1 FAST prediction mode

The *FAST* prediction mode has been designed in such a way as to facilitate the hardware implementation of this standard in applications where very high throughputs are required. In particular, a potential bottleneck in the hardware implementation lies the fact that, in order to calculate a predictor of the current sample, most prediction modes employ the reconstructed value of the previous sample on the same line and same band. This introduces an inherent sequentiality in the encoding process, preventing the encoder from performing the calculations needed to obtain the predictor of the current sample until the previous reconstructed sample has been obtained.

In order to enable the development of very fast architectures, the *FAST* prediction mode breaks this dependency and never employs the sample in the current band on the left of the current pixel. This mode is based on the *reduced* prediction mode with *column-oriented* local sums. The combination of reduced mode and column-oriented local sums almost completely avoids using the reconstructed value of the previous pixels on the same line. The *FAST* prediction mode breaks this dependency completely, by defining modified boundary conditions for the local sums.

In particular, the local sum $\sigma_{z,y,x}$ is defined as

$$\sigma_{z,y,x} = \begin{cases} 4s_{z,y-1,x}, & y > 0 \\ 4s_{z-1,y,x-1}, & z > 0, y = 0, x > 0 \end{cases}$$

The value of $\sigma_{0,0,x}$ and $\sigma_{z,0,0}$ is not defined, as it is not needed.

The scaled predicted sample value $\tilde{s}_z(t)$ is an integer number defined as

$$\tilde{s}_z(t) = \begin{cases} \text{clip}\left(\left\lfloor \frac{\text{mod}_R^*\left[\hat{d}_z(t) + 2^{\Omega}(\sigma_z(t) - 4s_{mid})\right]}{2^{\Omega+1}} \right\rfloor + 2s_{mid} + 1, \{2s_{min}, 2s_{max} + 1\} \right), & y > 0 \text{ or } (z > 0 \text{ and } y = 0 \text{ and } x > 0) \\ 2s_{z-1,0,0}, & z > 0, y = 0, x > 0, P > 0 \\ 2s_{mid}, & y = 0 \text{ and } (z = 0 \text{ or } P = 0) \end{cases}$$

In this calculation the predicted central local difference $\hat{d}_z(t)$ is equal to the inner product of vectors $\mathbf{W}_z(t)$ and $\mathbf{U}_z(t)$:

$$\hat{d}_z(t) = \mathbf{W}_z(t)^T \mathbf{U}_z(t)$$

except for $z = 0$, in which case $\hat{d}_z(t) = 0$. The local difference vector is same as in the reduced prediction mode:

$$\mathbf{U}_z(t) = \begin{bmatrix} d_{z-1}(t) \\ d_{z-2}(t) \\ \vdots \\ d_{z-P}(t) \end{bmatrix}.$$