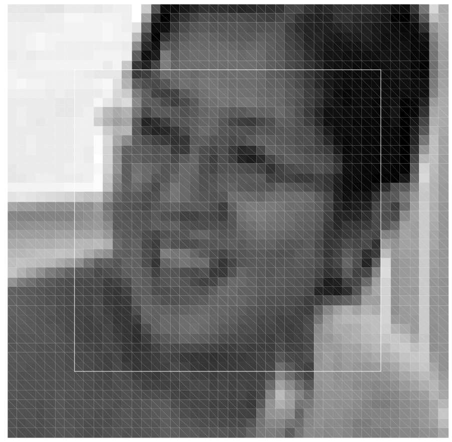

Figure 7.2 Search region in previous (reference) frame

compensation block size is $N \times N$ samples; C_{ij} and R_{ij} are current and reference area samples respectively.

1. Mean Squared Error: $$MSE = \frac{1}{N^2}\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}(C_{ij} - R_{ij})^2 \tag{7.1}$$

2. Mean Absolute Error: $$MAE = \frac{1}{N^2}\sum_{i=0}^{N-1}\sum_{j=0}^{N-1}|C_{ij} - R_{ij}| \tag{7.2}$$

3. Sum of Absolute Errors: $$SAE = \sum_{i=0}^{N-1}\sum_{j=0}^{N-1}|C_{ij} - R_{ij}| \tag{7.3}$$

Example

Evaluating MSE for every possible offset in the search region of Figure 7.2 gives a ‘map’ of MSE (Figure 7.3). This graph has a minimum at (+2, 0) which means that the best match is obtained by selecting a 32 × 32 sample reference region at an offset of 2 to the right of the block position in the current frame. MAE and SAE (sometimes referred to as SAD, Sum of Absolute Differences) are easier to calculate than MSE; their ‘maps’ are shown in Figure 7.4 and Figure 7.5. Whilst the gradient of the map is different from the MSE case, both these measures have a minimum at location (+2, 0).

SAE is probably the most widely-used measure of residual energy for reasons of computational simplicity. The H.264 reference model software [5] uses SA(T)D, the sum of absolute differences of the *transformed* residual data, as its prediction energy measure (for both Intra and Inter prediction). Transforming the residual at each search location increases computation but improves the accuracy of the energy measure. A simple multiply-free transform is used and so the extra computational cost is not excessive.

The results of the above example indicate that the best choice of motion vector is (+2,0). The minimum of the MSE or SAE map indicates the offset that produces a minimal residual energy and this is likely to produce the smallest energy of quantised transform