of the most feasible approaches for such multiview applications has turned out to be such wherein only a limited number of input views, e.g. a mono or a stereo video plus some supplementary data, is provided to a decoder side and all required views are then rendered (i.e. synthesized) locally by the decoder to be displayed on a display.

In the encoding of 3D video content, video compression systems, such as Advanced Video Coding standard H.264/AVC or the Multiview Video Coding MVC extension of H.264/AVC can be used.

SUMMARY

Some embodiments provide a method for encoding and decoding video information. In some embodiments of the method a prediction method for a texture block may be determined on the basis of availability of a co-located depth block; and on the basis of the availability of the co-located depth block, a first prediction block for the texture block may be derived on the basis of the co-located depth block, if the co-located depth block is available. If the co-located depth block is not available, a second prediction block for the texture block may be derived without using the co-located depth block.

Various aspects of examples of the invention are provided in the detailed description.

According to an aspect of the invention, a method is disclosed, the method comprising:

receiving one or more encoded texture views and one or more encoded depth views;

decoding one or more indications of the one or more encoded texture views and the one or more encoded depth views to determine which input texture views and input depth views have been encoded; and

decoding the encoded texture views and the encoded depth views from a bitstream, wherein the encoded texture views and the encoded depth views have one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;

- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;
- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:
    - a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid may not be an integer;
    - the first sampling grid does not cover the same sampling area as the second sampling grid.

According to an aspect of the invention, an apparatus is disclosed, the apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

receive one or more encoded texture views and one or more encoded depth views;

decode one or more indications of the one or more encoded texture views and the one or more encoded depth views to determine which input texture views and input depth views have been encoded; and

decode the encoded texture views and the encoded depth views from a bitstream, wherein the encoded texture views and the encoded depth views have one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;
- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;

- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:
    - a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid may not be an integer;

the first sampling grid does not cover the same sampling area as the second sampling grid.

According to an aspect of the invention, a method is disclosed, the method comprising:

receiving, capturing, or deriving one or more input texture views and one or more input depth views;

determining which input texture views and input depth views are to be encoded;

encoding one or more indications of the one or more encoded texture views and the one or more encoded depth views; and

encoding the input texture views and the input depth views determined to be encoded into a bitstream, wherein the encoded texture views and the encoded depth views have one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;
- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;
- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:

- a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid may not be an integer;

the first sampling grid does not cover the same sampling area as the second sampling grid.

According to an aspect of the invention, an apparatus is disclosed, the apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

receive, capture, or derive one or more input texture views and one or more input depth views;

determine which input texture views and input depth views are to be encoded;

encode one or more indications of the one or more encoded texture views and the one or more encoded depth views; and

encode the input texture views and the input depth views determined to be encoded into a bitstream, wherein the encoded texture views and the encoded depth views have one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;
- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;
- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:
  - a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid may not be an integer;

- the first sampling grid does not cover the same sampling area as the second sampling grid.

According to an aspect of the invention, a method is disclosed, the method comprising:

examining availability of a depth block co-located with a texture block;

performing one of the following on the basis of availability of the co-located depth block:

determining a prediction method for a texture block on the basis of availability of the co-located depth block, the prediction method using the co-located depth block if the co-located depth block is available and the prediction method not using the co-located depth block if the co-located depth block is not available; or

on the basis of a co-located depth sample within the co-located depth block being unavailable in said examining, padding or interpolating the co-located depth sample on the basis of one or more available depth samples and treating the co-located depth block as available and determining the prediction method to use the co-located depth block;

deriving a prediction block for the texture block on the basis of the prediction method.

According to an aspect of the invention, an apparatus is disclosed, the apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

examine availability of a depth block co-located with a texture block;

perform one of the following on the basis of availability of the co-located depth block:

determine a prediction method for a texture block on the basis of availability of the co-located depth block, the prediction method using the co-located depth block if the co-located depth block is available and the prediction method not using the co-located depth block if the co-located depth block is not available; or

on the basis of a co-located depth sample within the co-located depth block being unavailable in said examining, pad or interpolate the co-located depth sample on the

basis of one or more available depth samples and treat the co-located depth block as available and determine the prediction method to use the co-located depth block;

derive a prediction block for the texture block on the basis of the prediction method.

According to an aspect of the invention, an apparatus is disclosed, the apparatus comprising

means for examining availability of a depth block co-located with a texture block;

means for performing one of the following on the basis of availability of the co-located depth block:

determining a prediction method for a texture block on the basis of availability of the co-located depth block, the prediction method using the co-located depth block if the co-located depth block is available and the prediction method not using the co-located depth block if the co-located depth block is not available; or

on the basis of a co-located depth sample within the co-located depth block being unavailable in said examining, padding or interpolating the co-located depth sample on the basis of one or more available depth samples and treating the co-located depth block as available and determining the prediction method to use the co-located depth block;

means for deriving a prediction block for the texture block on the basis of the prediction method.

According to an aspect of the invention, a computer program product is disclosed, the computer program product including one or more sequences of one or more instructions which, when executed by one or more processors, cause an apparatus to at least perform the following:

examine availability of a depth block co-located with a texture block;

perform one of the following on the basis of availability of the co-located depth block:

determine a prediction method for a texture block on the basis of availability of the co-located depth block, the prediction method using the co-located depth block if the co-located depth block is available and the prediction method not using the co-located depth block if the co-located depth block is not available; or

on the basis of a co-located depth sample within the co-located depth block being unavailable in said examining, pad or interpolate the co-located depth sample on the basis of one or more available depth samples and treat the co-located depth block as available and determine the prediction method to use the co-located depth block;

derive a prediction block for the texture block on the basis of the prediction method.

According to ~~a first~~ an aspect of the present invention, there is provided a method comprising:

examining availability of a depth block co-located with a texture block;

determining a prediction method for a texture block on the basis of availability of a co-located depth block; and

deriving a first prediction block for the texture block on the basis of the availability of the co-located depth block, if the co-located depth block is available; and otherwise deriving a second prediction block for the texture block without using the co-located depth block.

According to ~~a second~~ an aspect of the present invention, there is provided a method comprising:

examining availability of a depth block co-located with a texture block;

determining a prediction method for a texture block on the basis of availability of a co-located depth block; and

deriving a first prediction block for the texture block on the basis of the availability of the co-located depth block, if the co-located depth block is available; and otherwise deriving a second prediction block for the texture block without using the co-located depth block.

According to ~~a third~~ an aspect of the present invention, there is provided an apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

examine availability of a depth block co-located with a texture block;

determine a prediction method for a texture block on the basis of availability of a co-located depth block; and

derive a first prediction block for the texture block on the basis of the co-located depth block, if the co-located depth block is available; and otherwise deriving a second prediction block for the texture block without using the co-located depth block.

According to ~~a fourth~~ an aspect of the present invention, there is provided an apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

examine availability of a depth block co-located with a texture block;

determine a prediction method for a texture block on the basis of availability of a co-located depth block; and

derive a first prediction block for the texture block on the basis of the co-located depth block, if the co-located depth block is available; and otherwise deriving a second prediction block for the texture block without using the co-located depth block.

According to ~~a fifth~~ an aspect of the present invention, there is provided an apparatus comprising:

means for examining availability of a depth block co-located with a texture block;

means for determining a prediction method for a texture block on the basis of availability of a co-located depth block; and

means for deriving a first prediction block for the texture block on the basis of the co-located depth block, if the co-located depth block is available; and otherwise deriving a second prediction block for the texture block without using the co-located depth block.

According to ~~a sixth~~ an aspect of the present invention, there is provided an apparatus comprising:

means for examining availability of a depth block co-located with a texture block;

determining a prediction method for a texture block on the basis of availability of a co-located depth block; and

means for deriving a first prediction block for the texture block on the basis of the co-located depth block, if the co-located depth block is available; and otherwise deriving a second prediction block for the texture block without using the co-located depth block.

According to ~~a seventh~~ an aspect of the present invention, there is provided a computer program product including one or more sequences of one or more instructions which, when executed by one or more processors, cause an apparatus to at least perform the following:

examine availability of a depth block co-located with a texture block;

determine a prediction method for a texture block on the basis of availability of a co-located depth block; and

derive a first prediction block for the texture block on the basis of the co-located depth block, if the co-located depth block is available; and otherwise deriving a second prediction block for the texture block without using the co-located depth block.

According to an ~~eighth~~ aspect of the present invention, there is provided a computer program product including one or more sequences of one or more instructions

which, when executed by one or more processors, cause an apparatus to at least perform the following:

examine availability of a depth block co-located with a texture block;

determine a prediction method for a texture block on the basis of availability of a co-located depth block; and

derive a first prediction block for the texture block on the basis of the co-located depth block, if the co-located depth block is available; and otherwise deriving a second prediction block for the texture block without using the co-located depth block.

According to ~~a ninth~~ an aspect of the present invention, there is provided a method comprising:

receiving, capturing, or deriving one or more input texture views and one or more input depth views;

determining which input texture views and input depth views are encoded;

encoding one or more indications of the one or more encoded texture views and the one or more encoded depth views; and

encoding the input texture views and the input depth views determined to be encoded into a bitstream, wherein the encoded texture views and the encoded depth views having one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;
- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;
- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:

- a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid is not an integer;
- the first sampling grid does not cover the same sampling area as the second sampling grid.

According to ~~a tenth~~ an aspect of the present invention, there is provided a method comprising:

receiving, capturing, or deriving one or more input texture views and one or more input depth views;

determining which input texture views and input depth views are encoded, wherein the determination comprises one or more of the following:

- concluding if input depth views are needed for prediction of any of the one or more encoded texture views, and determining that depth views needed for prediction of any of the one or more encoded texture views are encoded, while depth views not needed for prediction of any of the one or more encoded texture views are not encoded;
- receiving information which texture views are expected or known to be output on the basis of the bitstream and determining the encoded texture and depth views to facilitate decoding or view synthesis of said texture views expected or known to be output;

encoding the input texture views and the input depth views determined to be encoded into a bitstream; and

encoding one or more indications of the one or more encoded texture views and the one or more encoded depth views.

According to an ~~eleventh~~ aspect of the present invention, there is provided a method comprising:

receiving one or more encoded texture views and one or more encoded depth views;

decoding one or more indications of the one or more encoded texture views and the one or more encoded depth views to determine which input texture views and input depth views have been encoded; and

decoding the encoded texture views and the encoded depth views from a bitstream, wherein the encoded texture views and the encoded depth views having one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;
- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;
- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:
    - a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid is not an integer;
    - the first sampling grid does not cover the same sampling area as the second sampling grid.

According to ~~a twelfth~~ an aspect of the present invention, there is provided an apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

receive, capture, or derive one or more input texture views and one or more input depth views;

determine which input texture views and input depth views are encoded;

encode one or more indications of the one or more encoded texture views and the one or more encoded depth views; and

encode the input texture views and the input depth views determined to be encoded into a bitstream, wherein the encoded texture views and the encoded depth views having one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;
- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;
- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:
    - o a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid is not an integer;
    - o the first sampling grid does not cover the same sampling area as the second sampling grid.

According to ~~a thirteenth~~ an aspect of the present invention, there is provided an apparatus comprising at least one processor and at least one memory including computer

program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

receive, capture, or derive one or more input texture views and one or more input depth views;

determine which input texture views and input depth views are encoded, wherein the determination comprises one or more of the following:

- conclude if input depth views are needed for prediction of any of the one or more encoded texture views, and determine that depth views needed for prediction of any of the one or more encoded texture views are encoded, while depth views not needed for prediction of any of the one or more encoded texture views are not encoded;
- receive information which texture views are expected or known to be output on the basis of the bitstream and determine the encoded texture and depth views to facilitate decoding or view synthesis of said texture views expected or known to be output;

encode the input texture views and the input depth views determined to be encoded into a bitstream; and

encode one or more indications of the one or more encoded texture views and the one or more encoded depth views.

According to ~~a fourteenth~~ an aspect of the present invention, there is provided an apparatus comprising at least one processor and at least one memory including computer program code, the at least one memory and the computer program code configured to, with the at least one processor, cause the apparatus to:

receive one or more encoded texture views and one or more encoded depth views;

decode one or more indications of the one or more encoded texture views and the one or more encoded depth views to determine which input texture views and input depth views have been encoded; and

decode the encoded texture views and the encoded depth views from a bitstream, wherein the encoded texture views and the encoded depth views having one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;
- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;
- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:
    - a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid is not an integer;
    - the first sampling grid does not cover the same sampling area as the second sampling grid.

According to ~~a fifteenth~~ an aspect of the present invention, there is provided an apparatus comprising:

means for receiving, capturing, or deriving one or more input texture views and one or more input depth views;

means for determining which input texture views and input depth views are encoded;

means for encoding one or more indications of the one or more encoded texture views and the one or more encoded depth views; and

means for encoding the input texture views and the input depth views determined to be encoded into a bitstream, wherein the encoded texture views and the encoded depth views having one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;

- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;
- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:
    - a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid is not an integer;
    - the first sampling grid does not cover the same sampling area as the second sampling grid.

According to ~~a sixteenth~~ an aspect of the present invention, there is provided an apparatus comprising:

means for receiving, capturing, or deriving one or more input texture views and one or more input depth views;

means for determining which input texture views and input depth views are encoded, wherein the means for determination comprises one or more of the following:

- means for concluding if input depth views are needed for prediction of any of the one or more encoded texture views, and determining that depth views needed for prediction of any of the one or more encoded texture views are encoded, while depth views not needed for prediction of any of the one or more encoded texture views are not encoded;
- means for receiving information which texture views are expected or known to be output on the basis of the bitstream and determining the encoded texture and depth views to facilitate decoding or view synthesis of said texture views expected or known to be output;

means for encoding the input texture views and the input depth views determined to be encoded into a bitstream; and

means for encoding one or more indications of the one or more encoded texture views and the one or more encoded depth views.

According to ~~a seventeenth~~ an aspect of the present invention, there is provided an apparatus comprising:

means for receiving one or more encoded texture views and one or more encoded depth views;

means for decoding one or more indications of the one or more encoded texture views and the one or more encoded depth views to determine which input texture views and input depth views have been encoded; and

means for decoding the encoded texture views and the encoded depth views from a bitstream, wherein the encoded texture views and the encoded depth views having one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;
- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;
- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:
    - a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid is not an integer;
    - the first sampling grid does not cover the same sampling area as the second sampling grid.

According to an ~~eighteenth~~ aspect of the present invention, there is provided a computer program product including one or more sequences of one or more instructions

According to ~~a nineteenth~~ an aspect of the present invention, there is provided a computer program product including one or more sequences of one or more instructions which, when executed by one or more processors, cause an apparatus to at least perform the following:

receive, capture, or derive one or more input texture views and one or more input depth views;

determine which input texture views and input depth views are encoded, wherein the determination comprises one or more of the following:

- conclude if input depth views are needed for prediction of any of the one or more encoded texture views, and determine that depth views needed for prediction of any of the one or more encoded texture views are encoded, while depth views not needed for prediction of any of the one or more encoded texture views are not encoded;
- receive information which texture views are expected or known to be output on the basis of the bitstream and determine the encoded texture and depth views to facilitate decoding or view synthesis of said texture views expected or known to be output;

encode the input texture views and the input depth views determined to be encoded into a bitstream; and

encode one or more indications of the one or more encoded texture views and the one or more encoded depth views.

According to ~~a twentieth~~ an aspect of the present invention, there is provided a computer program product including one or more sequences of one or more instructions which, when executed by one or more processors, cause an apparatus to at least perform the following:

receive one or more encoded texture views and one or more encoded depth views;

decode one or more indications of the one or more encoded texture views and the one or more encoded depth views to determine which input texture views and input depth views have been encoded; and

decode the encoded texture views and the encoded depth views from a bitstream, wherein the encoded texture views and the encoded depth views having one or more of the following characteristics:

- an encoded depth view represents a viewpoint that is not represented by any encoded texture view of the bitstream;
- two or more encoded depth views represent a same viewpoint;
- a first encoded depth view comprises depth view components of a first depth map type and a second encoded depth view comprises depth view components of a second depth map type, the first depth map type and the second depth map type being different;
- an encoded depth view and an encoded texture view represent a same viewpoint, a first sampling grid being used for depth view components of the encoded depth view and a second sampling grid being used for texture view component of the encoded texture view, and the first sampling grid and the second sampling grid having one or more of the following characteristics:
    - o a ratio of a horizontal or vertical sample dimension of the first sampling grid and a horizontal or vertical sample dimension, respectively, of the second sampling grid is not an integer;

the first sampling grid does not cover the same sampling area as the second sampling grid.

According to ~~a twenty-first~~ an aspect of the present invention, there is provided a method comprising:

receiving from a bitstream a first depth view of a first viewpoint, the bitstream not including a texture view of the first viewpoint,

decoding the first depth view,

using backward view synthesis to the first viewpoint based on the decoded first depth view.

BRIEF DESCRIPTION OF THE DRAWINGS

For a more complete understanding of example embodiments of the present invention, reference is now made to the following descriptions taken in connection with the accompanying drawings in which: