##### Filtering process for a luma sample

Inputs of this process are:

– sample values, pi and qi with i = 0..3,

– variables dEp1 and dEq1 containing decisions to filter pixels p1 and q1 respectively,

– a variable tC.

Output of this process is:

– number of filtered samples nDp and nDq,

– filtered sample values, pi’ and qj’ with i = 0..nDp − 1, j = 0..nDq − 1

Depending on dE, the following applies:

– When the variable dE is equal to 2, the following strong filtering applies while nDp and nDq are set equal to 3:

p0’ = Clip3( p0−2\*tc, p0+2\*tc, ( p2 + 2\*p1 + 2\*p0 + 2\*q0 + q1 + 4 ) >> 3 ) (8‑334)

p1’ = Clip3( p1−2\*tc, p1+2\*tc, ( p2 + p1 + p0 + q0 + 2 ) >> 2 ) (8‑335)

p2’ = Clip3( p2−2\*tc, p2+2\*tc, ( 2\*p3 + 3\*p2 + p1 + p0 + q0 + 4 ) >> 3 ) (8‑336)

q0’ = Clip3( q0−2\*tc, q0+2\*tc, ( p1 + 2\*p0 + 2\*q0 + 2\*q1 + q2 + 4 ) >> 3 ) (8‑337)

q1’ = Clip3( q1−2\*tc, q1+2\*tc, ( p0 + q0 + q1 + q2 + 2 ) >> 2 ) (8‑338)

q2’ = Clip3( q2−2\*tc, q2+2\*tc, ( p0 + q0 + q1 + 3\*q2 + 2\*q3 + 4 ) >> 3 ) (8‑339)

– Otherwise, the following weak filtering applies while nDp and nDq are set equal to 0:

Δ = ( 9 \* ( q0 –  p0 ) − 3 \* ( q1 – p1 ) + 8 ) >> 4 (8‑340)

* + When abs(Δ) is less than tc\*10, the following ordered steps apply:
    - The filtered sample values p0’ and q0’ are specified as follows:

Δ = Clip3( -tc, tc, Δ ) (8‑341)

p0’ = Clip1Y( p0 + Δ ) (8‑342)

q0’ = Clip1Y( q0 - Δ ) (8‑343)

* + - If dEp1 is equal to 1, the filtered sample value pi’ is specified as follows:

Δp = Clip3( -(tc >> 1), tc >> 1, ( ( ( p2 + p0 + 1 ) >> 1 ) – p1 + Δ ) >>1 ) (8‑344)

pi’ = Clip1Y( p1 + Δp ) (8‑345)

* + - If dEq1 is equal to 1, the filtered sample value qi’ is specified as follows:

Δq = Clip3( -(tc >> 1), tc >> 1, ( ( ( q2 + q0 + 1 ) >> 1 ) – q1 – Δ ) >>1 ) (8‑346)

qi’ = Clip1Y( q1 + Δq ) (8‑347)

* + - nDp is set equal to dEp1+1 and nDq is set equal to dEq1+1.

Each of the filtered sample values, pi’ with i = 0..nDp−1, is substituted by the corresponding input sample value pi if any of the following conditions are true.

– pcm\_flag of the coding unit covering the sample pi is equal to 1 and pcm\_loop\_filter\_disable\_flag is equal to 1.

– QP’Y of the coding unit covering the sample pi is equal to 0 and qpprime\_y\_zero\_transquant\_bypass\_flag is equal to 1.

Similarly, each of the filtered sample values, qj’ with j = 0..nDq−1, is substituted by the corresponding input sample value qj if any of the following conditions are true.

– pcm\_flag of the coding unit covering the sample qj is equal to 1 and pcm\_loop\_filter\_disable\_flag is equal to 1.

– QP’Y of the coding unit covering the sample qj is equal to 0 and qpprime\_y\_zero\_transquant\_bypass\_flag is equal to 1.

Table 8‑12 – Derivation of threshold variables β and tC from input Q

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Q** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 |
| **β** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 6 | 7 | 8 |
| **tC** | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 |
| **Q** | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 | 31 | 32 | 33 | 34 | 35 | 36 | 37 |
| **β** | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 | 36 |
| **tC** | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 1 | 2 | 2 | 2 | 2 | 3 | 3 | 3 | 3 | 4 | 4 | 4 |
| **Q** | 38 | 39 | 40 | 41 | 42 | 43 | 44 | 45 | 46 | 47 | 48 | 49 | 50 | 51 | 52 | 53 | 54 | 55 |  |
| **β** | 38 | 40 | 42 | 44 | 46 | 48 | 50 | 52 | 54 | 56 | 58 | 60 | 62 | 64 | 64 | 64 | 64 | 64 |  |
| **tC** | 5 | 5 | 6 | 6 | 7 | 8 | 9 | 9 | 10 | 10 | 11 | 11 | 12 | 12 | 13 | 13 | 14 | 14 |  |

##### Filtering process for a chroma sample

Inputs of this process are:

– sample values, pi and qi with i = 0..1,

– a variable tC.

Output of this process is:

– The filtered sample values, p0’ and q0’.

The filtered sample values p0’ and q0’ are derived by

Δ = Clip3( -tC, tC, ( ( ( ( q0 – p0 ) << 2 ) + p1 – q1 + 4 ) >> 3 ) ) (8‑348)

p0’ = Clip1C( p0 + Δ ) (8‑349)

q0’ = Clip1C( q0 - Δ ) (8‑350)

The filtered sample value, p0’ is substituted by the corresponding input sample value p0 if any of the following conditions are true.

– pcm\_flag of the coding unit covering the sample p0 is equal to 1 and pcm\_loop\_filter\_disable\_flag is equal to 1.

– QP’Y of the coding unit covering the sample p0 is equal to 0 and qpprime\_y\_zero\_transquant\_bypass\_flag is equal to 1.

Similarly, the filtered sample value, q0’ is substituted by the corresponding input sample value q0 if any of the following conditions are true.

– pcm\_flag of the coding unit covering the sample q0 is equal to 1 and pcm\_loop\_filter\_disable\_flag is equal to 1.

– QP’Y of the coding unit covering the sample q0 is equal to 0 and qpprime\_y\_zero\_transquant\_bypass\_flag is equal to 1.