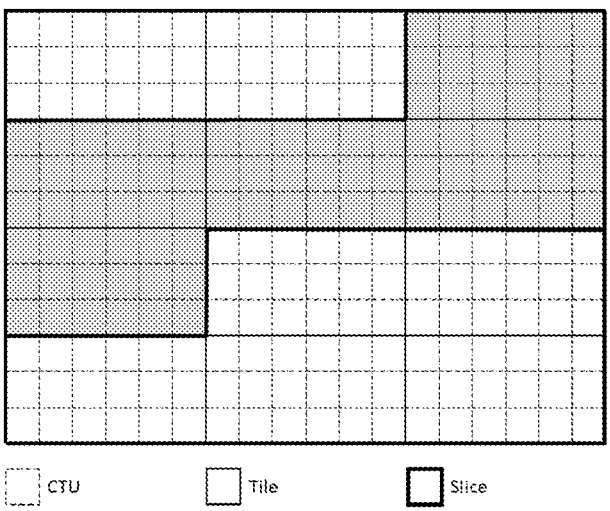


FIG. 1

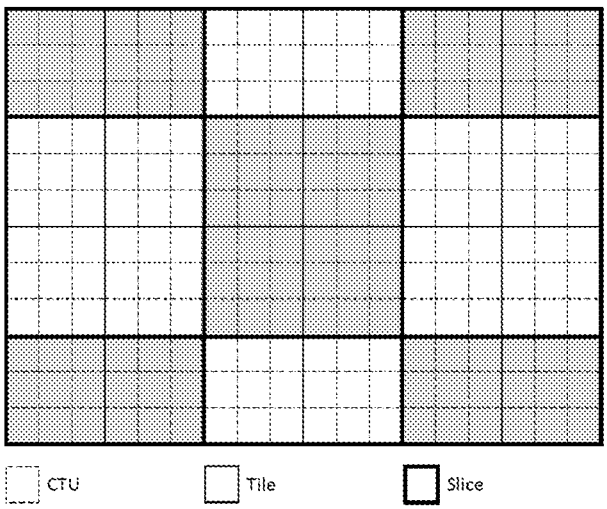


FIG. 2

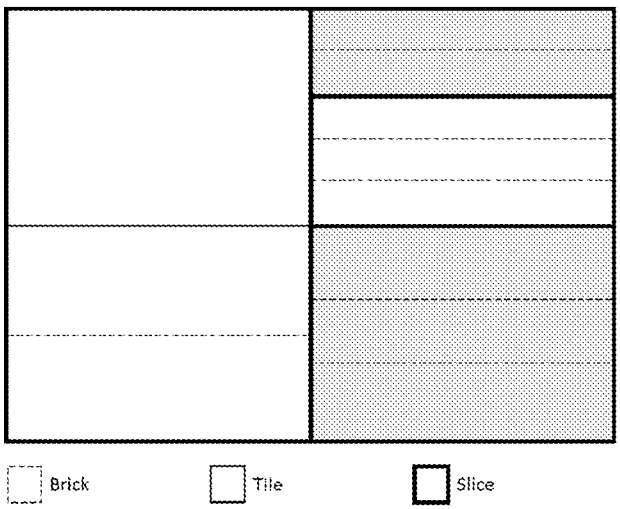


FIG. 3

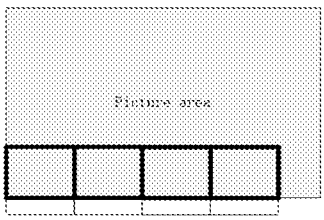


FIG. 4A

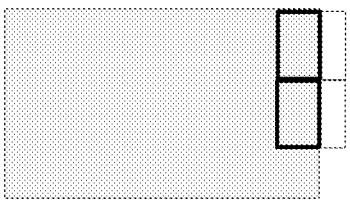


FIG. 4B

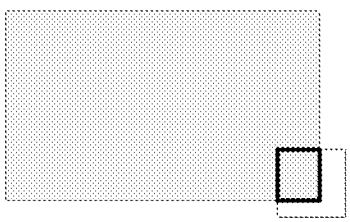


FIG. 4C

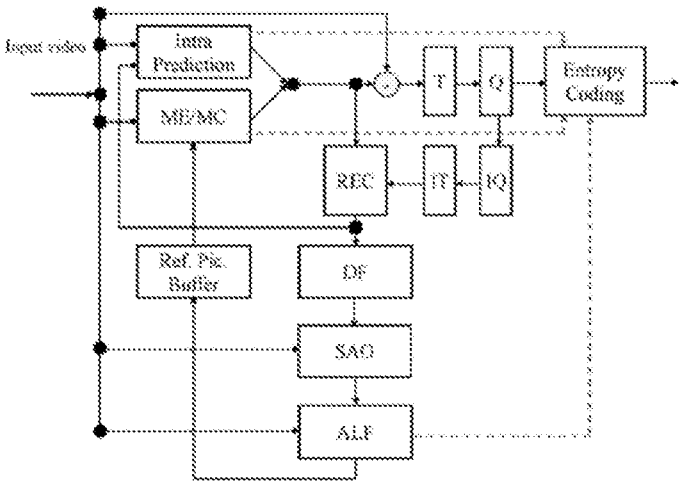

Input video
Intra Prediction
MD/MC
T
Q
Entropy Coding
REC
IT
IQ
Ref. Pic. Buffer
DF
SAO
ALF

FIG. 5

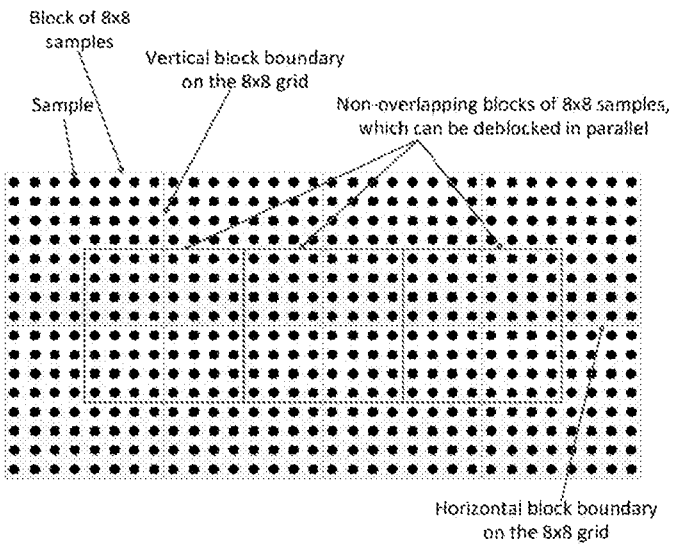

Block of 8x8 samples
Vertical block boundary on the 8x8 grid
Sample
Non-overlapping blocks of 8x8 samples, which can be deblocked in parallel
Horizontal block boundary on the 8x8 grid

FIG. 6

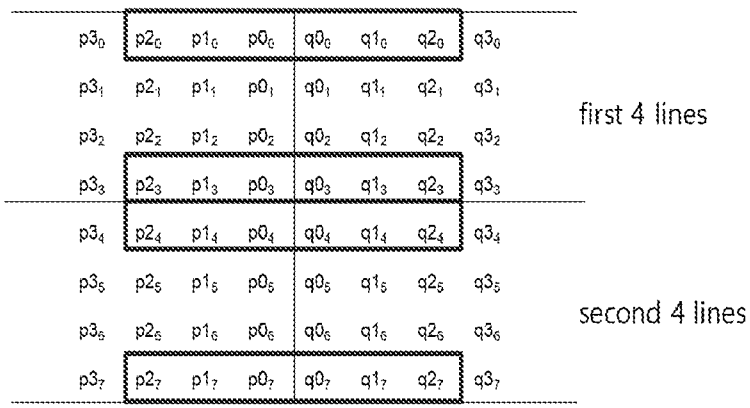

p3₀ p2₀ p1₀ p0₀ q0₀ q1₀ q2₀ q3₀
p3₁ p2₁ p1₁ p0₁ q0₁ q1₁ q2₁ q3₁
p3₂ p2₂ p1₂ p0₂ q0₂ q1₂ q2₂ q3₂
p3₃ p2₃ p1₃ p0₃ q0₃ q1₃ q2₃ q3₃
p3₄ p2₄ p1₄ p0₄ q0₄ q1₄ q2₄ q3₄
p3₅ p2₅ p1₅ p0₅ q0₅ q1₅ q2₅ q3₅
p3₆ p2₆ p1₆ p0₆ q0₆ q1₆ q2₆ q3₆
p3₇ p2₇ p1₇ p0₇ q0₇ q1₇ q2₇ q3₇
first 4 lines
second 4 lines

FIG. 7

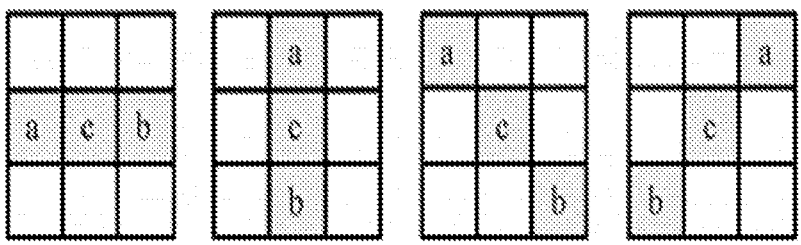


FIG. 8

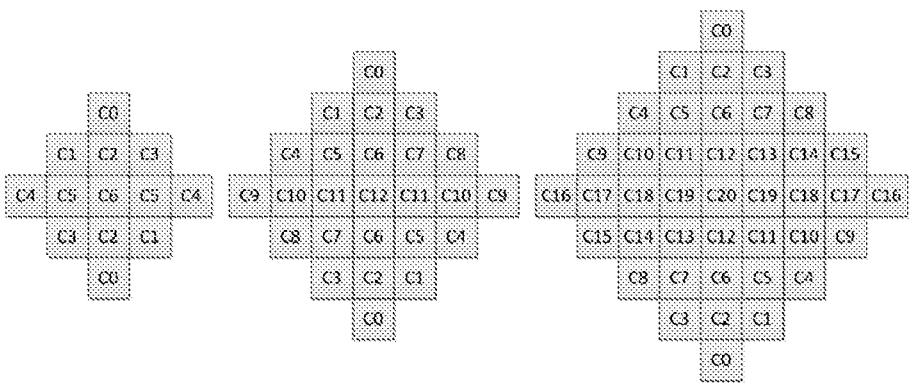

C0
C1 C2 C3
C4 C5 C6 C7 C8
C9 C10 C11 C12 C13 C14 C15
C16 C17 C18 C19 C20 C19 C18 C17 C16
C15 C14 C13 C12 C11 C10 C9
C8 C7 C6 C5 C4
C3 C2 C1
C0

FIG. 9

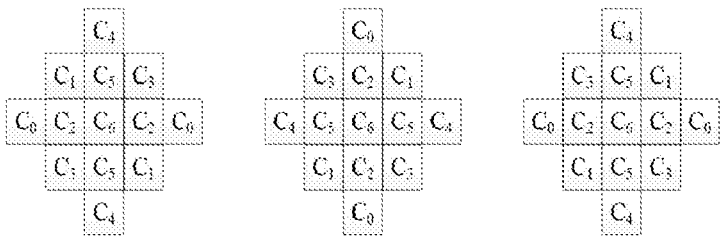

C4
C1 C5 C3
C0 C2 C6 C2 C0
C1 C5 C1
C4
C0
C3 C2 C1
C4 C3 C6 C5 C4
C3 C2 C3
C0
C4
C3 C5 C1
C0 C2 C6 C2 C0
C1 C5 C3
C4

FIG. 10

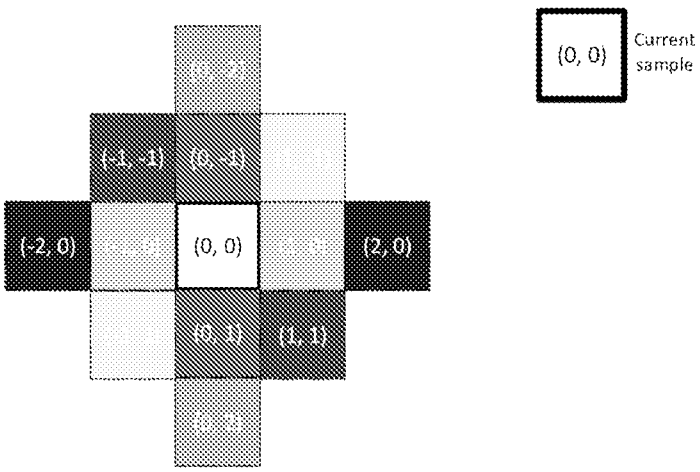


FIG. 11

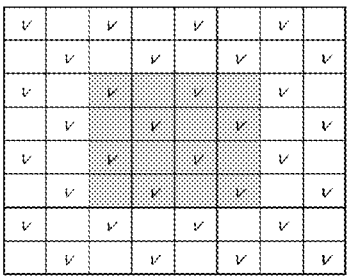


FIG. 12A

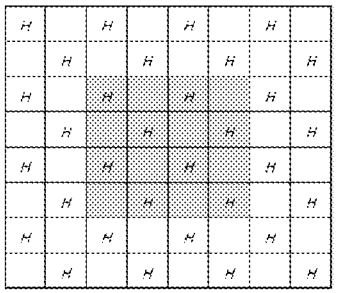


FIG. 12B

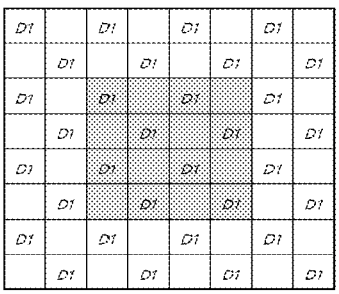


FIG. 12C

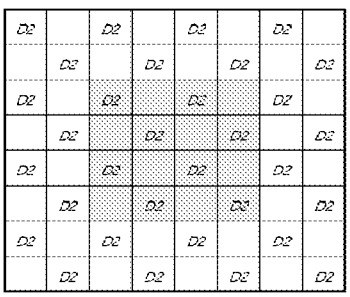


FIG. 12D

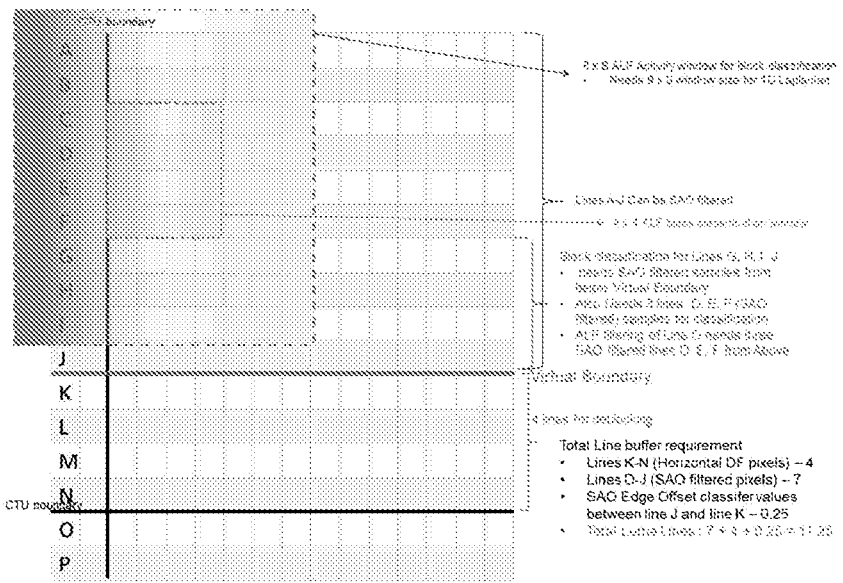

J
K
L
M
N
O
P
Virtual Boundary
Total Line buffer requirement
Lines K-N (Horizontal DF pixels) – 4
Lines D-J (SAO filtered pixels) – 7
SAO Edge Offset classifier values between line J and line K – 0.25

FIG. 13

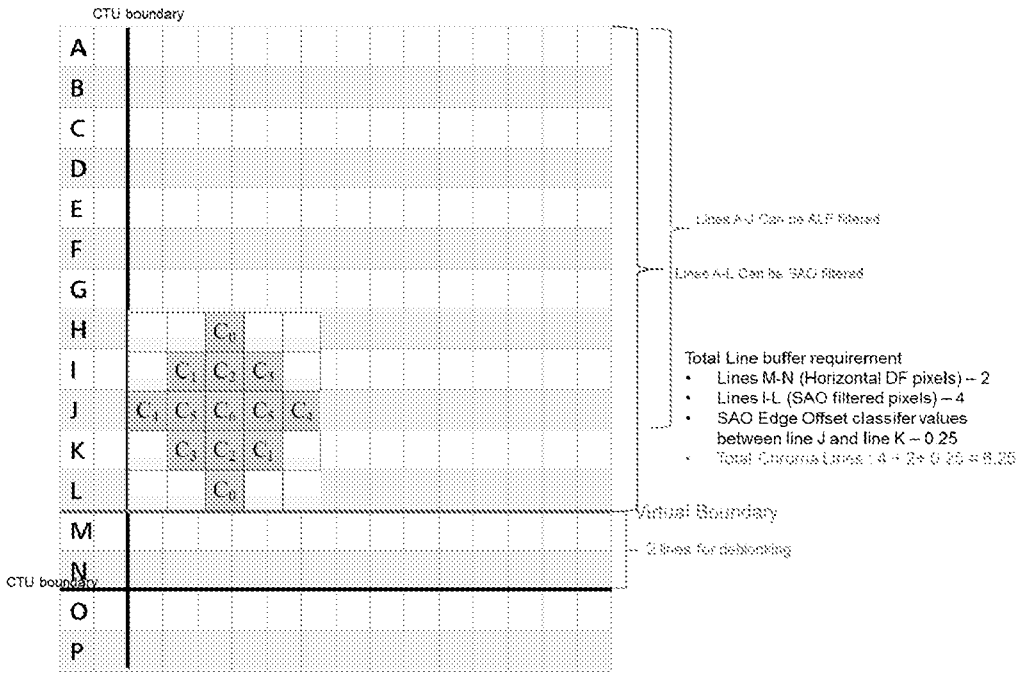

CTU boundary
A
B
C
D
E
F
G
H
I
J
K
L
M
N
O
P
CTU boundary
Lines A-J Can be ALF filtered
Lines A-L Can be SAO filtered
Total Line buffer requirement
• Lines M-N (Horizontal DF pixels) – 2
• Lines I-L (SAO filtered pixels) – 4
• SAO Edge Offset classifer values between line J and line K – 0.25
• Total Chroma Lines : 4 + 2+ 0.25 = 6.25
Virtual Boundary
2 lines for deblocking

FIG. 14

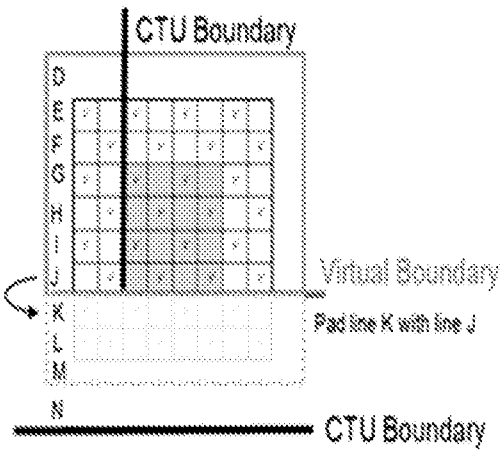


FIG. 15A

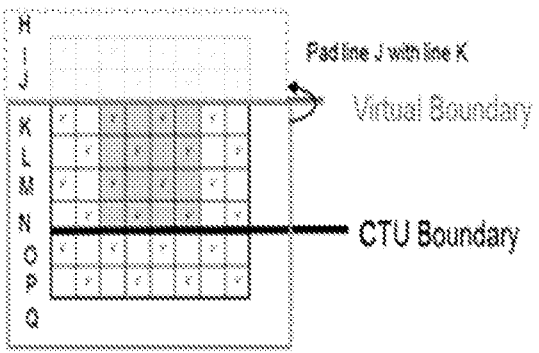


FIG. 15B

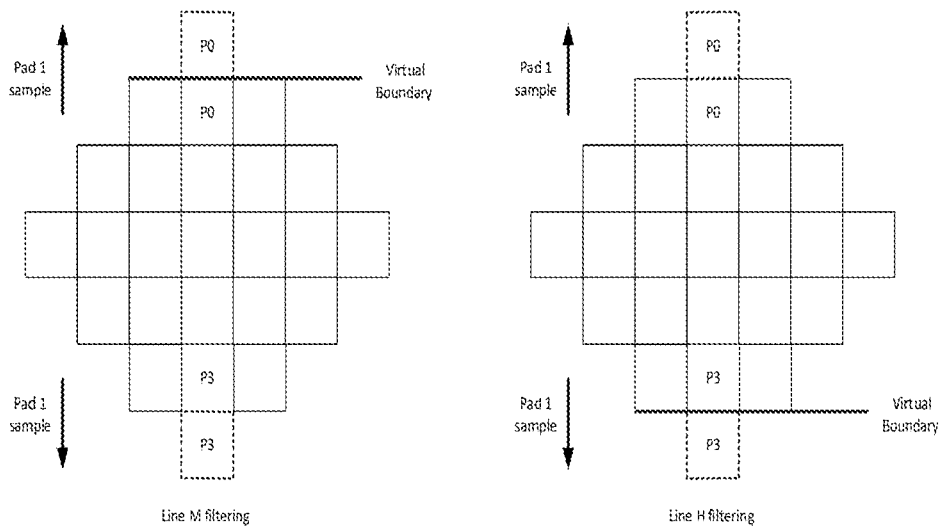

Pad 1 sample
P0
P0
Virtual Boundary
P3
P3
Pad 1 sample
Line M filtering
Pad 1 sample
P0
P0
P3
P3
Virtual Boundary
Pad 1 sample
Line H filtering

FIG. 16A

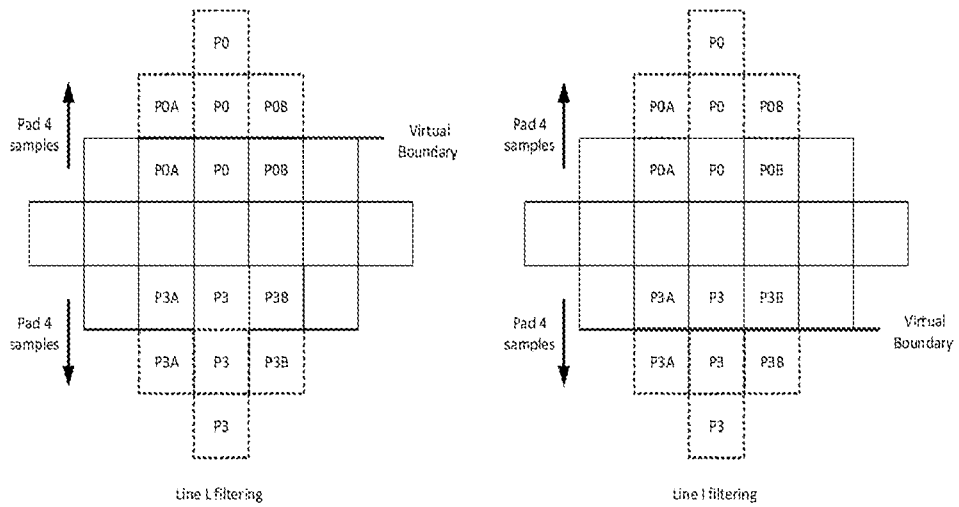

P0
P0A
P0
P0B
Pad 4 samples
Virtual Boundary
P3A
P3
P3B
Pad 4 samples
P3
line I filtering
P0
P0A
P0
P0B
Pad 4 samples
P3A
P3
P3B
Pad 4 samples
Virtual Boundary
P3
line I filtering

FIG. 16B

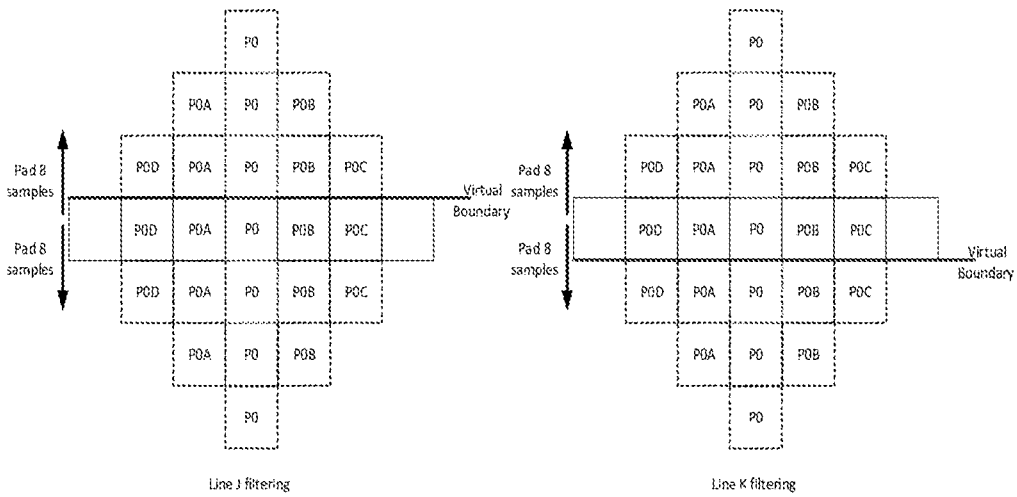

P0
P0A
P0B
P0D
P0C
Pad 8 samples
Virtual Boundary
Line J filtering
Line K filtering

FIG. 16C

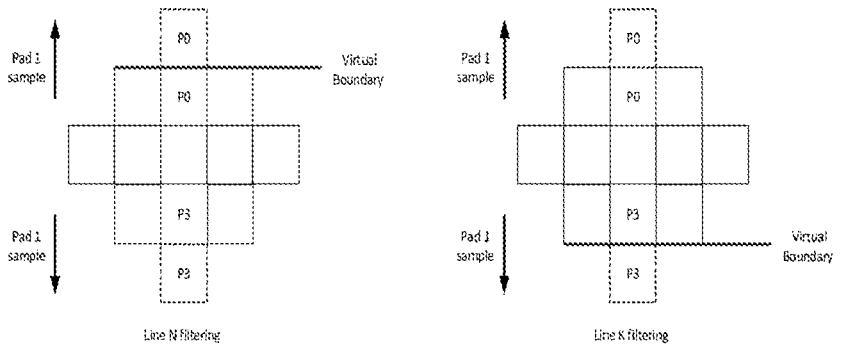


FIG. 17A

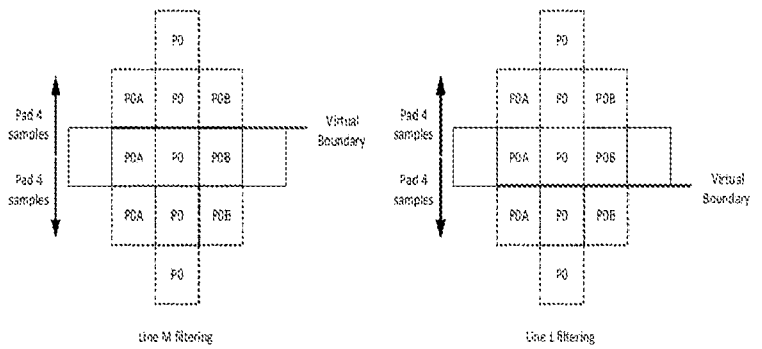


FIG. 17B

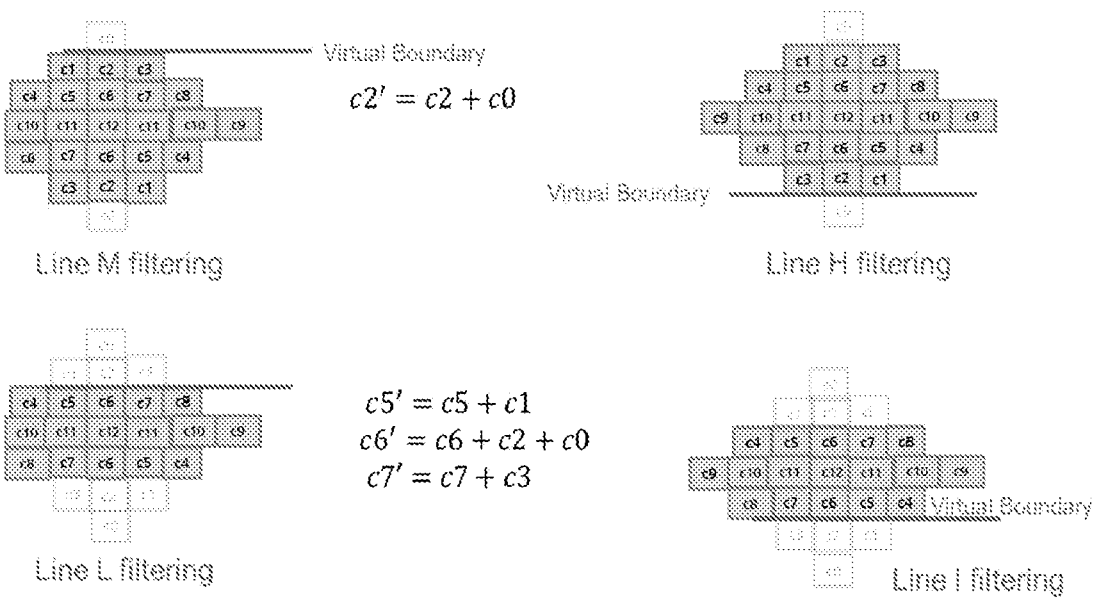
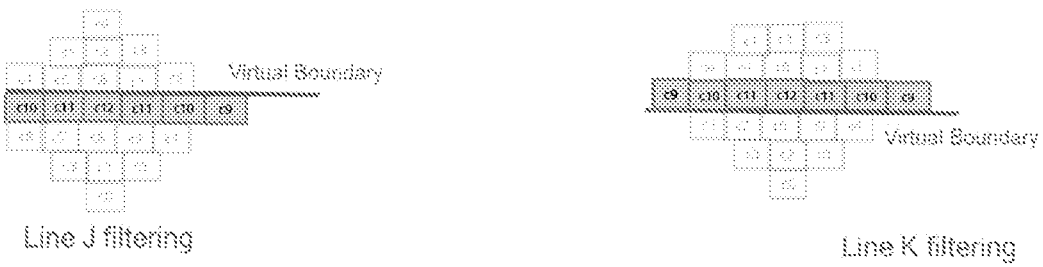

Virtual Boundary
$c2' = c2 + c0$
Line M filtering
Virtual Boundary
Line H filtering
$c5' = c5 + c1$
$c6' = c6 + c2 + c0$
$c7' = c7 + c3$
Line L filtering
Virtual Boundary
Line I filtering

FIG. 18A



$$c10' = c10 + c4 + c8$$
$$c11' = c11 + c5 + c7 + c1 + c3$$
$$c12' = c12 + 2 * c6 + 2 * c2 + 2 * c0$$

FIG. 18B

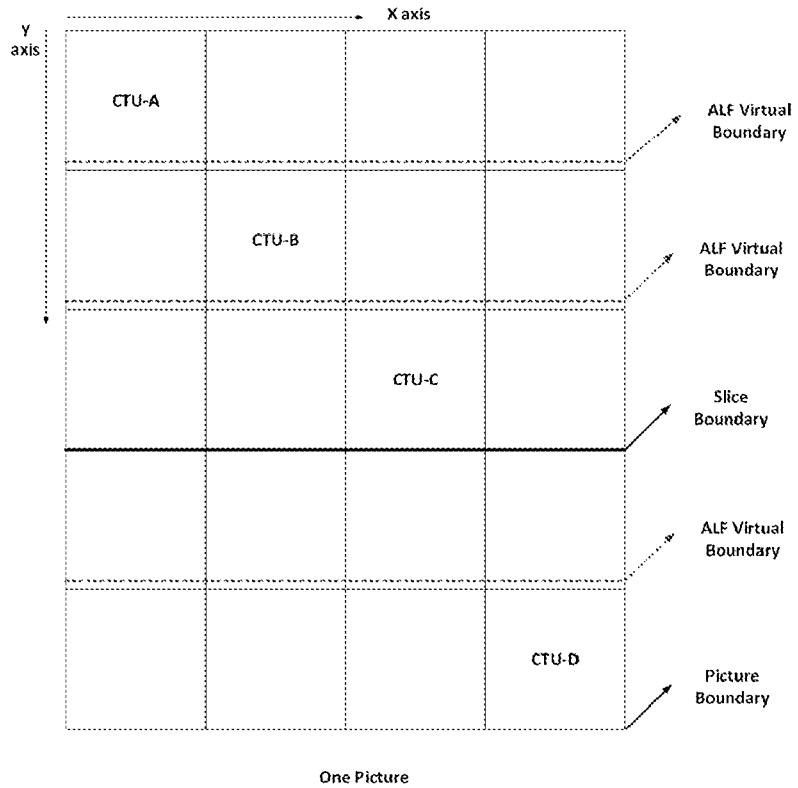

X axis
Y axis
CTU-A
CTU-B
CTU-C
CTU-D
ALF Virtual Boundary
ALF Virtual Boundary
Slice Boundary
ALF Virtual Boundary
Picture Boundary
One Picture

FIG. 19

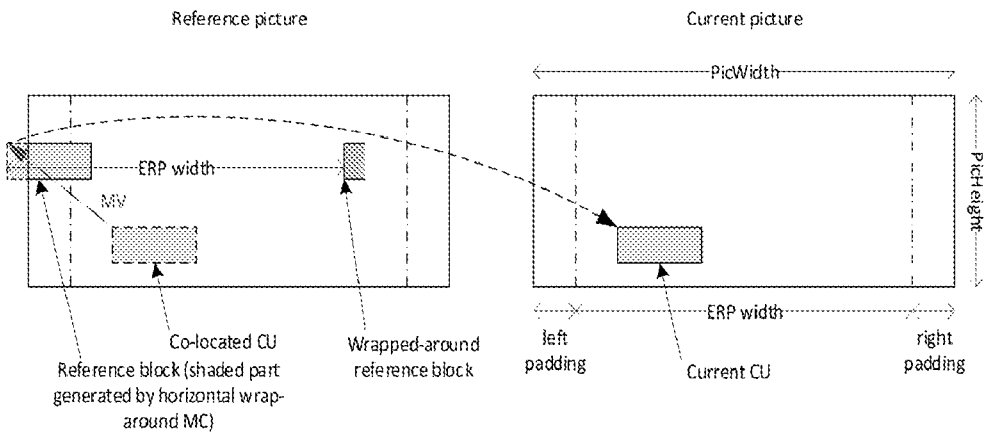

Reference picture
Current picture
PicWidth
PicHeight
ERP width
MV
Co-located CU
Reference block (shaded part generated by horizontal wrap-around MC)
Wrapped-around reference block
left padding
Current CU
ERP width
right padding

FIG. 20

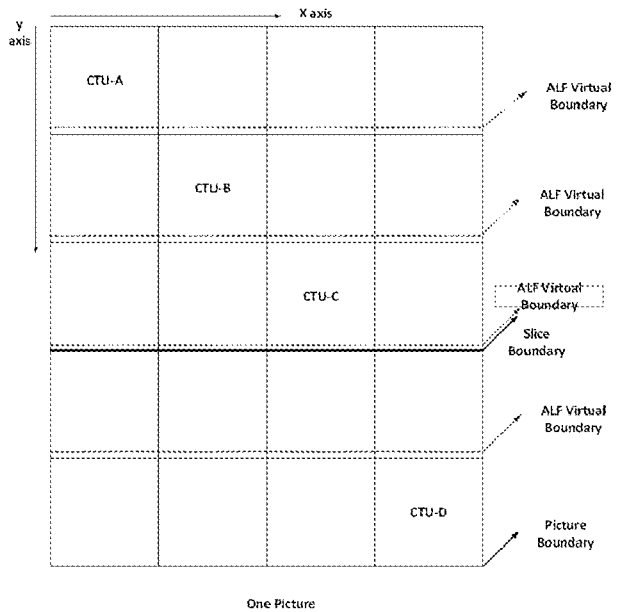

X axis
y axis
CTU-A
CTU-B
CTU-C
CTU-D
ALF Virtual Boundary
ALF Virtual Boundary
ALF Virtual Boundary
Slice Boundary
ALF Virtual Boundary
Picture Boundary
One Picture

FIG. 21

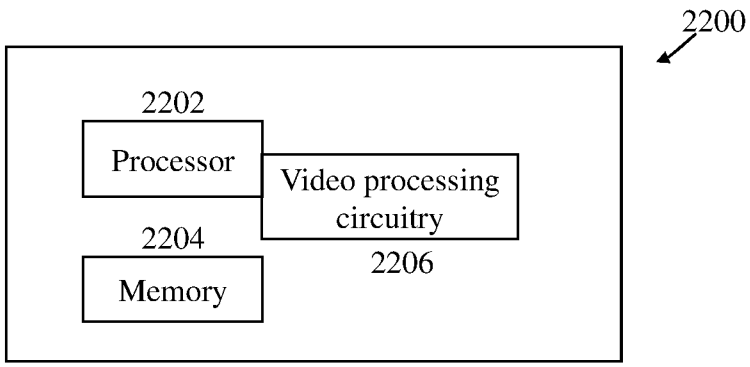

2200
2202
Processor
Video processing circuitry
2204
Memory
2206

FIG. 22

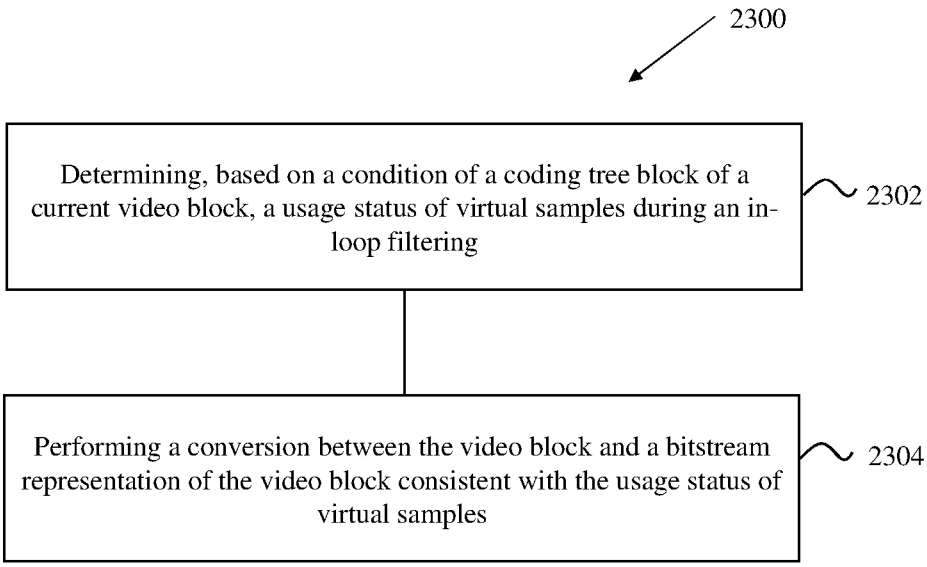

2300
Determining, based on a condition of a coding tree block of a current video block, a usage status of virtual samples during an in-loop filtering
2302
Performing a conversion between the video block and a bitstream representation of the video block consistent with the usage status of virtual samples
2304

FIG. 23

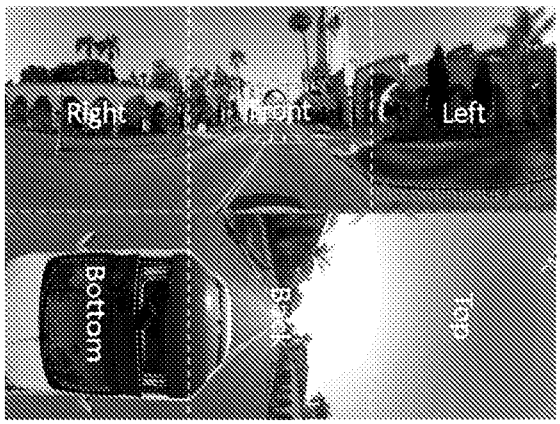


FIG. 24

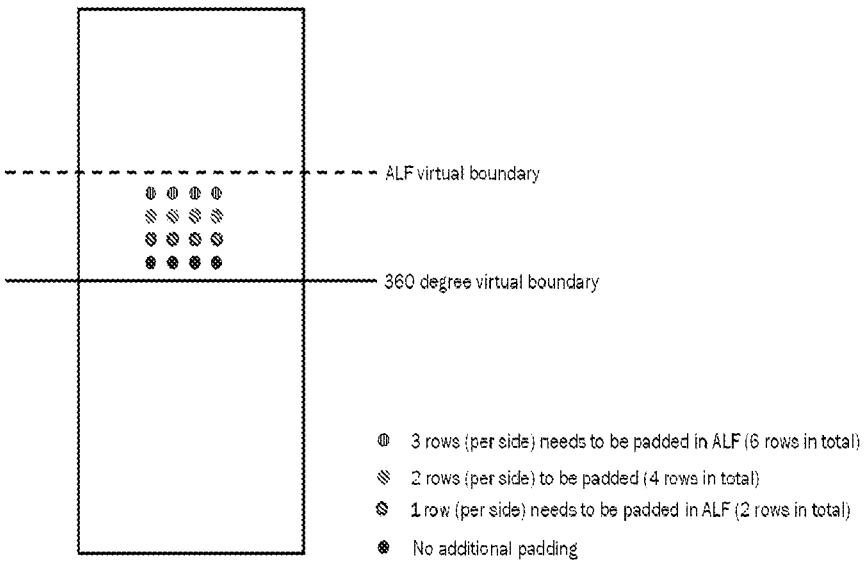

ALF virtual boundary
360 degree virtual boundary
3 rows (per side) needs to be padded in ALF (6 rows in total)
2 rows (per side) to be padded (4 rows in total)
1 row (per side) needs to be padded in ALF (2 rows in total)
No additional padding

FIG. 25

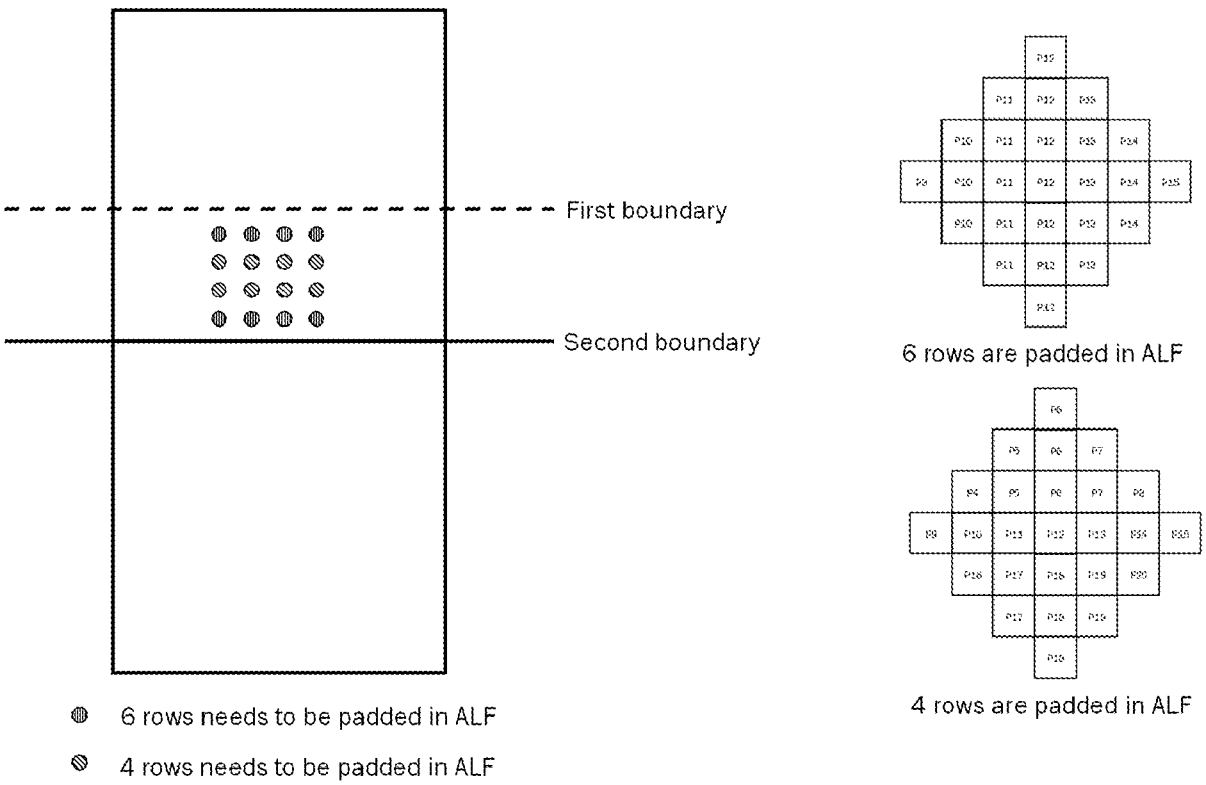

First boundary
Second boundary
6 rows needs to be padded in ALF
4 rows needs to be padded in ALF
6 rows are padded in ALF
4 rows are padded in ALF

FIG. 26

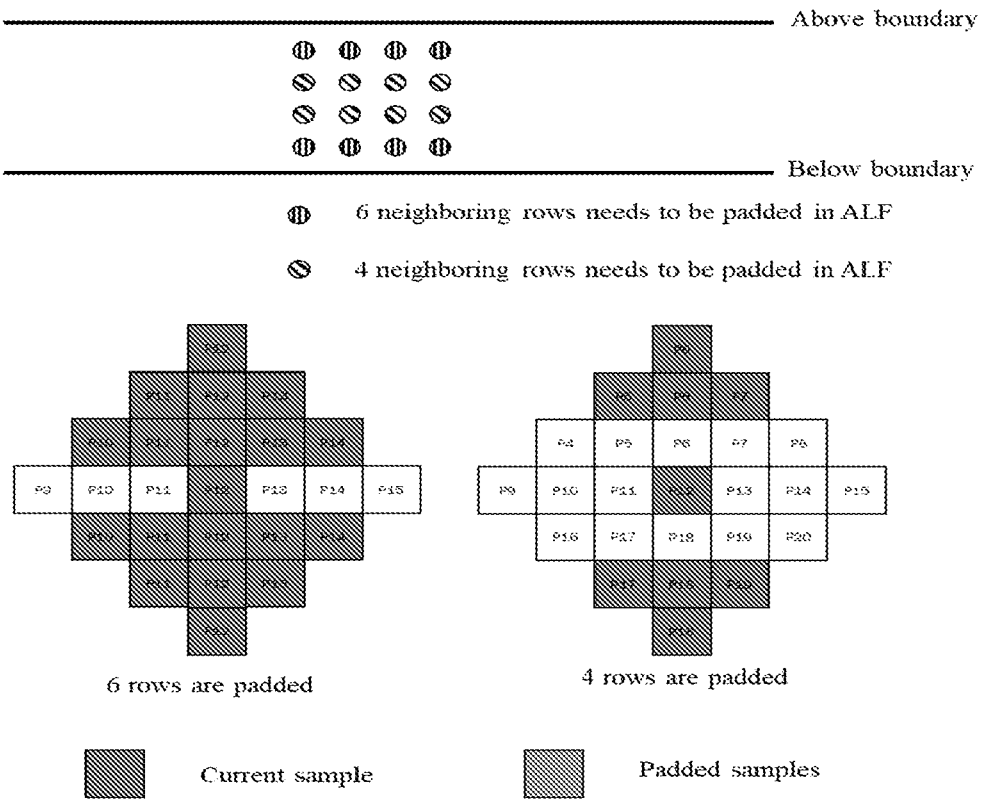

Above boundary
Below boundary
6 neighboring rows needs to be padded in ALF
4 neighboring rows needs to be padded in ALF
P0
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P18
P19
P20
6 rows are padded
4 rows are padded
Current sample
Padded samples

FIG. 27

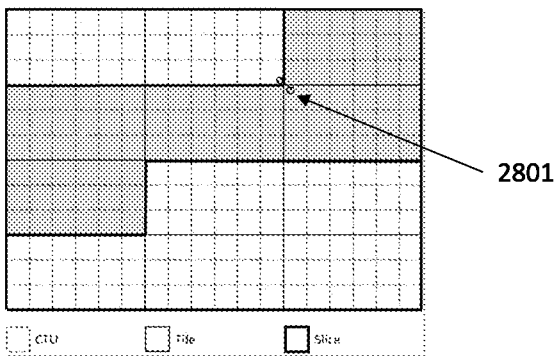


FIG. 28

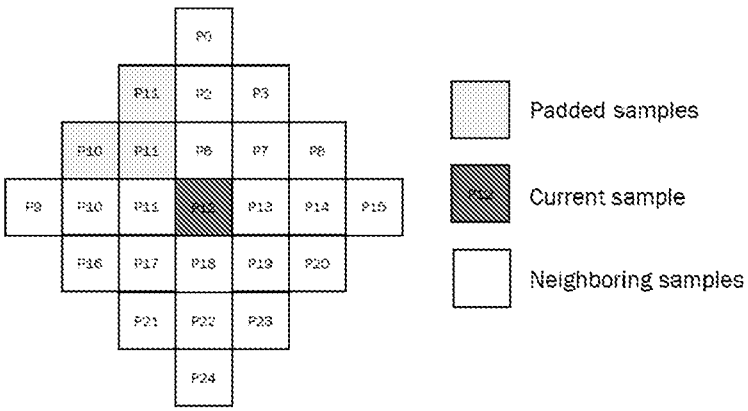

P0
P1
P2
P3
P4
P5
P6
P7
P8
P9
P10
P11
P12
P13
P14
P15
P16
P17
P18
P19
P20
P21
P22
P23
P24
Padded samples
Current sample
Neighboring samples

FIG. 29

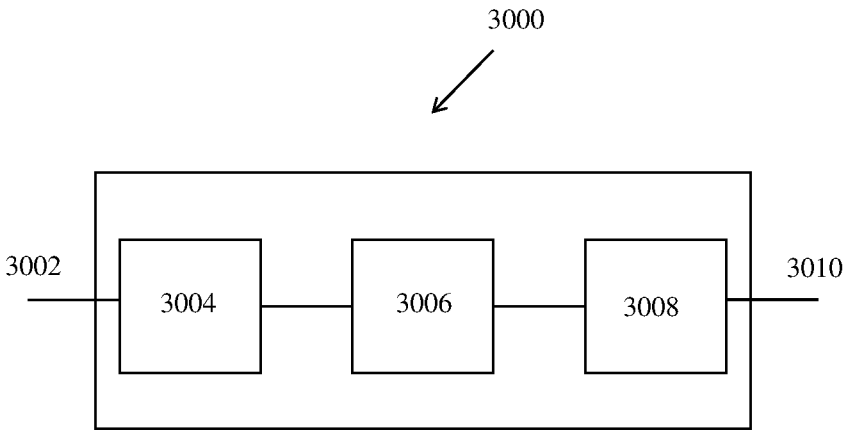


FIG. 30

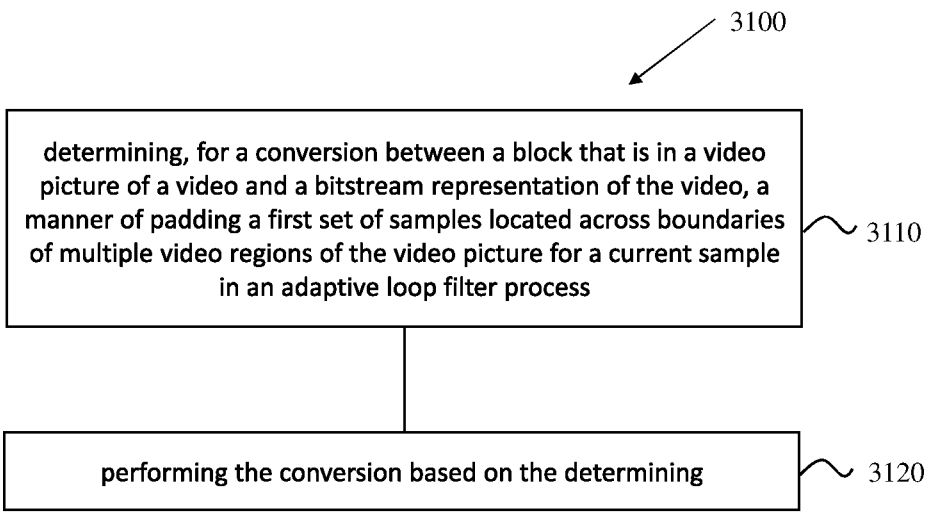

3100
determining, for a conversion between a block that is in a video picture of a video and a bitstream representation of the video, a manner of padding a first set of samples located across boundaries of multiple video regions of the video picture for a current sample in an adaptive loop filter process
3110
performing the conversion based on the determining
3120

FIG. 31

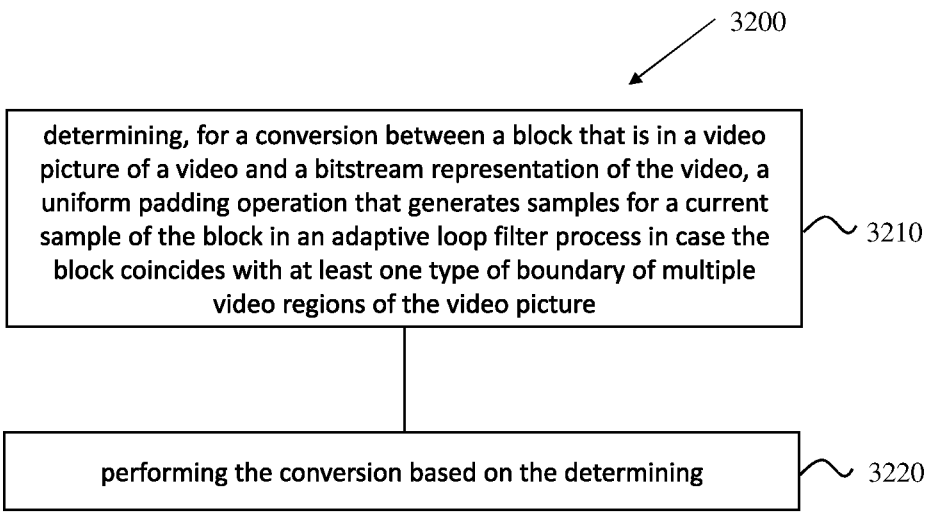

3200
determining, for a conversion between a block that is in a video picture of a video and a bitstream representation of the video, a uniform padding operation that generates samples for a current sample of the block in an adaptive loop filter process in case the block coincides with at least one type of boundary of multiple video regions of the video picture
3210
performing the conversion based on the determining
3220

FIG. 32

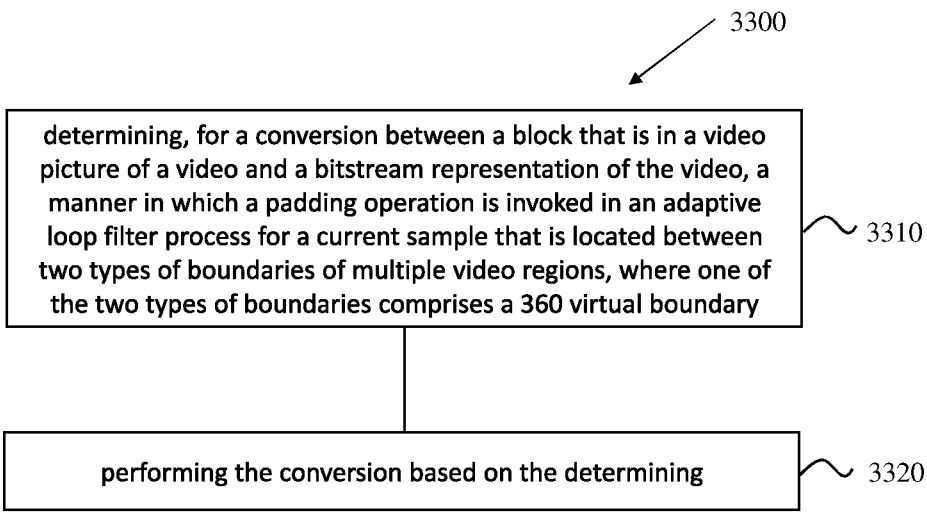

3300
determining, for a conversion between a block that is in a video picture of a video and a bitstream representation of the video, a manner in which a padding operation is invoked in an adaptive loop filter process for a current sample that is located between two types of boundaries of multiple video regions, where one of the two types of boundaries comprises a 360 virtual boundary
3310
performing the conversion based on the determining
3320

FIG. 33