

SUMMARY

According to some example embodiments of the present invention there is provided a slice header prediction method and apparatuses for 3D video encoding and decoding. In some example embodiments the following features can be derived from the header prediction method. Any decoding order of texture and depth view components may be supported. Also flexible prediction of syntax elements from any slice header appearing earlier in decoding order within the same access unit is allowed. The prediction can be turned on or off on view component basis. The syntax elements of the slice header may be categorized in a few sets and the use of the prediction as well as the prediction source for each set can be individually controlled. By using some example embodiments of the method all syntax elements of the slice header may be predicted.

In some example embodiments the slice header prediction tool can be summarized as follows. Syntax elements of slice headers are grouped into group of slices (GOS) parameter sets. GOS parameter sets may be valid at maximum for an access unit. GOS parameter sets specified for an access unit may be made. The slice header of the texture view component of the base view implicitly forms GOS parameter set. GOS parameter sets may be included in-line in the bitstream.

In some example embodiments the GOS parameter set contains three types of syntax elements or structures. The GOS parameter set may contain syntax structures that may be copied from an identified GOS parameter set. These syntax structures include reference picture list modification, prediction weight table, and decoded reference picture marking. The GOS parameter set may also contain syntax structures that remain unchanged for an entire view component. The GOS parameter set may optionally contain syntax structures that remain unchanged for the entire access unit.

A GOS parameter set may inherit syntax structures from more than one other GOS parameter set. For example, reference picture list modification may be inherited from one GOS parameter set, while decoded reference picture marking may be inherited from another GOS parameter set.

GOS parameter sets may be repeated. If they are repeated for each slice, the same error robustness as having a full slice header may be obtained.

Various aspects of examples of the invention are set out in the claims.

According to a first aspect of the present invention, there is provided a method comprising: encoding an uncompressed picture into a coded picture comprising a slice, the encoding comprising:

classifying syntax elements for the slice into a first set and a second set;
determining syntax element values for the first set and the second set;
encoding the first set selectively in a first group of slices parameter set or a slice header, wherein said encoding comprising one of the following:
providing an indication of an inclusion of the respective first set from another group of slices parameter set; or
encoding the syntax element values of the first set; or
omitting both of the above; and

encoding the second set selectively in a second group of slices parameter set or the slice header,
wherein said encoding comprising one of the following: for encoding three-dimensional (3D) video
content comprising a texture view component and a depth view component, comprising:
5 encoding an uncompressed picture into a coded picture comprising a coded slice of the texture
view component and a coded slice of the depth view component, the encoding comprising:
classifying syntax elements for the slice of the depth view component into a first set and a second
set;
determining syntax element values for the first set and the second set;
10 encoding syntax element values for the first set selectively in a group of slices parameter set or
slice header of the slice of the depth view component;
providing an indication, in the slice header of the slice of the depth view component, whether the
syntax element values for the first set is to be inferred from the group of slices parameter set, or included
in the slice header of the slice of the depth view component ; and
15 encoding the syntax element values of the second set in the slice header of the slice of the depth
view component.

~~providing an indication of an inclusion of the respective second set from another group of slices parameter set; or~~

~~encoding the syntax element values of the second set; or~~

~~emitting both of the above.~~

According to a second 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:

~~classify syntax elements for a slice of a coded picture comprising into a first set and a second set;~~

~~determine syntax element values for the first set and the second set;~~

~~encode the first set selectively in a first group of slices parameter set or a slice header comprising one of the following:~~

~~providing an indication of an inclusion of the respective first set from another group of slices parameter set; or~~

~~encoding the syntax element values of the first set; or~~

~~emitting both of the above; and~~

~~encode the second set selectively in a second group of slices parameter set or the slice header comprising one of the following:~~

~~providing an indication of an inclusion of the respective second set from another group of slices parameter set; or~~

~~encoding the syntax element values of the second set; or~~

~~emitting both of the above.~~ for encoding three-dimensional (3D) video content comprising a texture view component and a depth view component, 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:

encode an uncompressed picture into a coded picture comprising a coded slice of the texture view component and a coded slice of the depth view component, the encoding comprising:

classify syntax elements for the slice of the depth view component into a first set and a second set;

determine syntax element values for the first set and the second set;

encode syntax element values for the first set selectively in a group of slices parameter set or slice header of the slice of the depth view component;

provide an indication, in the slice header of the slice of the depth view component, whether the syntax element values for the first set is to be inferred from the group of slices parameter set, or included in the slice header of the slice of the depth view component ; and

encode the syntax element values of the second set in the slice header of the slice of the depth view component.

According to a third 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:

5 classify syntax elements for a slice of a coded picture comprising into a first set and a second set;
 determine syntax element values for the first set and the second set;
 encode the first set selectively in a first group of slices parameter set or a slice header comprising
 one of the following:

providing an indication of an inclusion of the respective first set from another group of slices
 parameter set; or

10 encoding the syntax element values of the first set; or
 emitting both of the above; and

encode the second set selectively in a second group of slices parameter set or the slice header
 comprising one of the following:

15 providing an indication of an inclusion of the respective second set from another group of slices
 parameter set; or

encoding the syntax element values of the second set; or

emitting both of the above; for encoding three-dimensional (3D) video content comprising a
 texture view component and a depth view component, the computer program product including one or
 more sequences of one or more instructions which, when executed by one or more processors, cause an
20 apparatus to at least perform the following:

encode an uncompressed picture into a coded picture comprising a coded slice of the texture view
 component and a coded slice of the depth view component, the encoding comprising:

classify syntax elements for the slice of the depth view component into a first set and a second
 set;

25 determine syntax element values for the first set and the second set;

encode syntax element values for the first set selectively in a group of slices parameter set or
 slice header of the slice of the depth view component;

30 provide an indication, in the slice header of the slice of the depth view component, whether the
 syntax element values for the first set is to be inferred from the group of slices parameter set, or included
 in the slice header of the slice of the depth view component ; and

encode the syntax element values of the second set in the slice header of the slice of the depth
 view component.

35 According to a fourth aspect of the present invention, there is provided an apparatus comprising a
 method for decoding coded three-dimensional (3D) video content comprising a texture view component
 and a depth view component, the method comprising:

decoding a coded slice of the depth view component;

identifying a first location of a first set of syntax elements and a second location of a second set
 of syntax elements to be used for decoding the coded slice of the depth view component to be one of a
 slice header of the slice of the depth view component or a group of slices parameter set,

decoding from the slice header of the slice of the depth view component a first indication whether the syntax element values for the first set is to be inferred from the group of slices parameter set, or included in the slice header of the slice of the depth view component;

5 in response to the first indication indicating that the syntax element values for the first set is included in the slice header of the slice of the depth view component, decoding the syntax element values of the first set from the slice header of the slice of the depth view component, otherwise, predicting the syntax element values for the first set from the group of slices parameter set;

decoding the syntax element values of the second set from the slice header of the slice of the depth view component; and

10 decoding the coded slice of a depth view component using the decoded first set and the second set of syntax elements.

means for classifying syntax elements for a slice of a coded picture comprising into a first set and a second set;

means for determining syntax element values for the first set and the second set;

means for encoding the first set selectively in a first group of slices parameter set or a slice header comprising one of the following:

providing an indication of an inclusion of the respective first set from another group of slices parameter set; or

encoding the syntax element values of the first set; or

omitting both of the above; and

means for encoding the second set selectively in a second group of slices parameter set or the slice header comprising one of the following:

providing an indication of an inclusion of the respective second set from another group of slices parameter set; or

encoding the syntax element values of the second set; or

omitting both of the above.

According to a fifth aspect of the present invention, there is provided a method comprising: decoding a coded slice of a coded picture, the decoding comprising: identifying a first location of a first set of syntax elements and a second location of a second set of syntax elements to be used for decoding the coded slice to be one of a slice header or a group of slices parameter set;

decoding the first set of syntax elements and the second set of syntax elements to be used for decoding the coded slice, comprising:

decoding a first indication of an inclusion of the respective first set from a third group of slices parameter set, and as a response to the first indication being indicative of the third group of slices parameter set, decoding a respective first set of syntax elements from the third group of slices parameter set; and

decoding a second indication of an inclusion of the respective second set from a fourth group of slices parameter set, and as response to the first indication being indicative of the fourth group of slices parameter set, decoding a respective first set of syntax elements from the fourth group of slices parameter set; and

decoding the coded slice using the decoded first set and the second set of syntax elements. an apparatus for decoding coded three-dimensional (3D) video content comprising a texture view component and a depth view component, 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:

decode a coded slice of the depth view component;

identify a first location of a first set of syntax elements and a second location of a second set of syntax elements to be used for decoding the coded slice of the depth view component to be one of a slice header of the slice of the depth view component or a group of slices parameter set,

decode from the slice header of the slice of the depth view component a first indication whether the syntax element values for the first set is to be inferred from the group of slices parameter set, or included in the slice header of the slice of the depth view component;

in response to the first indication indicating that the syntax element values for the first set is included in the slice header of the slice of the depth view component, decode the syntax element values of the first set from the slice header of the slice of the depth view component, otherwise, predicting the syntax element values for the first set from the group of slices parameter set;

decode the syntax element values of the second set from the slice header of the slice of the depth view component; and

decode the coded slice of a depth view component using the decoded first set and the second set of syntax elements.

~~According to a sixth 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:~~

~~decode a coded slice of a coded picture by:~~

~~identifying a first location of a first set of syntax elements and a second location of a second set of syntax elements to be used for decoding the coded slice to be one of a slice header or a group of slices parameter set,~~

~~decoding the first set of syntax elements and the second set of syntax elements to be used for decoding the coded slice, comprising: a computer program product for decoding coded three-dimensional (3D) video content comprising a texture view component and a depth view component, 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:~~

~~decode a coded slice of the depth view component;~~

~~identify a first location of a first set of syntax elements and a second location of a second set of syntax elements to be used for decoding the coded slice of the depth view component to be one of a slice header of the slice of the depth view component or a group of slices parameter set,~~

~~decode from the slice header of the slice of the depth view component a first indication whether the syntax element values for the first set is to be inferred from the group of slices parameter set, or included in the slice header of the slice of the depth view component;~~

~~in response to the first indication indicating that the syntax element values for the first set is included in the slice header of the slice of the depth view component, decode the syntax element values of the first set from the slice header of the slice of the depth view component, otherwise, predicting the syntax element values for the first set from the group of slices parameter set;~~

~~decode the syntax element values of the second set from the slice header of the slice of the depth view component; and~~

~~decode the coded slice of a depth view component using the decoded first set and the second set of syntax elements.~~

decoding a first indication of an inclusion of the respective first set from a third group of slices parameter set, and as a response to the first indication being indicative of the third group of slices parameter set, decoding a respective first set of syntax elements from the third group of slices parameter set; and

decoding a second indication of an inclusion of the respective second set from a fourth group of slices parameter set, and as response to the first indication being indicative of the fourth group of slices parameter set, decoding a respective first set of syntax elements from the fourth group of slices parameter set; and

decoding the coded slice using the decoded first set and the second set of syntax elements.

According to a seventh 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:

decode a coded slice of a coded picture by:

identifying a first location of a first set of syntax elements and a second location of a second set of syntax elements to be used for decoding the coded slice to be one of a slice header or a group of slices parameter set;

decoding the first set of syntax elements and the second set of syntax elements to be used for decoding the coded slice, comprising:

decoding a first indication of an inclusion of the respective first set from a third group of slices parameter set, and as a response to the first indication being indicative of the third group of slices parameter set, decoding a respective first set of syntax elements from the third group of slices parameter set; and

decoding a second indication of an inclusion of the respective second set from a fourth group of slices parameter set, and as response to the first indication being indicative of the fourth group of slices parameter set, decoding a respective first set of syntax elements from the fourth group of slices parameter set; and

decoding the coded slice using the decoded first set and the second set of syntax elements.

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

decoding a coded slice of a coded picture, the decoding comprising:

identifying a first location of a first set of syntax elements and a second location of a second set of syntax elements to be used for decoding the coded slice to be one of a slice header or a group of slices parameter set;

decoding the first set of syntax elements and the second set of syntax elements to be used for decoding the coded slice, comprising:

decoding a first indication of an inclusion of the respective first set from a third group of slices parameter set, and as a response to the first indication being indicative of the third group of slices parameter set, decoding a respective first set of syntax elements from the third group of slices parameter set; or if the first indication is not indicative of the third group of slices parameter set, decoding syntax elements of the first set; and

decoding a second indication of an inclusion of the respective second set from a fourth group of slices parameter set, and as response to the first indication being indicative of the fourth group of slices parameter set, decoding a respective first set of syntax elements from the fourth group of slices parameter set; or if the second indication is not indicative of the fourth group of slices parameter set, decoding syntax elements of the second set; and

decoding the coded slice using the decoded first set of syntax elements and the second set of syntax elements.

According to a ninth 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:

decode a coded slice of a coded picture by:

identifying a first location of a first set of syntax elements and a second location of a second set of syntax elements to be used for decoding the coded slice to be one of a slice header or a group of slices parameter set;

decoding the first set of syntax elements and the second set of syntax elements to be used for decoding the coded slice, comprising:

decoding a first indication of an inclusion of the respective first set from a third group of slices parameter set, and as a response to the first indication being indicative of the third group of slices parameter set, decoding a respective first set of syntax elements from the third group of slices parameter set; or if the first indication is not indicative of the third group of slices parameter set, decode syntax elements of the first set; and

decoding a second indication of an inclusion of the respective second set from a fourth group of slices parameter set, and as response to the first indication being indicative of the fourth group of slices parameter set, decoding a respective first set of syntax elements from the fourth group of slices parameter set; or if the second indication is not indicative of the fourth group of slices parameter set, decode syntax elements of the second set; and

decoding the coded slice using the decoded first set of syntax elements and the second set of syntax elements.

According to a tenth 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:

decode a coded slice of a coded picture by:

identifying a first location of a first set of syntax elements and a second location of a second set of syntax elements to be used for decoding the coded slice to be one of a slice header or a group of slices parameter set;

decoding the first set of syntax elements and the second set of syntax elements to be used for decoding the coded slice, comprising:

decoding a first indication of an inclusion of the respective first set from a third group of slices parameter set, and as a response to the first indication being indicative of the third group of slices parameter set, decoding a respective first set of syntax elements from the third group of slices parameter

set; or if the first indication is not indicative of the third group of slices parameter set, decoding syntax elements of the first set; and

decoding a second indication of an inclusion of the respective second set from a fourth group of slices parameter set, and as response to the first indication being indicative of the fourth group of slices parameter set, decoding a respective first set of syntax elements from the fourth group of slices parameter set; or if the second indication is not indicative of the fourth group of slices parameter set, decoding syntax elements of the second set; and

decoding the coded slice using the decoded first set of syntax elements and the second set of syntax elements.

According to an eleventh aspect of the present invention, there is provided an apparatus comprising:

means for decoding a coded slice of a coded picture, the decoding comprising:

means for identifying a first location of a first set of syntax elements and a second location of a second set of syntax elements to be used for decoding the coded slice to be one of a slice header or a group of slices parameter set,

means for decoding the first set of syntax elements and the second set of syntax elements to be used for decoding the coded slice, comprising:

means for decoding a first indication of an inclusion of the respective first set from a third group of slices parameter set, and as a response to the first indication being indicative of the third group of slices parameter set, decoding a respective first set of syntax elements from the third group of slices parameter set; or if the first indication is not indicative of the third group of slices parameter set, decoding syntax elements of the first set; and

means for decoding a second indication of an inclusion of the respective second set from a fourth group of slices parameter set, and as response to the first indication being indicative of the fourth group of slices parameter set, decoding a respective first set of syntax elements from the fourth group of slices parameter set; or if the second indication is not indicative of the fourth group of slices parameter set, decoding syntax elements of the second set; and

means for decoding the coded slice using the decoded first set of syntax elements and the second set of syntax elements.

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:

Fig. 1 shows a block diagram of a video coding system according to an example embodiment;

Fig. 2 shows an apparatus for video coding according to an example embodiment;

Fig. 3 shows an arrangement for video coding comprising a plurality of apparatuses, networks and network elements according to an example embodiment; and

Figs. 4a, 4b show block diagrams for video encoding and decoding according to an example embodiment;

Figure 5 shows a simplified model of a DIBR-based 3DV system;