[0005]

[NPL 1] ITU-T H.264 03/2010

[Summary of Invention]

[Technical Problem]

[0006]

However, there is a situation where IPCM blocks prohibit improvement of coding efficiency. A data amount of an IPCM block depends on a size of luma and chroma bit-depth. As a bit-depth is greater, a data amount of an uncompressed IPCM block is larger. Therefore, in the above situation, IPCM blocks prohibit improvement of coding efficiency.

[0007]

In order to address the above, one non-limiting and exemplary embodiment provides an image coding method and an image decoding method by which coding efficiency can be improved by using an adaptive bit-depth.

[Solution to Problem]

[0008]

According to one~~In one general~~ aspect of the present invention~~disclosure for solving the above problem~~, there is provided an image coding method of coding images to generate a coded stream, the image coding method including: writing a first parameter into a sequence parameter set in the coded stream to be generated, the first parameter representing a first bit-depth that is a bit-depth of a reconstructed sample in the images; and writing a second parameter different from the first parameter into the sequence parameter set, the second parameter representing a second bit-depth that is a bit-depth of an Intra Pulse Code Modulation (IPCM) sample in the images.

[0009]

Thereby, it is possible to set the bit-depth for IPCM samples separately and independently from the bit-depth for reconstructed samples. Therefore, redundant data of the IPCM samples can be reduced. As a result, coding efficiency can be improved.

a third bit-depth is written, the third bit-depth being a bit-depth of an original sample in the images, and the image coding method may further include converting the original sample at the third bit-depth into a sample at the second bit-depth, so as to decrease the bit-depth of the IPCM sample corresponding to the original sample.

[0019]

Thereby, it is possible to reduce redundant data of IPCM samples corresponding to original samples. As a result, coding efficiency can be improved.

[0020]

Still further, in the writing of the first parameter, the first parameter representing the first bit-depth that may be larger than a third bit-depth is written, the third bit-depth being a bit-depth of an original sample in the images, and the image coding method may further include converting the original sample at the third bit-depth into a sample at the first bit-depth, so as to increase the bit-depth of the reconstructed sample corresponding to the original sample.

[0021]

Thereby, it is possible to increase the bit-depth of reconstructed samples corresponding to original samples. As a result, image quality can be improved.

[0022]

Still further, the image coding method may further include writing a coded sample coded using the reconstructed sample at the first bit-depth into the coded stream.

[0023]

Thereby, coded samples coded using reconstructed samples at the bit-depth for reconstructed samples are written to the coded stream.

[0024]

In another aspect of the present invention~~disclosure~~, there is provided an image decoding method of decoding images in a coded stream, the image decoding method including: obtaining a first parameter from a sequence parameter set in the coded stream, the first parameter representing a first bit-depth that is a bit-depth of a reconstructed

[0040]

Still further, the image decoding method may further include obtaining a coded sample to be decoded using the reconstructed sample at the first bit-depth from the coded stream.

[0041]

Thereby, it is possible to decode coded samples obtained from the coded stream, by using reconstructed samples at the bit-depth for reconstructed samples.

[0042]

In still another aspect of the present invention~~disclosure~~, there is provided an image coding apparatus that codes images to generate a coded stream, the image coding apparatus including: a first writing unit configured to write a first parameter into a sequence parameter set in the coded stream to be generated, the first parameter representing a first bit-depth that is a bit-depth of a reconstructed sample in the images; and a second writing unit configured to write a second parameter different from the first parameter into the sequence parameter set, the second parameter representing a second bit-depth that is a bit-depth of an Intra Pulse Code Modulation (IPCM) sample in the images.

[0043]

Thereby, the image coding method is implemented as the image coding apparatus.

[0044]

In still another aspect of the present invention~~disclosure~~, there is provided an image decoding apparatus that decodes images in a coded stream, the image decoding apparatus including: a first obtaining unit configured to obtain a first parameter from a sequence parameter set in the coded stream, the first parameter representing a first bit-depth that is a bit-depth of a reconstructed sample in the images; and a second obtaining unit configured to obtain a second parameter different from the first parameter from the sequence parameter set, the second parameter representing a second bit-depth that is a bit-depth of an Intra Pulse Code Modulation (IPCM) sample in the images.

[0045]

Thereby, the image decoding method is implemented as the image decoding apparatus.

[0046]

In still another aspect of the present invention~~disclosure~~, there is provided an image coding and decoding apparatus including an image coding unit configured to code images to generate a coded stream, wherein the image coding unit includes: a first writing unit configured to write a first parameter into a sequence parameter set in the coded stream to be generated, the first parameter representing a first bit-depth that is a bit-depth of a reconstructed sample in the images; and a second writing unit configured to write a second parameter different from the first parameter into the sequence parameter set, the second parameter representing a second bit-depth that is a bit-depth of an Intra Pulse Code Modulation (IPCM) sample in the images, and the image coding and decoding apparatus further including an image decoding unit configured to decode images in a coded stream, wherein the image decoding unit includes: a first obtaining unit configured to obtain a first parameter from a sequence parameter set in the coded stream, the first parameter representing a first bit-depth that is a bit-depth of a reconstructed sample in the images; and a second obtaining unit configured to obtain a second parameter different from the first parameter from the sequence parameter set, the second parameter representing a second bit-depth that is a bit-depth of an IPCM sample in the images.

[0047]

Thereby, the image coding apparatus and the image decoding apparatus are implemented as the image coding and decoding apparatus.

[Advantageous Effects of Invention]

[0048]

According to embodiments of the present invention~~disclosure~~, it is possible to set a bit-depth for IPCM samples separately and independently from a bit-depth for reconstructed samples. Therefore, redundant data of