met.

[0152] Clause 38. The method of clause 36, wherein at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if the condition where more than of one of sub nodes of the current node are occupied is met.

[0153] Clause 39. The method of clause 38, wherein a sub-node is occupied if there are at least one points in the sub-node.

[0154] Clause 40. The method of clause 36, wherein at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if the condition where
5 an intra prediction is enabled for the current node is met.

[0155] Clause 41. The method of clause 36, wherein at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if the condition where the least one of: the AC inter prediction or the DC inter prediction is enabled for an octree layer to which the current node belongs is met.

10 [0156] Clause 42. The method of any of clauses 36-41, wherein at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if all or partial of the conditions are met.

[0157] Clause 43. The method of clause 1, wherein at least one of: an AC intra prediction or a DC intra prediction is applied for one node in a current frame based on a
15 condition being met.

[0158] Clause 44. The method of clause 43, wherein at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if the condition where at least one of: the AC intra prediction or the DC intra prediction is enabled for the current node is met.

20 [0159] Clause 45. The method of clause 43, wherein at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if the condition where an inter prediction is not applied to the current node is met.

[0160] Clause 46. The method of clause 43, wherein at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if the condition where
25 an octree occupancy code of a reference node is not equal to an octree occupancy code of a current node is met.

[0161] Clause 47. The method of any of clauses 43-46, wherein at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if all or partial of the conditions are met.

30 [0162] Clause 48. The method of clause 1, wherein the prediction is applied for a sub-

node of a current node based on a condition being met.

[0163] Clause 49. The method of clause 48, wherein an inter prediction is applied to one sub-node of the current node, if the inter prediction is applied to the current node and there is a reference sub node in a reference frame.

5 [0164] Clause 50. The method of clause 49, wherein an intra prediction is applied to one sub node of the current node, if the intra prediction is applied to the current node and an inter prediction is not applied to the current sub node.

[0165] Clause 51. The method of clause 49, wherein an intra prediction is applied to one sub node of the current node, if the intra prediction is applied to the current node.

10 [0166] Clause 52. The method of clause 1, wherein the predicted value is generated based on at least one of: an inter prediction value and/or an intra prediction in Region-Adaptive Hierarchical Transform (RAHT) on sets of layers of an octree scan.

[0167] Clause 53. The method of clause 52, wherein if there is no reference node in a reference frame for a current node, at least one of: AC predicted value or DC predicted
15 value is generated based on the intra prediction value, wherein the reference node and the current node share a same octree location.

[0168] Clause 54. The method of clause 52, wherein at least one of: AC or DC predicted value is generated based on an intra prediction value on a set of layers of the octree scan.

[0169] Clause 55. The method of clause 54, wherein the set of layers comprises last M
20 layers of the octree scan, or wherein the set of layers comprises all layers except first M layers of the octree scan.

[0170] Clause 56. The method of clause 55, wherein M is signalled to a decoder, or wherein M is pre-defined.

[0171] Clause 57. The method of clause 56, wherein M is coded with at least one of:
25 fixed-length coding, unary coding, or truncated unary coding, or wherein M is coded in a predictive way.

[0172] Clause 58. The method of clause 52, wherein at least one of: AC or DC predicted value is generated based on an inter prediction value and an intra prediction value on a set of layers of the octree scan.

30 [0173] Clause 59. The method of clause 58, wherein the set of layers comprises first N

layers of the octree scan.

[0174] Clause 60. The method of clause 59, wherein N is signalled to a decoder, or wherein N is pre-defined.

[0175] Clause 61. The method of clause 60, wherein N is coded with at least one of:
5 fixed-length coding, unary coding, or truncated unary coding, or wherein N is coded in a predictive way.

[0176] Clause 62. The method of clause 58, wherein the at least one of: AC predicted value or DC predicted value is transform results of predicted attributes.

[0177] Clause 63. The method of clause 62, wherein the predicted attributes are
10 indicated by a predicted attribute of each sub node of a current node.

[0178] Clause 64. The method of clause 62, wherein a predicted attribute of one sub node is an intra prediction value.

[0179] Clause 65. The method of clause 62, wherein a predicted attribute of one sub node is an inter prediction value.

15 [0180] Clause 66. The method of clause 62, wherein a predicted attribute of a sub node is an inter prediction value of the sub node, if the inter prediction value of the sub node is not equal to zero.

[0181] Clause 67. The method of clause 62, wherein a predicted attribute of a sub node is an intra prediction value of the sub node if the inter prediction value of the sub node is
20 equal to zero.

[0182] Clause 68. The method of clause 62, wherein predicted attributes of all sub nodes are inter prediction values of all sub nodes, if there is a reference node.

[0183] Clause 69. The method of clause 62, wherein predicted attributes of all sub nodes are intra prediction values of all sub nodes, if there is no reference node.

25 [0184] Clause 70. The method of clause 58, wherein the AC predicted value is reconstructed AC coefficients of a reference node in a reference frame, if there is a reference node.

[0185] Clause 71. The method of clause 58, wherein the AC predicted value is transform results of intra predicted attributes, if there is no reference node.

[0186] Clause 72. The method of clause 58, wherein the DC predicted value is reconstructed DC coefficients of a reference node in a reference frame, if there is a reference node.

[0187] Clause 73. The method of clause 58, wherein the DC predicted value is transform results of intra predicted attributes, if there is no reference node.

[0188] Clause 74. The method of clause 52, wherein at least one of: AC predicted value or DC predicted value is generated based on a combination of an inter prediction and an intra prediction value.

[0189] Clause 75. The method of clause 74, wherein at least one of the AC predicted value or DC predicted value is a weighted average value of the inter prediction and the intra prediction value on a set of layers of an octree scan.

[0190] Clause 76. The method of clause 75, wherein the set of layers is from (N+1)-th layer to M-th layer of the octree scan, wherein M and N are integer numbers.

[0191] Clause 77. The method of clause 76, wherein N and M are signalled to a decoder, or wherein N and M are pre-defined.

[0192] Clause 78. The method of clause 77, wherein N and M are coded with at least one of: fixed-length coding, unary coding, or truncated unary coding, or wherein N and M are coded in a predictive way.

[0193] Clause 79. The method of clause 74, wherein at least one of: AC predicted value or DC predicted value is transform results of predicted attributes.

[0194] Clause 80. The method of clause 79, wherein the predicted attributes are indicated by a predicted attribute of each sub node of a current node.

[0195] Clause 81. The method of clause 79, wherein a predicted attribute of a sub node is an intra prediction value.

[0196] Clause 82. The method of clause 79, wherein a predicted attribute of a sub node is a weighted average value of inter prediction value and intra prediction value.

[0197] Clause 83. The method of clause 79, wherein a predicted attribute of a sub node is weighted average value of inter prediction value and intra prediction value of the sub node, if the inter prediction value of the sub node is not equal to zero.

[0198] Clause 84. The method of clause 79, wherein a predicted attribute of a sub node is an intra prediction value of a sub node, if the inter prediction value of the sub node is equal to zero.

[0199] Clause 85. The method of clause 79, wherein a predicted attribute of each sub node is a weighted average value of inter prediction value and intra prediction value, if there is a reference node.

[0200] Clause 86. The method of clause 79, wherein predicted attributes of all sub nodes are intra prediction values of all sub nodes, if there is no reference node.

[0201] Clause 87. The method of clause 74, wherein the AC predicted value is a weighted average value of reconstructed AC coefficients of a reference node in a reference frame and transform results of intra predicted attributes, if there is a reference node.

[0202] Clause 88. The method of clause 74, wherein the AC predicted value is transform results of intra predicted attributes, if there is no reference node.

[0203] Clause 89. The method of clause 74, wherein the DC predicted value is a weighted average value of reconstructed DC coefficients of a reference node in a reference frame and transform results of intra predicted attributes, if there is a reference node.

[0204] Clause 90. The method of clause 74, wherein the DC predicted value is transform results of intra predicted attributes, if there is no reference node.

[0205] Clause 91. The method of clause 74, wherein a weighted average of A and B is calculated as: $Average_{weight} = \frac{W_{inter} \times A + W_{intra} \times B}{W_{inter} + W_{intra}}$, and wherein and are weighting factors, wherein A represents an inter prediction value of a sub node and B represents an intra prediction of the sub node, or wherein A represents reconstructed AC and/or DC coefficients of a reference node in a reference frame, and B represents transform results of the intra predicted attributes.

[0206] Clause 92. The method of clause 74, wherein weights of inter prediction and intra prediction are derived at an encoder, and/or wherein the weights of inter prediction and intra prediction are derived at a decoder.

[0207] Clause 93. The method of clause 74, wherein weights of inter prediction and intra prediction are determined by a current layer L where a current node is in.

[0208] Clause 94. The method of clause 93, wherein a weight of inter prediction is higher and a weight of intra prediction is lower, if the the current node is in a lower layer of the octree.

[0209] Clause 95. The method of clause 93, wherein a weight of inter prediction is
5 calculated as: , wherein M and L are numbers.

[0210] Clause 96. The method of clause 93, wherein a weight of intra prediction is calculated as: , wherein M and L are numbers.

[0211] Clause 97. The method of clause 74, wherein weights of inter prediction and intra prediction are signalled to a decoder.

10 [0212] Clause 98. The method of clause 97, wherein the weights of inter prediction and intra prediction of each layer are signalled to the decoder.

[0213] Clause 99. The method of clause 97, wherein the weights of inter prediction and intra prediction are coded with at least one of: fixed-length coding, unary coding, or truncated unary coding, or wherein the weights of inter prediction and intra prediction are
15 coded in a predictive way.

[0214] Clause 100. The method of clause 52, wherein a plurality of ways of using inter and intra prediction results and/or a plurality of ways of layers to be utilized are enabled.

[0215] Clause 101. The method of clause 100, wherein which way to be applied is pre-defined, or wherein which way to be applied is signalled, or wherein which way to be
20 applied is derived on-the-fly.

[0216] Clause 102. The method of clause 1, wherein reconstructed coefficients are stored, if a transform is performed.

[0217] Clause 103. The method of clause 102, wherein for each node, there is at least one indication to indicate a node location.

25 [0218] Clause 104. The method of clause 103, wherein there is an indication to indicate an octree location of a node, or wherein there is an indication to indicate an octree layer of the node.

[0219] Clause 105. The method of clause 103, wherein the indication is derived at an encoder, or wherein the indication is derived at a decoder, or wherein the indication is
30 corresponding to reconstructed coefficients of each node.

[0220] Clause 106. The method of clause 103, wherein the indication and the corresponding reconstructed coefficients are stored in one list.

[0221] Clause 107. The method of clause 103, wherein reconstructed coefficients are selected based on the indication from the list, if the inter prediction is enabled.

5 [0222] Clause 108. The method of clause 1, wherein an approach is signaled to determine an inter prediction value.

[0223] Clause 109. The method of clause 108, wherein there is a plurality of approaches to determine the inter prediction value.

10 [0224] Clause 110. The method of clause 109, wherein there is a plurality of approaches to determine the inter prediction value in transform domain.

[0225] Clause 111. The method of clause 110, wherein the inter prediction value in transform domain is derived from reconstructed coefficients of a reference node.

[0226] Clause 112. The method of clause 110, wherein the inter prediction value in transform domain is derived from transform result of an inter predicted attribute.

15 [0227] Clause 113. The method of clause 108, wherein there is an indication to indicate the approach to determine the inter prediction value.

[0228] Clause 114. The method of clause 113, wherein there is a specific value of indication, for each approach to determine the inter prediction value.

20 [0229] Clause 115. The method of clause 108, wherein the indication is derived at an encoder, or wherein the indication is signaled to a decoder.

[0230] Clause 116. The method of clause 115, wherein the indication is coded with at least one of: fixed-length coding, unary coding, or truncated unary coding, or wherein the indication is coded in a predictive way.

25 [0231] Clause 117. The method of any of clauses 1-116, wherein whether to and/or how to obtain the predicted value by performing at least one of the AC prediction or the DCI prediction is indicated from an encoder to a decoder in one of: a bitstream, a frame, a tile, a slice, or a octree.

[0232] Clause 118. The method of any of clauses 1-116, wherein whether to and/or how to obtain the predicted value by performing at least one of the AC prediction or the DCI

prediction is dependent on coding information, wherein the coding information comprises at least one of: dimensions, colour format, colour component, slice type, or picture type.

[0233] Clause 119. The method of any of clauses 1-118, wherein the conversion includes encoding the target frame into the bitstream.

5 [0234] Clause 120. The method of any of clauses 1-118, wherein the conversion includes decoding the target frame from the bitstream.

[0235] Clause 121. An apparatus for video processing comprising a processor and a non-transitory memory with instructions thereon, wherein the instructions upon execution by the processor, cause the processor to perform a method in accordance with any of
10 clauses 1-120.

[0236] Clause 122. A non-transitory computer-readable storage medium storing instructions that cause a processor to perform a method in accordance with any of clauses 1-120.

[0237] Clause 123. A non-transitory computer-readable recording medium storing a
15 bitstream of a video which is generated by a method performed by an apparatus for video processing, wherein the method comprises: obtaining a predicted value of a target frame of a point cloud sequence by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain; and generating the bitstream based on the predicted value.

20 [0238] Clause 124. A method for storing a bitstream of a video, comprising: obtaining a predicted value of a target frame of a point cloud sequence by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain; generating the bitstream based on the predicted value; and storing the bitstream in a non-transitory computer-readable recording medium.

25 **Example Device**

[0239] Fig. 7 illustrates a block diagram of a computing device 700 in which various embodiments of the present disclosure can be implemented. The computing device 700 may be implemented as or included in the source device 110 (or the GPCC encoder 116 or 200) or the destination device 120 (or the GPCC decoder 126 or 300).

30 [0240] It would be appreciated that the computing device 700 shown in Fig. 7 is merely

for purpose of illustration, without suggesting any limitation to the functions and scopes of the embodiments of the present disclosure in any manner.

[0241] As shown in Fig. 7, the computing device 700 includes a general-purpose computing device 700. The computing device 700 may at least comprise one or more
5 processors or processing units 710, a memory 720, a storage unit 730, one or more communication units 740, one or more input devices 750, and one or more output devices 760.

[0242] In some embodiments, the computing device 700 may be implemented as any user terminal or server terminal having the computing capability. The server terminal may
10 be a server, a large-scale computing device or the like that is provided by a service provider. The user terminal may for example be any type of mobile terminal, fixed terminal, or portable terminal, including a mobile phone, station, unit, device, multimedia computer, multimedia tablet, Internet node, communicator, desktop computer, laptop computer, notebook computer, netbook computer, tablet computer, personal
15 communication system (PCS) device, personal navigation device, personal digital assistant (PDA), audio/video player, digital camera/video camera, positioning device, television receiver, radio broadcast receiver, E-book device, gaming device, or any combination thereof, including the accessories and peripherals of these devices, or any combination thereof. It would be contemplated that the computing device 700 can support
20 any type of interface to a user (such as “wearable” circuitry and the like).

[0243] The processing unit 710 may be a physical or virtual processor and can implement various processes based on programs stored in the memory 720. In a multi-processor system, multiple processing units execute computer executable instructions in parallel so as to improve the parallel processing capability of the computing device 700.
25 The processing unit 710 may also be referred to as a central processing unit (CPU), a microprocessor, a controller or a microcontroller.

[0244] The computing device 700 typically includes various computer storage medium. Such medium can be any medium accessible by the computing device 700, including, but not limited to, volatile and non-volatile medium, or detachable and non-detachable
30 medium. The memory 720 can be a volatile memory (for example, a register, cache, Random Access Memory (RAM)), a non-volatile memory (such as a Read-Only Memory (ROM), Electrically Erasable Programmable Read-Only Memory (EEPROM), or a flash

memory), or any combination thereof. The storage unit 730 may be any detachable or non-detachable medium and may include a machine-readable medium such as a memory, flash memory drive, magnetic disk or another other media, which can be used for storing information and/or data and can be accessed in the computing device 700.

5 [0245] The computing device 700 may further include additional detachable/non-detachable, volatile/non-volatile memory medium. Although not shown in Fig. 7, it is possible to provide a magnetic disk drive for reading from and/or writing into a detachable and non-volatile magnetic disk and an optical disk drive for reading from and/or writing into a detachable non-volatile optical disk. In such cases, each drive may be connected to
10 a bus (not shown) via one or more data medium interfaces.

[0246] The communication unit 740 communicates with a further computing device via the communication medium. In addition, the functions of the components in the computing device 700 can be implemented by a single computing cluster or multiple computing machines that can communicate via communication connections. Therefore, the
15 computing device 700 can operate in a networked environment using a logical connection with one or more other servers, networked personal computers (PCs) or further general network nodes.

[0247] The input device 750 may be one or more of a variety of input devices, such as a mouse, keyboard, tracking ball, voice-input device, and the like. The output device 760
20 may be one or more of a variety of output devices, such as a display, loudspeaker, printer, and the like. By means of the communication unit 740, the computing device 700 can further communicate with one or more external devices (not shown) such as the storage devices and display device, with one or more devices enabling the user to interact with the computing device 700, or any devices (such as a network card, a modem and the like)
25 enabling the computing device 700 to communicate with one or more other computing devices, if required. Such communication can be performed via input/output (I/O) interfaces (not shown).

[0248] In some embodiments, instead of being integrated in a single device, some or all components of the computing device 700 may also be arranged in cloud computing
30 architecture. In the cloud computing architecture, the components may be provided remotely and work together to implement the functionalities described in the present disclosure. In some embodiments, cloud computing provides computing, software, data

access and storage service, which will not require end users to be aware of the physical locations or configurations of the systems or hardware providing these services. In various embodiments, the cloud computing provides the services via a wide area network (such as Internet) using suitable protocols. For example, a cloud computing provider provides applications over the wide area network, which can be accessed through a web browser or any other computing components. The software or components of the cloud computing architecture and corresponding data may be stored on a server at a remote position. The computing resources in the cloud computing environment may be merged or distributed at locations in a remote data center. Cloud computing infrastructures may provide the services through a shared data center, though they behave as a single access point for the users. Therefore, the cloud computing architectures may be used to provide the components and functionalities described herein from a service provider at a remote location. Alternatively, they may be provided from a conventional server or installed directly or otherwise on a client device.

[0249] The computing device 700 may be used to implement video encoding/decoding in embodiments of the present disclosure. The memory 720 may include one or more point cloud coding modules 725 having one or more program instructions. These modules are accessible and executable by the processing unit 710 to perform the functionalities of the various embodiments described herein.

[0250] In the example embodiments of performing video encoding, the input device 750 may receive video data as an input 770 to be encoded. The video data may be processed, for example, by the point cloud coding module 725, to generate an encoded bitstream. The encoded bitstream may be provided via the output device 760 as an output 780.

[0251] In the example embodiments of performing video decoding, the input device 750 may receive an encoded bitstream as the input 770. The encoded bitstream may be processed, for example, by the point cloud coding module 725, to generate decoded video data. The decoded video data may be provided via the output device 760 as the output 780.

[0252] While this disclosure has been particularly shown and described with references to preferred embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the spirit and scope of the present application as defined by the appended claims. Such variations are intended to be covered by the scope of this present application. As such, the foregoing

description of embodiments of the present application is not intended to be limiting.

I/We Claim:

1. A method of video processing, comprising:

obtaining, for a conversion between a target frame of a point cloud sequence and a
5 bitstream of the point cloud sequence, a predicted value of the target frame by performing at
least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain;
and

performing the conversion based on the predicted value.

10 2. The method of claim 1, wherein the AC prediction comprises at least one of: an AC
inter prediction or an AC intra prediction, and/or

wherein the DC prediction comprises at least one of: a DC inter prediction or a DC intra
prediction.

15 3. The method of claim 1, wherein the domain is a transform domain.

4. The method of claim 3, wherein the predicted value and a current value are in form
of AC coefficients, and/or

wherein the predicted value and the current value are in form of DC coefficients.

20 5. The method of claim 1, wherein the domain is an attribute domain.

6. The method of claim 5, wherein the predicted value and a current value are in form
of average attribute value or whole attribute value, or

25 wherein the predicted value and the current value are in form of conversion of average
attribute value or conversion of whole attribute value.

7. The method of claim 1, wherein an indication is used to indicate which domain where
the AC prediction and/or DC prediction is performed.

30 8. The method of claim 7, wherein if the indication is equal to a value, the AC prediction
and/or DC prediction is performed in transform domain, and/or

wherein if the indication is not equal to the value, the AC prediction and/or DC prediction is performed in attribute domain.

9. The method of claim 7, wherein if the indication is not equal to a value, the AC prediction and/or DC prediction is performed in transform domain, and/or

wherein if the indication is equal to the value, the AC prediction and/or DC prediction is performed in attribute domain.

10. The method of claim 7, wherein the indication is signaled or pre-defined.

11. The method of claim 1, wherein the predicted value is calculated from at least one of: an AC inter prediction or an AC intra prediction.

12. The method of claim 11, wherein the predicted value is set to a mean value of the AC inter prediction and the AC intra prediction, or

wherein the predicted value is set to a maximum value of the AC inter prediction and the AC intra prediction, or

wherein the predicted value is set to a minimum of the AC inter and intra prediction.

13. The method of claim 1, wherein an AC inter prediction is performed in transform domain, and/or

wherein a DCI inter prediction is performed in transform domain.

14. The method of claim 13, wherein a prediction residual of transform results is signaled.

15. The method of claim 13, wherein a processing is applied to a prediction residual of transform results before being signaled.

16. The method of claim 15, wherein the processing is quantization.

17. The method of claim 1, wherein an AC inter prediction is transform results of predicted attributes of a reference node in a reference frame, and/or

wherein an DC inter prediction is transform results of predicted attributes of a reference node in a reference frame.

18. The method of claim 17, wherein the predicted attributes of the reference node is
5 derived based on reconstructed attributes and reconstructed geometry of the reference frame.

19. The method of claim 1, wherein an AC inter prediction is reconstructed AC coefficients of a reference node in a reference frame, and/or

wherein a DC inter prediction is reconstructed AC coefficients of a reference node in a
10 reference frame.

20. The method of claim 1, wherein the predicted values is processed before being used as a prediction.

21. The method of claim 20, wherein the processing is dequantization.
15

22. The method of claim 1, wherein a prediction value of DC coefficients of all nodes in a current octree is calculated from a DC inter prediction value.

23. The method of claim 1, wherein a prediction value of DC coefficients of partial nodes in a current octree is calculated from a DC inter prediction value.
20

24. The method of claim 1, wherein a prediction value of DC coefficients of a first node in a current octree is calculated from a DC inter prediction value.
25

25. The method of claim 1, wherein different octree decompositions are applied to a current frame and a reference frame.

26. The method of claim 25, wherein a way to do an octree decomposition of a frame is
30 signaled to a decoder.

27. The method of claim 26, wherein an indication is used to indicate whether a same octree decomposition is applied to the current frame and the reference frame.

28. The method of claim 27, wherein the indication is signaled, or wherein the indication is pre-defined.

5 29. The method of claim 25, wherein an octree decomposition of the current frame is determined by geometry information of the current frame.

30. The method of claim 25, wherein an octree decomposition of the reference frame is determined by geometry information of the reference frame.

10 31. The method of claim 25, wherein for each node in the current frame, at most one reference node is in the reference frame.

15 32. The method of claim 31, wherein there is one reference node for a current node, if the reference node and the current node share a same octree location and the reference node is not empty.

20 33. The method of claim 31, wherein there is no reference nodes for a current node, if a reference node and the current node do not share a same octree location and/or the reference node is empty.

34. The method of claim 31, wherein there is one reference node for a current node, if the reference node and a current node share a same octree location.

25 35. The method of claim 31, wherein there is no reference node for a current node, if the reference node and a current node do not share a same octree location.

36. The method of claim 1, wherein at least one of: an AC inter prediction or a DC inter prediction is applied for one node in a current frame based on a condition being met.

30 37. The method of claim 36, wherein at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if the condition where there is one reference node in a reference frame is met.

38. The method of claim 36, wherein at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if the condition where more than one of sub nodes of the current node are occupied is met.

5 39. The method of claim 38, wherein a sub-node is occupied if there are at least one points in the sub-node.

10 40. The method of claim 36, wherein at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if the condition where an intra prediction is enabled for the current node is met.

15 41. The method of claim 36, wherein at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if the condition where the least one of: the AC inter prediction or the DC inter prediction is enabled for an octree layer to which the current node belongs is met.

20 42. The method of any of claims 36-41, wherein at least one of: the AC inter prediction or the DC inter prediction is applied to the current node, if all or partial of the conditions are met.

43. The method of claim 1, wherein at least one of: an AC intra prediction or a DC intra prediction is applied for one node in a current frame based on a condition being met.

25 44. The method of claim 43, wherein at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if the condition where at least one of: the AC intra prediction or the DC intra prediction is enabled for the current node is met.

30 45. The method of claim 43, wherein at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if the condition where an inter prediction is not applied to the current node is met.

46. The method of claim 43, wherein at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if the condition where an octree occupancy code of a reference node is not equal to an octree occupancy code of a current node is met.

47. The method of any of claims 43-46, wherein at least one of: the AC intra prediction or the DC intra prediction is applied to a current node, if all or partial of the conditions are met.

5 48. The method of claim 1, wherein the prediction is applied for a sub-node of a current node based on a condition being met.

49. The method of claim 48, wherein an inter prediction is applied to one sub-node of the current node, if the inter prediction is applied to the current node and there is a reference
10 sub node in a reference frame.

50. The method of claim 49, wherein an intra prediction is applied to one sub node of the current node, if the intra prediction is applied to the current node and an inter prediction is not applied to the current sub node.
15

51. The method of claim 49, wherein an intra prediction is applied to one sub node of the current node, if the intra prediction is applied to the current node.

52. The method of claim 1, wherein the predicted value is generated based on at least
20 one of: an inter prediction value and/or an intra prediction in Region-Adaptive Hierarchical Transform (RAHT) on sets of layers of an octree scan.

53. The method of claim 52, wherein if there is no reference node in a reference frame for a current node, at least one of: AC predicted value or DC predicted value is generated based
25 on the intra prediction value, wherein the reference node and the current node share a same octree location.

54. The method of claim 52, wherein at least one of: AC or DC predicted value is generated based on an intra prediction value on a set of layers of the octree scan.
30

55. The method of claim 54, wherein the set of layers comprises last M layers of the octree scan, or

wherein the set of layers comprises all layers except first M layers of the octree scan.

56. The method of claim 55, wherein M is signaled to a decoder, or wherein M is pre-defined.

57. The method of claim 56, wherein M is coded with at least one of: fixed-length coding,
5 unary coding, or truncated unary coding, or
wherein M is coded in a predictive way.

58. The method of claim 52, wherein at least one of: AC or DC predicted value is
generated based on an inter prediction value and an intra prediction value on a set of layers of
10 the octree scan.

59. The method of claim 58, wherein the set of layers comprises first N layers of the octree scan.

15 60. The method of claim 59, wherein N is signaled to a decoder, or wherein N is pre-defined.

61. The method of claim 60, wherein N is coded with at least one of: fixed-length coding,
unary coding, or truncated unary coding, or
20 wherein N is coded in a predictive way.

62. The method of claim 58, wherein the at least one of: AC predicted value or DC predicted value is transform results of predicted attributes.

25 63. The method of claim 62, wherein the predicted attributes are indicated by a predicted attribute of each sub node of a current node.

64. The method of claim 62, wherein a predicted attribute of one sub node is an intra
prediction value.
30

65. The method of claim 62, wherein a predicted attribute of one sub node is an inter prediction value.

66. The method of claim 62, wherein a predicted attribute of a sub node is an inter prediction value of the sub node, if the inter prediction value of the sub node is not equal to zero.

5 67. The method of claim 62, wherein a predicted attribute of a sub node is an intra prediction value of the sub node if the inter prediction value of the sub node is equal to zero.

68. The method of claim 62, wherein predicted attributes of all sub nodes are inter prediction values of all sub nodes, if there is a reference node.

10

69. The method of claim 62, wherein predicted attributes of all sub nodes are intra prediction values of all sub nodes, if there is no reference node.

70. The method of claim 58, wherein the AC predicted value is reconstructed AC
15 coefficients of a reference node in a reference frame, if there is a reference node.

71. The method of claim 58, wherein the AC predicted value is transform results of intra predicted attributes, if there is no reference node.

20 72. The method of claim 58, wherein the DC predicted value is reconstructed DC coefficients of a reference node in a reference frame, if there is a reference node.

73. The method of claim 58, wherein the DC predicted value is transform results of intra predicted attributes, if there is no reference node.

25

74. The method of claim 52, wherein at least one of: AC predicted value or DC predicted value is generated based on a combination of an inter prediction and an intra prediction value.

75. The method of claim 74, wherein at least one of the AC predicted value or DC
30 predicted value is a weighted average value of the inter prediction and the intra prediction value on a set of layers of an octree scan.

76. The method of claim 75, wherein the set of layers is from (N+1)-th layer to M-th layer of the octree scan, wherein M and N are integer numbers.

77. The method of claim 76, wherein N and M are signaled to a decoder, or wherein N and M are pre-defined.

5 78. The method of claim 77, wherein N and M are coded with at least one of: fixed-length coding, unary coding, or truncated unary coding, or wherein N and M are coded in a predictive way.

10 79. The method of claim 74, wherein at least one of: AC predicted value or DC predicted value is transform results of predicted attributes.

80. The method of claim 79, wherein the predicted attributes are indicated by a predicted attribute of each sub node of a current node.

15 81. The method of claim 79, wherein a predicted attribute of a sub node is an intra prediction value.

20 82. The method of claim 79, wherein a predicted attribute of a sub node is a weighted average value of inter prediction value and intra prediction value.

83. The method of claim 79, wherein a predicted attribute of a sub node is weighted average value of inter prediction value and intra prediction value of the sub node, if the inter prediction value of the sub node is not equal to zero.

25 84. The method of claim 79, wherein a predicted attribute of a sub node is an intra prediction value of a sub node, if the inter prediction value of the sub node is equal to zero.

30 85. The method of claim 79, wherein a predicted attribute of each sub node is a weighted average value of inter prediction value and intra prediction value, if there is a reference node.

86. The method of claim 79, wherein predicted attributes of all sub nodes are intra prediction values of all sub nodes, if there is no reference node.

87. The method of claim 74, wherein the AC predicted value is a weighted average value of reconstructed AC coefficients of a reference node in a reference frame and transform results of intra predicted attributes, if there is a reference node.

5 88. The method of claim 74, wherein the AC predicted value is transform results of intra predicted attributes, if there is no reference node.

89. The method of claim 74, wherein the DC predicted value is a weighted average value of reconstructed DC coefficients of a reference node in a reference frame and transform results
10 of intra predicted attributes, if there is a reference node.

90. The method of claim 74, wherein the DC predicted value is transform results of intra predicted attributes, if there is no reference node.

15 91. The method of claim 74, wherein a weighted average of A and B is calculated as:

$$Average_{weight} = \frac{W_{inter} \times A + W_{intra} \times B}{W_{inter} + W_{intra}},$$
 and wherein W_{inter} and W_{intra} are weighting factors,

wherein A represents an inter prediction value of a sub node and B represents an intra prediction of the sub node, or

20 wherein A represents reconstructed AC and/or DC coefficients of a reference node in a reference frame, and B represents transform results of the intra predicted attributes.

92. The method of claim 74, wherein weights of inter prediction and intra prediction are derived at an encoder, and/or

25 wherein the weights of inter prediction and intra prediction are derived at a decoder.

93. The method of claim 74, wherein weights of inter prediction and intra prediction are determined by a current layer L where a current node is in.

30 94. The method of claim 93, wherein a weight of inter prediction is higher and a weight of intra prediction is lower, if the current node is in a lower layer of the octree.

95. The method of claim 93, wherein a weight of inter prediction is calculated as:

$W_{inter} = M - L + 1$, wherein M and L are numbers.

96. The method of claim 93, wherein a weight of intra prediction is calculated as:

$W_{intra} = L - N$, wherein M and L are numbers.

5

97. The method of claim 74, wherein weights of inter prediction and intra prediction are signaled to a decoder.

98. The method of claim 97, wherein the weights of inter prediction and intra prediction of each layer are signaled to the decoder.

10

99. The method of claim 97, wherein the weights of inter prediction and intra prediction are coded with at least one of: fixed-length coding, unary coding, or truncated unary coding, or wherein the weights of inter prediction and intra prediction are coded in a predictive way.

15

100. The method of claim 52, wherein a plurality of ways of using inter and intra prediction results and/or a plurality of ways of layers to be utilized are enabled.

20

101. The method of claim 100, wherein which way to be applied is pre-defined, or wherein which way to be applied is signaled, or wherein which way to be applied is derived on-the-fly.

102. The method of claim 1, wherein reconstructed coefficients are stored, if a transform is performed.

25

103. The method of claim 102, wherein for each node, there is at least one indication to indicate a node location.

30

104. The method of claim 103, wherein there is an indication to indicate an octree location of a node, or wherein there is an indication to indicate an octree layer of the node.

105. The method of claim 103, wherein the indication is derived at an encoder, or

wherein the indication is derived at a decoder, or
wherein the indication is corresponding to reconstructed coefficients of each node.

106. The method of claim 103, wherein the indication and the corresponding
5 reconstructed coefficients are stored in one list.

107. The method of claim 103, wherein reconstructed coefficients are selected based on
the indication from the list, if the inter prediction is enabled.

108. The method of claim 1, wherein an approach is signaled to determine an inter
10 prediction value.

109. The method of claim 108, wherein there is a plurality of approaches to determine
the inter prediction value.
15

110. The method of claim 109, wherein there is a plurality of approaches to determine
the inter prediction value in transform domain.

111. The method of claim 110, wherein the inter prediction value in transform domain
20 is derived from reconstructed coefficients of a reference node.

112. The method of claim 110, wherein the inter prediction value in transform domain
is derived from transform result of an inter predicted attribute.

113. The method of claim 108, wherein there is an indication to indicate the approach
25 to determine the inter prediction value.

114. The method of claim 113, wherein there is a specific value of indication, for each
approach to determine the inter prediction value.
30

115. The method of claim 108, wherein the indication is derived at an encoder, or
wherein the indication is signaled to a decoder.

116. The method of claim 115, wherein the indication is coded with at least one of: fixed-length coding, unary coding, or truncated unary coding, or wherein the indication is coded in a predictive way.

5 117. The method of any of claims 1-116, wherein whether to and/or how to obtain the predicted value by performing at least one of the AC prediction or the DCI prediction is indicated from an encoder to a decoder in one of:

a bitstream,
a frame,
10 a tile,
a slice, or
an octree.

118. The method of any of claims 1-116, wherein whether to and/or how to obtain the
15 predicted value by performing at least one of the AC prediction or the DCI prediction is dependent on coding information, wherein the coding information comprises at least one of:

dimensions,
colour format,
colour component,
20 slice type, or
picture type.

119. The method of any of claims 1-118, wherein the conversion includes encoding
the target frame into the bitstream.

25 120. The method of any of claims 1-118, wherein the conversion includes decoding the target frame from the bitstream.

30 121. An apparatus for video processing comprising a processor and a non-transitory memory with instructions thereon, wherein the instructions upon execution by the processor, cause the processor to perform a method in accordance with any of claims 1-120.

122. A non-transitory computer-readable storage medium storing instructions that cause a processor to perform a method in accordance with any of claims 1-120.

123. A non-transitory computer-readable recording medium storing a bitstream of a video which is generated by a method performed by an apparatus for video processing, wherein the method comprises:

- 5 obtaining a predicted value of a target frame of a point cloud sequence by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain; and
 generating the bitstream based on the predicted value.

- 10 124. A method for storing a bitstream of a video, comprising:
 obtaining a predicted value of a target frame of a point cloud sequence by performing at least one of: alternating current (AC) prediction or direct current (DC) prediction in a domain;
 generating the bitstream based on the predicted value; and
15 storing the bitstream in a non-transitory computer-readable recording medium.

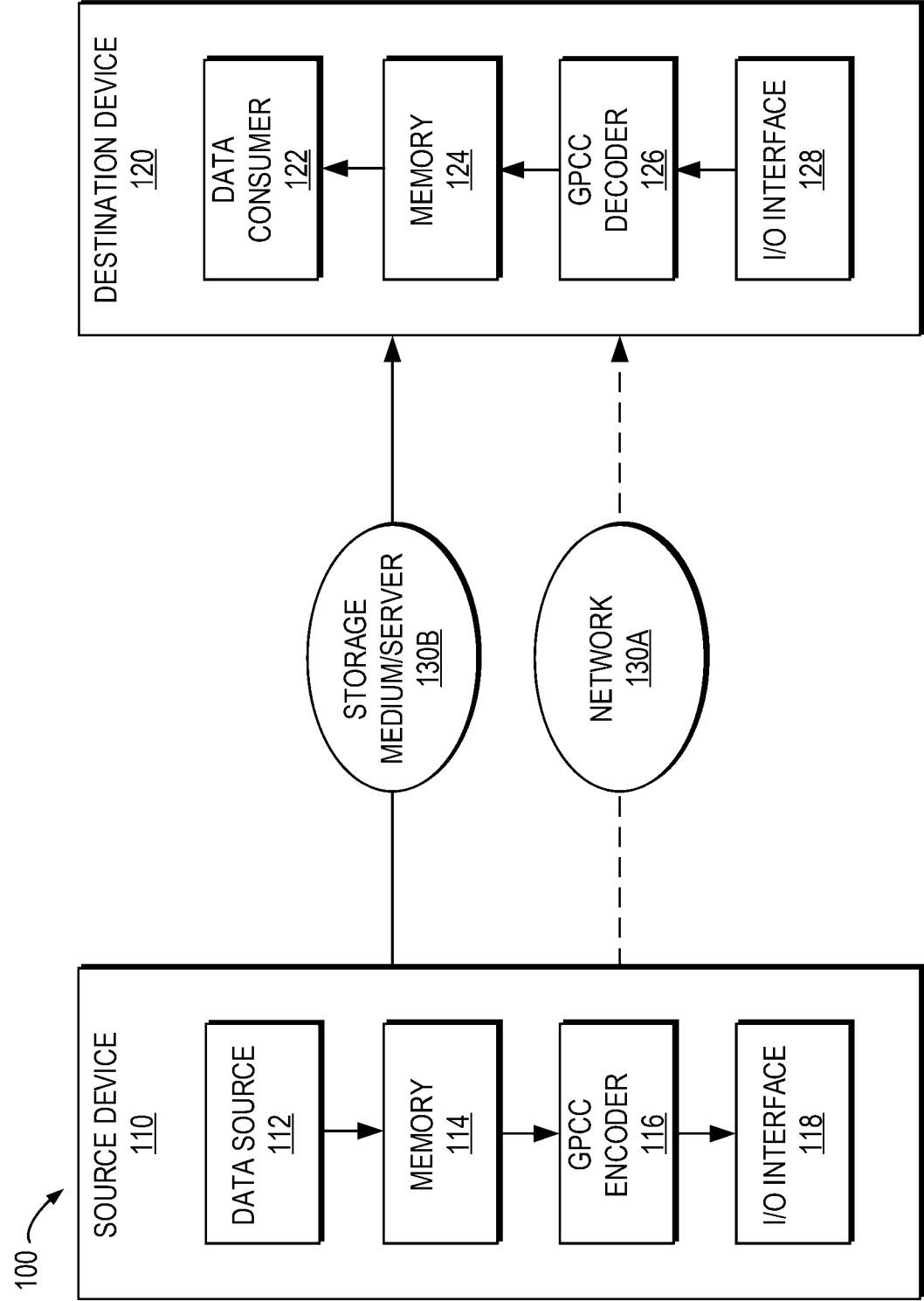


Fig. 1

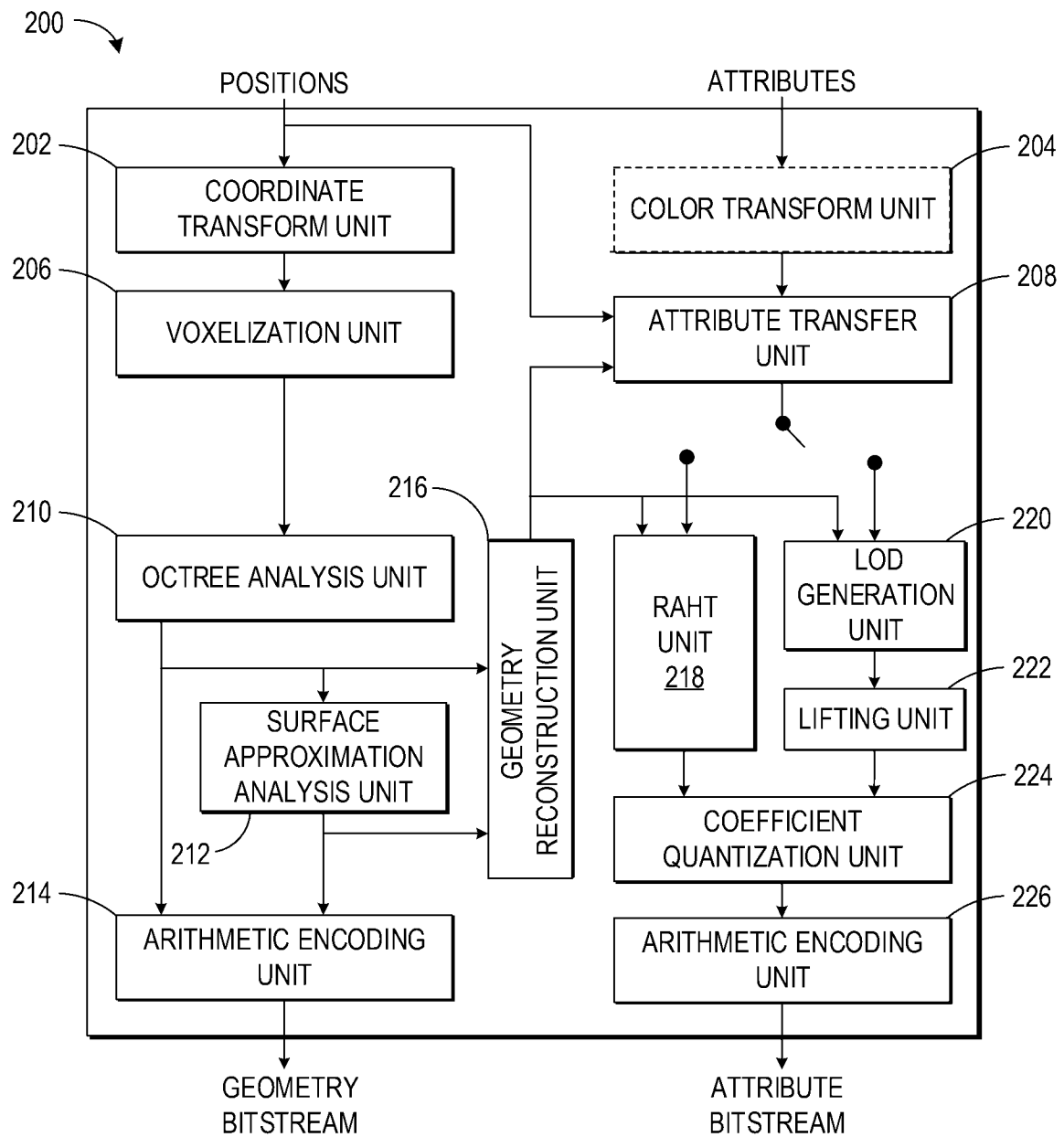


Fig. 2

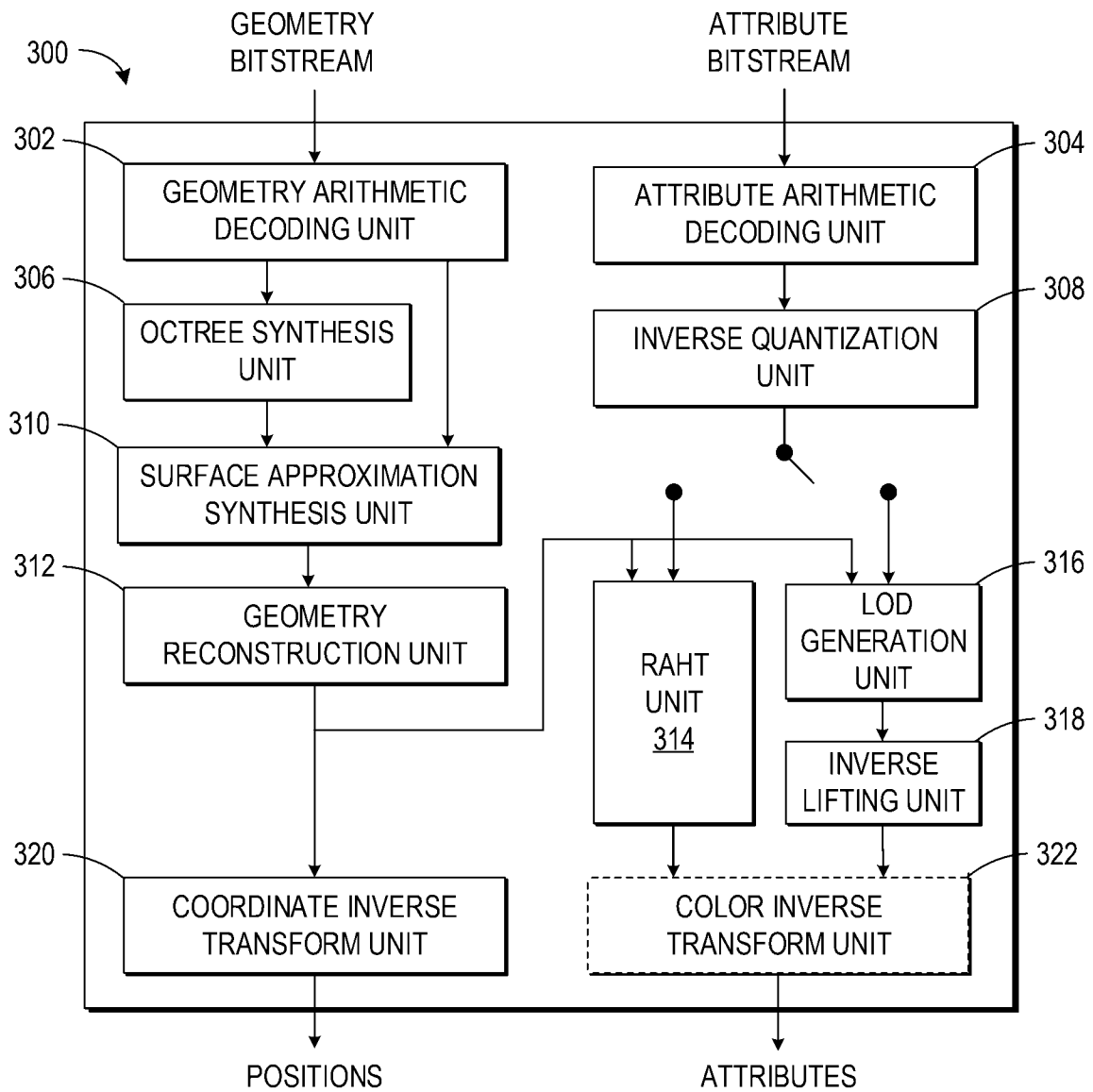


Fig. 3

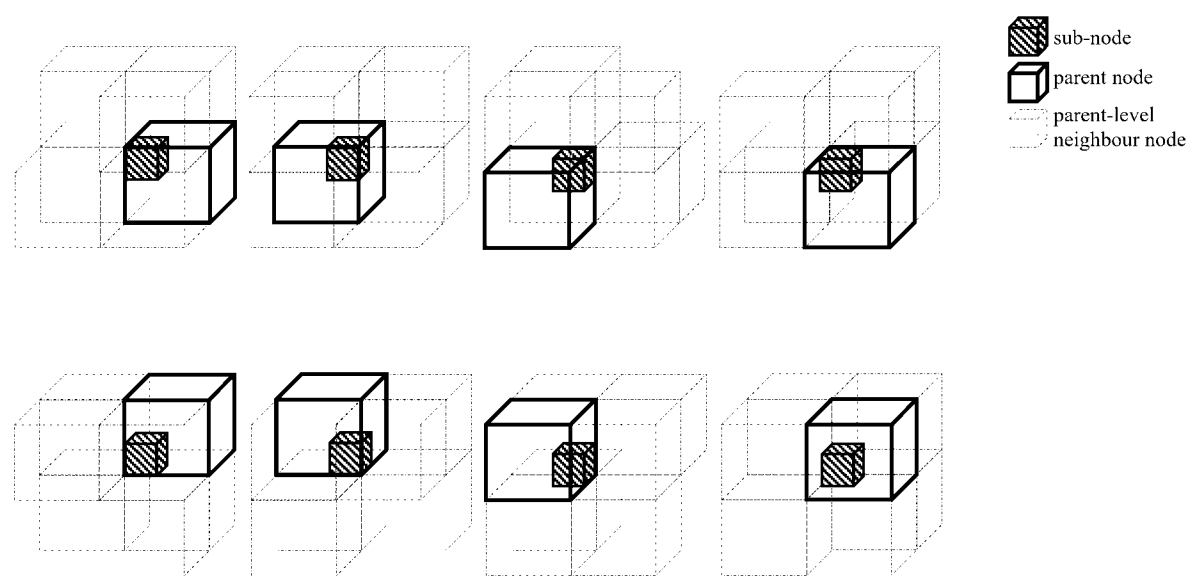


Fig. 4

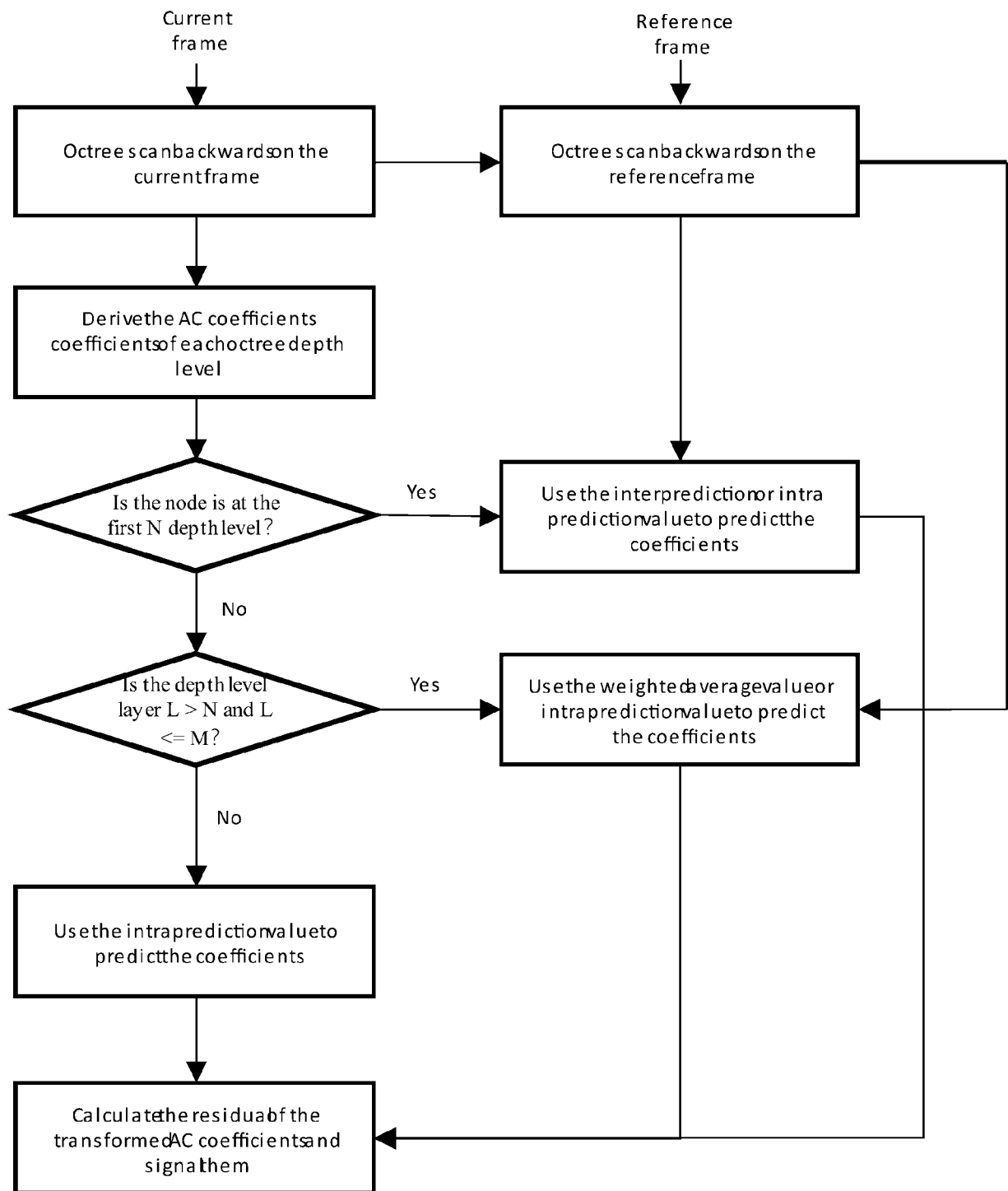


Fig. 5

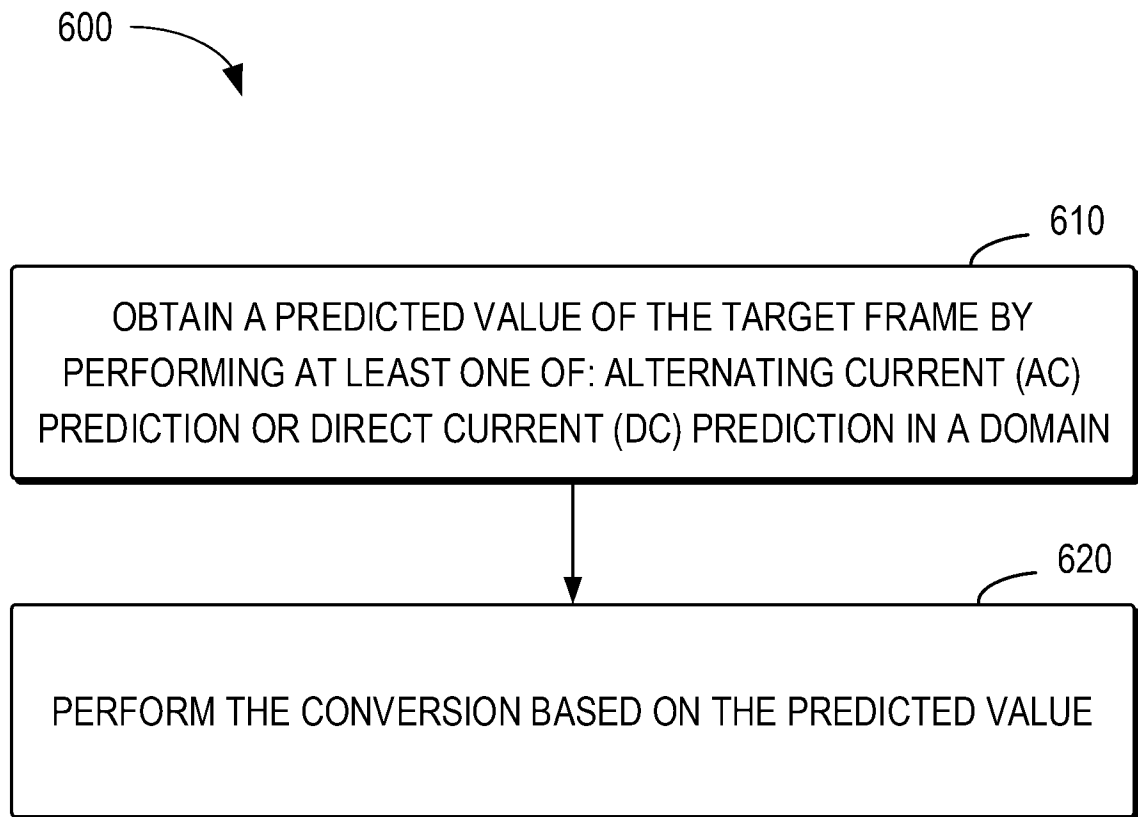


Fig. 6

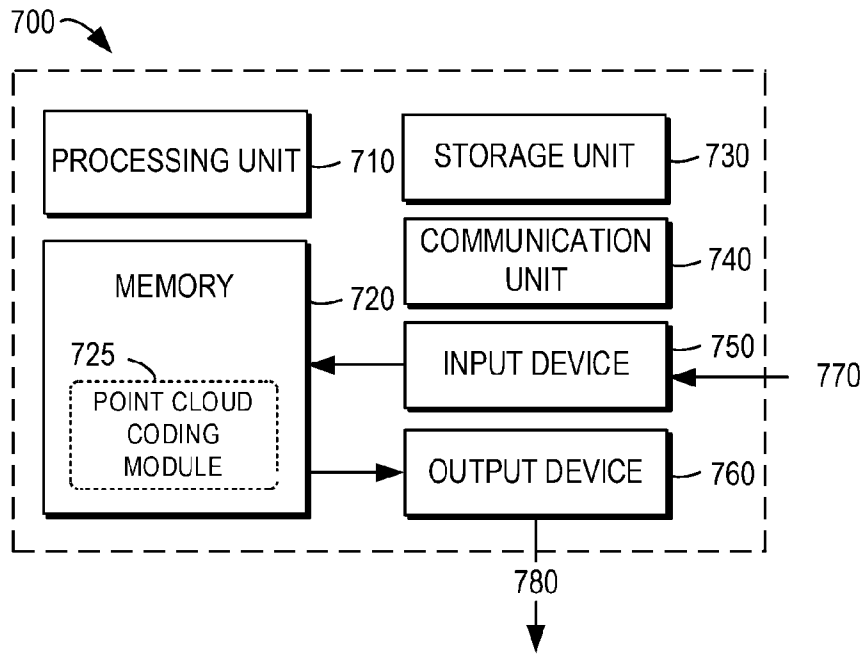


Fig. 7

INTERNATIONAL SEARCH REPORT

International application No.

PCT/CN2024/086881

A. CLASSIFICATION OF SUBJECT MATTER

H04N19/107(2014.01)i; H04N19/96(2014.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC:H04N

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

CNTXT,ENTXT,ENTXTC,DWPI:frame,point cloud, sequence, DC, AC, prediction, alternating, direct, inter, intra, coefficient, attribute, transform, indicate, weight, node, quantitative, condition, RAHT, region, hierarchical, layer

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 202215596 A1 (QUALCOMM INCORPORATED) 07 July 2022 (2022-07-07) Description, paragraphs 2-238, figures 1-12	1-75, 87-90, 92-124
A	US 2023102401 A1 (QUALCOMM INCORPORATED) 30 March 2023 (2023-03-30) The whole document	1-124
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INTERNATIONAL SEARCH REPORT
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International application No.
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