**method 1**

##### **8.4.4.2.6 Specification of intra prediction mode in the range of INTRA\_ANGULAR2.. INTRA\_ANGULAR34**

Inputs to this process are:

– the intra prediction mode predModeIntra,

– the neighbouring samples p[ x ][ y ], with x = −1, y = −1..nTbS \* 2 − 1 and x = 0..nTbS \* 2 − 1, y = −1,

– a variable nTbS specifying the transform block size,

– a variable cIdx specifying the colour component of the current block.

Outputs of this process are the predicted samples predSamples[ x ][ y ], with x, y = 0..nTbS − 1.

Figure 8‑2 illustrates the total 33 intra angles and Table 8‑4 specifies the mapping table between predModeIntra and the angle parameter intraPredAngle.



Figure 8‑2 – Intra prediction angle definition (informative)

Table 8‑4 – Specification of intraPredAngle

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **predModeIntra** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** |
| **intraPredAngle** | - | 32 | 26 | 21 | 17 | 13 | 9 | 5 | 2 | 0 | −2 | −5 | −9 | −13 | −17 | −21 | −26 |
| **intraPredAngle (4:2:2 chroma)** | - | 32 | 32 | 32 | 32 | 26 | 17 | 9 | 5 | 0 | -5 | -9 | -17 | -26 | -32 | -32 | -32 |
| **predModeIntra** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** | **33** | **34** |
| **intraPredAngle** | −32 | −26 | −21 | −17 | −13 | −9 | −5 | −2 | 0 | 2 | 5 | 9 | 13 | 17 | 21 | 26 | 32 |
| **intraPredAngle (4:2:2 chroma)** | -17 | -13 | -9 | -9 | -5 | -5 | -2 | -2 | 0 | 2 | 2 | 5 | 5 | 9 | 9 | 13 | 17 |

Table 8‑5 further specifies the mapping table between predModeIntra and the inverse angle parameter invAngle.

Table 8‑5 – Specification of invAngle

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **predModeIntra** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** |
| **invAngle** | −4096 | −1638 | −910 | −630 | −482 | −390 | −315 | −256 |
| **invAngle (4:2:2 chroma)** | −1638 | −910 | −482 | −315 | −256 | −256 | −256 | −482 |
| **predModeIntra** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** |
| **invAngle** | −315 | −390 | −482 | −630 | −910 | −1638 | −4096 | - |
| **invAngle (4:2:2 chroma)** | −630 | −910 | −910 | −1638 | −1638 | −4096 | −4096 | - |

– If predModeIntra is equal or greater than 18 the following ordered steps apply:

1. The reference sample array ref[ x ] is specified as follows:

* The following applies:

ref[ x ] = p[ −1 + x ][ −1 ], with x = 0..nTbS (8‑47)

* If intraPredAngle is less than 0, the main reference sample array is extended as follows:
* When ( nTbS \* intraPredAngle )  >>  5 is less than −1,

ref[ x ] = p[ −1 ][ −1 + ( ( x \* invAngle + 128 )  >>  8 ) ],  
 with x = −1..( nTbS \* intraPredAngle )  >>  5 (8‑48)

* Otherwise,

ref[ x ] = p[ −1 + x ][ −1 ], with x = nTbS + 1..2 \* nTbS (8‑49)

1. The values of the prediction samples predSamples[ x ][ y ], with x, y = 0..nTbS − 1 are derived as follows:
   1. The index variable iIdx and the multiplication factor iFact are derived as follows:

iIdx = ( ( y + 1 ) \* intraPredAngle )  >>  5 (8‑50)

iFact = ( ( y + 1 ) \* intraPredAngle ) & 31 (8‑51)

* 1. Depending on the value of iFact, the following applies:
* If iFact is not equal to 0, the value of the prediction samples predSamples[ x ][ y ] is derived as follows:

predSamples[ x ][ y ] =   
 ( ( 32 − iFact ) \* ref[ x + iIdx + 1 ] + iFact \* ref[ x + iIdx + 2 ] + 16 )  >>  5 (8‑52)

* Otherwise, the value of the prediction samples predSamples[ x ][ y ] is derived as follows:

predSamples[ x ][ y ] = ref[ x + iIdx + 1 ] (8‑53)

* 1. When predModeIntra is equal to 26 (vertical), cIdx is equal to 0 and nTbS is less than 32, the following filtering applies with x = 0, y = 0..nTbS − 1:

predSamples[ x ][ y ] = Clip1Y( p[ x ][ −1 ] + ( ( p[ −1 ][ y ] − p[ −1 ][ −1 ] )  >>  1 ) ) (8‑54)

– Otherwise, the following ordered steps apply:

1. The reference sample array ref[ x ] is specified as follows:

* The following applies:

ref[ x ] = p[ −1 ][ −1 + x ], with x = 0..nTbS (8‑55)

* If intraPredAngle is less than 0, the main reference sample array is extended as follows:
* When ( nTbS \* intraPredAngle )  >>  5 is less than −1,

ref[ x ] = p[ −1 + ( ( x \* invAngle + 128 )  >>  8 ) ][ −1 ],  
 with x = −1..( nTbS \* intraPredAngle )  >>  5 (8‑56)

* Otherwise,

ref[ x ] = p[ −1 ][ −1 + x ], with x = nTbS + 1..2 \* nTbS (8‑57)

1. The values of the prediction samples predSamples[ x ][ y ], with x, y = 0..nTbS − 1 are derived as follows:
2. The index variable iIdx and the multiplication factor iFact are derived as follows:

iIdx = ( ( x + 1 ) \* intraPredAngle )  >>  5 (8‑58)

iFact = ( ( x + 1 ) \* intraPredAngle ) & 31 (8‑59)

1. Depending on the value of iFact, the following applies:

* If iFact is not equal to 0, the value of the prediction samples predSamples[ x ][ y ] is derived as follows:

predSamples[ x ][ y ] =   
 ( ( 32 − iFact ) \* ref[ y + iIdx + 1 ] + iFact \* ref[ y + iIdx + 2 ] + 16 )  >>  5 (8‑60)

* Otherwise, the value of the prediction samples predSamples[ x ][ y ] is derived as follows:

predSamples[ x ][ y ] = ref[ y + iIdx + 1 ] (8‑61)

1. When predModeIntra is equal to 10 (horizontal), cIdx is equal to 0 and nTbS is less than 32, the following filtering applies with x = 0..nTbS − 1, y = 0:

predSamples[ x ][ y ] = Clip1Y( p[ −1 ][ y ] + ( ( p[ x ][ −1 ] − p[ −1 ][ −1 ] )  >>  1 ) ) (8‑62)

method 2

##### **8.4.4.2.6 Specification of intra prediction mode in the range of INTRA\_ANGULAR2.. INTRA\_ANGULAR34**

Inputs to this process are:

– the intra prediction mode predModeIntra,

– the neighbouring samples p[ x ][ y ], with x = −1, y = −1..nTbS \* 2 − 1 and x = 0..nTbS \* 2 − 1, y = −1,

– a variable nTbS specifying the transform block size,

– a variable cIdx specifying the colour component of the current block.

Outputs of this process are the predicted samples predSamples[ x ][ y ], with x, y = 0..nTbS − 1.

Figure 8‑2 illustrates the total 33 intra angles and Table 8‑4 specifies the mapping table between predModeIntra and the angle parameter intraPredAngle.



Figure 8‑2 – Intra prediction angle definition (informative)

Table 8‑4 – Specification of intraPredAngle

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **predModeIntra** | **1** | **2** | **3** | **4** | **5** | **6** | **7** | **8** | **9** | **10** | **11** | **12** | **13** | **14** | **15** | **16** | **17** |
| **intraPredAngle** | - | 32 | 26 | 21 | 17 | 13 | 9 | 5 | 2 | 0 | −2 | −5 | −9 | −13 | −17 | −21 | −26 |
| **intraPredAngle (4:2:2 chroma)** | - | 32 | 32 | 32 | 32 | 26 | 17 | 9 | 5 | 0 | -5 | -9 | -17 | -26 | -32 | -26 | -21 |
| **predModeIntra** | **18** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** | **27** | **28** | **29** | **30** | **31** | **32** | **33** | **34** |
| **intraPredAngle** | −32 | −26 | −21 | −17 | −13 | −9 | −5 | −2 | 0 | 2 | 5 | 9 | 13 | 17 | 21 | 26 | 32 |
| **intraPredAngle (4:2:2 chroma)** | -17 | -13 | -9 | -9 | -5 | -5 | -2 | -2 | 0 | 2 | 2 | 5 | 5 | 9 | 9 | 13 | 17 |

Table 8‑5 further specifies the mapping table between predModeIntra and the inverse angle parameter invAngle.

Table 8‑5 – Specification of invAngle

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **predModeIntra** | **11** | **12** | **13** | **14** | **15** | **16** | **17** | **18** |
| **invAngle** | −4096 | −1638 | −910 | −630 | −482 | −390 | −315 | −256 |
| **invAngle (4:2:2 chroma)** | −1638 | −910 | −482 | −315 | −256 | −315 | −390 | −482 |
| **predModeIntra** | **19** | **20** | **21** | **22** | **23** | **24** | **25** | **26** |
| **invAngle** | −315 | −390 | −482 | −630 | −910 | −1638 | −4096 | - |
| **invAngle (4:2:2 chroma)** | −630 | −910 | −910 | −1638 | −1638 | −4096 | −4096 | - |

– If predModeIntra is equal or greater than 18 when ChromaArrayType is not equal to 2 or cIdx is equal to 0, or if predModeIntra is equal or greater than 15 when ChromaArrayType is equal to 2 and cIdx is not equal to 0, the following ordered steps apply:

1. The reference sample array ref[ x ] is specified as follows:

* The following applies:

ref[ x ] = p[ −1 + x ][ −1 ], with x = 0..nTbS (8‑47)

* If intraPredAngle is less than 0, the main reference sample array is extended as follows:
* When ( nTbS \* intraPredAngle )  >>  5 is less than −1,

ref[ x ] = p[ −1 ][ −1 + ( ( x \* invAngle + 128 )  >>  8 ) ],  
 with x = −1..( nTbS \* intraPredAngle )  >>  5 (8‑48)

* Otherwise,

ref[ x ] = p[ −1 + x ][ −1 ], with x = nTbS + 1..2 \* nTbS (8‑49)

1. The values of the prediction samples predSamples[ x ][ y ], with x, y = 0..nTbS − 1 are derived as follows:
   1. The index variable iIdx and the multiplication factor iFact are derived as follows:

iIdx = ( ( y + 1 ) \* intraPredAngle )  >>  5 (8‑50)

iFact = ( ( y + 1 ) \* intraPredAngle ) & 31 (8‑51)

* 1. Depending on the value of iFact, the following applies:
* If iFact is not equal to 0, the value of the prediction samples predSamples[ x ][ y ] is derived as follows:

predSamples[ x ][ y ] =   
 ( ( 32 − iFact ) \* ref[ x + iIdx + 1 ] + iFact \* ref[ x + iIdx + 2 ] + 16 )  >>  5 (8‑52)

* Otherwise, the value of the prediction samples predSamples[ x ][ y ] is derived as follows:

predSamples[ x ][ y ] = ref[ x + iIdx + 1 ] (8‑53)

* 1. When predModeIntra is equal to 26 (vertical), cIdx is equal to 0 and nTbS is less than 32, the following filtering applies with x = 0, y = 0..nTbS − 1:

predSamples[ x ][ y ] = Clip1Y( p[ x ][ −1 ] + ( ( p[ −1 ][ y ] − p[ −1 ][ −1 ] )  >>  1 ) ) (8‑54)

– Otherwise, the following ordered steps apply:

1. The reference sample array ref[ x ] is specified as follows:

* The following applies:

ref[ x ] = p[ −1 ][ −1 + x ], with x = 0..nTbS (8‑55)

* If intraPredAngle is less than 0, the main reference sample array is extended as follows:
* When ( nTbS \* intraPredAngle )  >>  5 is less than −1,

ref[ x ] = p[ −1 + ( ( x \* invAngle + 128 )  >>  8 ) ][ −1 ],  
 with x = −1..( nTbS \* intraPredAngle )  >>  5 (8‑56)

* Otherwise,

ref[ x ] = p[ −1 ][ −1 + x ], with x = nTbS + 1..2 \* nTbS (8‑57)

1. The values of the prediction samples predSamples[ x ][ y ], with x, y = 0..nTbS − 1 are derived as follows:
2. The index variable iIdx and the multiplication factor iFact are derived as follows:

iIdx = ( ( x + 1 ) \* intraPredAngle )  >>  5 (8‑58)

iFact = ( ( x + 1 ) \* intraPredAngle ) & 31 (8‑59)

1. Depending on the value of iFact, the following applies:

* If iFact is not equal to 0, the value of the prediction samples predSamples[ x ][ y ] is derived as follows:

predSamples[ x ][ y ] =   
 ( ( 32 − iFact ) \* ref[ y + iIdx + 1 ] + iFact \* ref[ y + iIdx + 2 ] + 16 )  >>  5 (8‑60)

* Otherwise, the value of the prediction samples predSamples[ x ][ y ] is derived as follows:

predSamples[ x ][ y ] = ref[ y + iIdx + 1 ] (8‑61)

1. When predModeIntra is equal to 10 (horizontal), cIdx is equal to 0 and nTbS is less than 32, the following filtering applies with x = 0..nTbS − 1, y = 0:

predSamples[ x ][ y ] = Clip1Y( p[ −1 ][ y ] + ( ( p[ x ][ −1 ] − p[ −1 ][ −1 ] )  >>  1 ) ) (8‑62)