A VIDEO ENCODER, A VIDEO DECODER AND CORRESPONDING METHODS~~Tile Groups For Flexible Tiling in Video Coding~~

~~CROSS-REFERENCE TO RELATED APPLICATIONS~~

~~**[0001]** This patent application claims the benefit of U.S. Provisional Patent Application No. 62/786,167, filed December 28, 2018 by Ye-Kui Wang, et. al., and titled "Flexible Tiling in Video Coding," which is hereby incorporated by reference.~~

TECHNICAL FIELD

[~~0002~~0001] The present disclosure is generally related to video coding, and is specifically related to a flexible video tiling scheme that supports multiple tiles with different resolutions in the same picture.

BACKGROUND

[~~0003~~0002] The amount of video data needed to depict even a relatively short video can be substantial, which may result in difficulties when the data is to be streamed or otherwise communicated across a communications network with limited bandwidth capacity. Thus, video data is generally compressed before being communicated across modern day telecommunications networks.

[0003] The size of a video could also be an issue when the video is stored on a storage device because memory resources may be limited. Video compression devices often use software and/or hardware at the source to code the video data prior to transmission or storage, thereby decreasing the quantity of data needed to represent digital video images. The compressed data is then received at the destination by a video decompression device that decodes the video data. With limited network resources and ever increasing demands of higher video quality, improved compression and decompression techniques that improve compression ratio with little to no sacrifice in image quality are desirable.

SUMMARY

[0004] In an embodiment, the disclosure includes a method implemented in an encoder, the method comprising: partitioning, by a processor of the encoder, a picture into a plurality of first level tiles; partitioning, by the processor, a subset of the first level tiles into a plurality of second level tiles; assigning, by the processor, the first level tiles and the second level tiles into one or more tile groups such that each tile group contains a number of first level tiles, one or

CLAIMS

What is claimed is:

1. A method implemented in an encoder, the method comprising:

partitioning, by a processor of the encoder, a picture into a plurality of first level tiles;

partitioning, by the processor, a subset of the first level tiles into a plurality of second level tiles;

assigning, by the processor, the first level tiles and the second level tiles into one or more tile groups such that each tile group contains a number of first level tiles, one or more consecutive sequences of second level tiles where each sequence of second level tiles is split from a single first level tile, or combinations thereof;

encoding, by the processor, the second level tiles into a bitstream.

2. A method implemented in an encoder, the method comprising:

partitioning, by a processor of the encoder, a picture into a plurality of first level tiles;

partitioning, by the processor, a subset of the first level tiles into a plurality of second level tiles;

assigning, by the processor, the first level tiles and the second level tiles into one or more tile groups such that all second level tiles created from a single first level tile are assigned to a same tile group;

encoding, by the processor, the second level tiles into a bitstream.

3. The method of any of claims 1-2, the method further comprising:

storing, in a memory of the encoder, the bitstream for communication toward a decoder.

4. The method of any of claims 1-3, wherein first level tiles outside the subset contain picture data at a first resolution, and wherein second level tiles contain picture data at a second resolution different from the first resolution.

5. The method of any of claims 1-4, wherein each first level tile in the subset of first level tiles includes two or more complete second level tiles.

6. The method of any of claims 1-5, wherein all second level tiles partitioned from a current first level tile are encoded prior to encoding any second level tiles partitioned from a subsequent first level tile.

7. The method of any of claims 1-6, wherein each of the one or more tile groups are constrained such that all tiles in an assigned tile group cover a rectangular portion of the picture.

8. A method implemented in a decoder, the method comprising:

receiving, by a processor of the decoder via a receiver, a bitstream including a picture partitioned into a plurality of first level tiles, wherein a subset of the first level tiles are further partitioned into a plurality of second level tiles, and wherein the first level tiles and the second level tiles are assigned to one or more tile groups such that each tile group contains one or more consecutive sequences of second level tiles where each sequence of second level tiles is split from a single first level tile, or combinations thereof;

decoding, by the processor, the second level tiles based on parameters in the bitstream; and

generating, by the processor, a reconstructed video sequence for display based on the decoded the second level tiles.

9. A method implemented in a decoder, the method comprising:

receiving, by a receiver, a bitstream including a picture partitioned into a plurality of first level tiles, wherein a subset of the first level tiles are further partitioned into a plurality of second level tiles, and wherein the first level tiles and the second level tiles are assigned to one or more tile groups such that all second level tiles created from a single first level tile are assigned to a same tile group;

decoding, by a processor of the decoder, the second level tiles based on parameters in the bitstream; and

generating, by the processor, a reconstructed video sequence for display based on the decoded the second level tiles.

10. The method of any of claims 8-9, wherein first level tiles outside the subset contain picture data at a first resolution, and wherein second level tiles contain picture data at a second resolution different from the first resolution.

11. The method of any of claims 8-10, wherein each first level tile in the subset of first level tiles includes two or more complete second level tiles.

12. The method of any of claims 8-11, wherein all second level tiles partitioned from a current first level tile are decoded prior to decoding any second level tiles partitioned from a subsequent first level tile.

13. The method of any of claims 8-12, wherein each of the one or more tile groups are constrained such that all tiles in an assigned tile group cover a rectangular portion of the picture.

14. A video coding device comprising:

a processor, a receiver coupled to the processor, and a transmitter coupled to the processor, the processor, receiver, and transmitter configured to perform the method of any of claims 1-13.

15. A non-transitory computer readable medium comprising a computer program product for use by a video coding device, the computer program product comprising computer executable instructions stored on the non-transitory computer readable medium such that when executed by a processor cause the video coding device to perform the method of any of claims 1-13.

16. An encoder comprising:

a partitioning unit, configured to:

partitioning a picture into a plurality of first level tiles; and

partitioning a subset of the first level tiles into a plurality of second level tiles;

an assigning unit, configured to assign the first level tiles and the second level tiles into one or more tile groups such that all second level tiles created from a single first level tile are assigned to a same tile group;

an encoding unit, configured to encode the second level tiles into a bitstream.

17. The encoder of claim 16, the encoder further comprising:

a storing unit, configured to store the bitstream for communication toward a decoder.

18. The encoder of any of claims 16-17, wherein the encoder is further configured to perform the method of any of claims 1-8.

19. A decoder comprising:

a receiving unit, configured to receive a bitstream including a picture partitioned into a plurality of first level tiles, wherein a subset of the first level tiles are further partitioned into a plurality of second level tiles, and wherein the first level tiles and the second level tiles are assigned to one or more tile groups such that all second level tiles created from a single first level tile are assigned to a same tile group;

a decoding unit, configured to decode the second level tiles based on parameters in the bitstream; and

a generating unit, configured to generate a reconstructed video sequence for display based on the decoded the second level tiles.

20. The decoder of claim 19, wherein the decoder is further configured to perform the method of any of claims 9-13.

21. A non-transitory computer-readable storage medium storing processor-executable instructions configured to cause a processor to generate an encoded bitstream by performing the method of any of claims 1-7.

22. A device for coding, comprising:

receiving unit, configured to receive a bitstream to decode;

transmission unit coupled to the receiving unit, the transmission unit, configured to transmit a decoded image to a display unit;

storage unit coupled to at least one of the receiving unit or the transmission unit, the storage unit, configured to store instructions; and

processing unit coupled to the storage unit, the processing unit, configured to execute the instructions stored in the storage unit to perform the method in any of claims 1 to 13.

23. An encoder comprising processing circuitry for carrying out the method according to claims 1 to 8.

24. A decoder comprising processing circuitry for carrying out the method according to any of claims 9 to 13.

25. A computer program comprising program code for performing the method according to any of claims 1 to 13 when executed on a computer or a processor.

26. A non-transitory computer-readable medium carrying a program code which, when executed by a computer device, causes the computer device to perform the method of any one of claims 1 to 13.

~~1. A method implemented in an encoder, the method comprising:~~

~~partitioning, by a processor of the encoder, a picture into a plurality of first level tiles;~~

~~partitioning, by the processor, a subset of the first level tiles into a plurality of second level tiles;~~

~~assigning, by the processor, the first level tiles and the second level tiles into one or more tile groups such that each tile group contains a number of first level tiles, one or more consecutive sequences of second level tiles where each sequence of second level tiles is split from a single first level tile, or combinations thereof;~~

~~encoding, by the processor, the first level tiles and the second level tiles into a bitstream; and~~

~~storing, in a memory of the encoder, the bitstream for communication toward a decoder.~~

~~2. A method implemented in an encoder, the method comprising:~~

~~partitioning, by a processor of the encoder, a picture into a plurality of first level tiles;~~

~~partitioning, by the processor, a subset of the first level tiles into a plurality of second level tiles;~~

~~assigning, by the processor, the first level tiles and the second level tiles into one or more tile groups such that all second level tiles created from a single first level tile are assigned to a same tile group;~~

~~encoding, by the processor, the first level tiles and the second level tiles into a bitstream; and~~

~~storing, in a memory of the encoder, the bitstream for communication toward a decoder.~~

~~3. The method of any of claims 1-2, wherein first level tiles outside the subset contain picture data at a first resolution, and wherein second level tiles contain picture data at a second resolution different from the first resolution.~~

4. The method of any of claims 1-3, wherein each first level tile in the subset of first level tiles includes two or more complete second level tiles.

5. The method of any of claims 1-4, wherein the first level tiles and the second level tiles are encoded according to a scan order, and wherein encoding according to the scan order includes:

encoding the first level tiles in raster scan order;

when one of the second level tiles is encountered, pause raster scan order encoding of the first level tiles; and

encode all consecutive second level tiles in raster scan order prior to continuing the raster scan order encoding of the first level tiles.

6. The method of any of claims 1-5, wherein all second level tiles partitioned from a current first level tile are encoded prior to encoding any second level tiles partitioned from a subsequent second level tile.

7. The method of any of claims 1-6, wherein each of the one or more tile groups are constrained such that all tiles in an assigned tile group cover a rectangular portion of the picture.

8. A method implemented in a decoder, the method comprising:

receiving, by a processor of the decoder via a receiver, a bitstream including a picture partitioned into a plurality of first level tiles, wherein a subset of the first level tiles are further partitioned into a plurality of second level tiles, and wherein the first level tiles and the second level tiles are assigned to one or more tile groups such that each tile group contains a number of first level tiles, one or more consecutive sequences of second level tiles where each sequence of second level tiles is split from a single first level tile, or combinations thereof;

decoding, by the processor, the first level tiles and the second level tiles based on the one or more tile groups; and

generating, by the processor, a reconstructed video sequence for display based on the decoded first level tiles and the second level tiles.

9. A method implemented in a decoder, the method comprising:

receiving, by a processor of the decoder via a receiver, a bitstream including a picture partitioned into a plurality of first level tiles, wherein a subset of the first level tiles are further partitioned into a plurality of second level tiles, and wherein the first level tiles and the second level tiles are assigned to one or more tile groups such that all second level tiles created from a single first level tile are assigned to a same tile group;

decoding, by the processor, the first level tiles and the second level tiles based on the one or more tile groups; and

generating, by the processor, a reconstructed video sequence for display based on the decoded first level tiles and the second level tiles.

10. The method of any of claims 8-9, wherein first level tiles outside the subset contain picture data at a first resolution, and wherein second level tiles contain picture data at a second resolution different from the first resolution.

11. The method of any of claims 8-10, wherein each first level tile in the subset of first level tiles includes two or more complete second level tiles.

12. The method of any of claims 8-11, wherein the first level tiles and the second level tiles are decoded according to a scan order, and wherein decoding according to the scan order includes:

decoding the first level tiles in raster scan order;

when one of the second level tiles is encountered, pause raster scan order encoding of the first level tiles; and

encode all consecutive second level tiles in raster scan order prior to continuing the raster scan order decoding of the first level tiles.

13. The method of any of claims 8-12, wherein all second level tiles partitioned from a current first level tile are decoded prior to decoding any second level tiles partitioned from a subsequent second level tile.

14. The method of any of claims 8-13, wherein each of the one or more tile groups are constrained such that all tiles in an assigned tile group cover a rectangular portion of the picture.

15. A video coding device comprising:

a processor, a receiver coupled to the processor, and a transmitter coupled to the processor, the processor, receiver, and transmitter configured to perform the method of any of claims 1-14.

16. A non-transitory computer readable medium comprising a computer program product for use by a video coding device, the computer program product comprising computer executable instructions stored on the non-transitory computer readable medium such that when executed by a processor cause the video coding device to perform the method of any of claims 1-14.

17. An encoder comprising:

a partitioning means for:

partitioning a picture into a plurality of first level tiles; and

partitioning a subset of the first level tiles into a plurality of second level tiles;

an assigning means for assigning the first level tiles and the second level tiles into one or more tile groups such that all second level tiles created from a single first level tile are assigned to a same tile group;

an encoding means for encoding the first level tiles and the second level tiles into a bitstream; and

a storage means for storing the bitstream for communication toward a decoder.

18. The encoder of claim 17, wherein the encoder is further configured to perform the method of any of claims 1-7.

19. A decoder comprising:

a receiving means for receiving a bitstream including a picture partitioned into a plurality of first level tiles, wherein a subset of the first level tiles are further partitioned into a plurality of second level tiles, and wherein the first level tiles and the second level tiles are assigned to one or more tile groups such that all second level tiles created from a single first level tile are assigned to a same tile group;

a decoding means for decoding the first level tiles and the second level tiles based on the one or more tile groups; and

a generating means for generating a reconstructed video sequence for display based on the decoded first level tiles and the second level tiles.

~~20. The decoder of claim 19, wherein the decoder is further configured to perform the method of any of claims 9-16.~~