Image interpolation is achieved by estimating the value of a point located between pixels. The image data is interpolated between the pixels to achieve a linear transition between the three points a_{12}, a_{21} and a_{32}, as illustrated in FIG. **4** in the heavier solid line. The resulting interpolated image is represented in cross hatching in FIG. **4**. The new interpolated image, corresponding to the crossed-hatched area, contains more information than the old image corresponding to the shaded or stippled area.

Interpolation of the analog intensity values among the subpixels in the shaded area is made in accordance with the following equations defining the intensity value of the data word representing a subpixel a'_{ij}:

$a'_{ij}=a_{ij}$ if a_{ij} is the center point of a sample pixel in the original video frame a.

Otherwise:

a'_{ij}=a linear interpolation between the analog values of adjacent a_{ij} from the original video frame a.

Data from sampled video frames can update the estimates from previously interpolated subpixels if combined by a suitable weighting factor. The foregoing image interpolation and zoom techniques are well known and are described in various publications including, for example: Pratt, *Digital Image Processing,* Wiley & Sons, New York, pages 110–116. Accordingly, the image interpolation and zoom technique will not be described in greater detail here.

In summary, by the use of either multiple image registration or image interpolation and zoom, a video image comprising a plurality of fine subpixels may be constructed from a plurality of video frames comprising a plurality of normally sized pixels. A larger number of small detectors could also be used to improve sampling density. However, the information contained in the subpixel composite video frame is still blurred in accordance with the diffraction point spread function of the aperture through which the image was viewed. Accordingly, there remains the task of removing the blur, at least partially, from the image, and reconstructing an unblurred image from the information contained in the highly sampled video frame of subpixels.

Unblurring by Matched Filters

The composite image comprising a plurality of subpixels may be substantially unblurred by correlating each small segment of the composite blurred image with a complete set of equally small blurred image primitives. An exemplary set of 25 image primitives is illustrated in FIG. **5**. Whenever a peak correlation is detected between a particular image primitive and a particular segment of the composite image, an equivalent unblurred image primitive is substituted in place of the blurred segment. In this manner, a synthesized reconstructed silhouette image is formed from a spatially correlated set of image primitives substituted in place of the original blurred image segments to which they correspond.

Before correlating the set of basic image primitives with the various segments of the blurred composite image, the image primitives themselves are first blurred by convolving them with the sensor degradation consisting of both the point spread function of the aperture, through which the original scene was viewed, and the detector shape, which samples the diffraction limited image. Accordingly, both the blurred composite image and the image primitives to which its segments are compared, are blurred by the same point spread function, thus enhancing correlation. This point spread function is a Bessel function defined by wavelength and the configuration of the aperture through which the scene is viewed, and may be computed in a deterministic manner in accordance with well known principles of classical optics. Blurring of the image primitives, such as those illustrated in FIG. **5** with the sensor degradation, is performed in accordance with well known principles of convolution theory.

The foregoing process is illustrated schematically in FIG. **6***a*. The camera **5** generates video data which is fed to a multiple image generator **15** which functions in accordance with either the multiple image registration previously described in connection with FIGS. **2***a*, **2***b*, **2***c* or the image interpolation described in connection with FIG. **4**. The generator **15** then feeds video data corresponding to a composite image of subpixels into a cumulative memory **17** which stores the combined video frame of subpixels. Segments of the video frame data stored in the memory **17** are then continuously fed to a set of parallel matched filters **19**. Each of the matched filters **19** corresponds to a blurred version of one primitive of a complete set of image primitives such as those illustrated in FIG. **5**. Correlation between each segment of the video frame and each of the matched filters is detected by a corresponding one of the correlation peak detectors **21**.

If a particular one of the blurred primitives matches a particular segment of the video data read out from the memory **17**, the corresponding one of the peak detectors **21** will enable the corresponding one of a plurality of primitive generators **23**. The enabled primitive generator feeds the corresponding original (or unblurred) image primitive to a memory **25**, the selected image primitive being stored in a location determined by an address generator **27**. This location corresponds to the location of the matching segment of the original video frame stored in the memory **17**. As a result, feeding a continuum of blurred image segments from the memory **17** through the matched filter **19** causes a new silhouette image to be synthesized in the memory **25** comprising a plurality of matching image primitives.

It is contemplated that the correlation process of FIG. **6***a* may be carried out using a memory and a charge coupled device transversal filter system such as that illustrated in FIG. **6***b*. In FIG. **6***b*, memory **17'** contains a plurality of pixels representing one frame of video data corresponding to the composite blurred image. The pixels are organized by row and column. Matched filter correlation of the type illustrated in FIG. **6***a* is implemented by the use of a charge coupled device transversal filter comprising a plurality of n-parallel charge coupled device serial registers **30**. In the example of FIG. **6***b*, $n=6$.

The top six rows of the CCD memory **17'** are transferred serially from left to right out of the memory **17'**, through the parallel CCD registers **30** and beneath a planar array **32** of charge sensing gate electrodes organized by n-rows and n-columns. This defines the dimensions of each of the segments of the video frame to be compared or matched as n pixels by n pixels. The n-rows of sensing gate electrodes in the array **32** are in vertical registration with the n-rows of the stored image **30**. The spacing in the x direction in the gate electrodes in the array **32** corresponds to the serial spacing of charge packets in each of the image registers **30**.

As the top six rows of data from the memory **17'** are clocked from left to right through the CCD registers **30**,