Real-time, adaptive contrast enhancement

Most video-cameras have automatic *exposure* control, to adapt to a wide range of scene illumination. The control of *contrast* is less easily automated, since a scene-dependent, nonlinear transfer function is often required to achieve satisfactory results. Note that the contents of the scene may make very unequal use of the intensity range; for example, a small area may command a wide intensity interval while the rest of the image all lies within a narrow interval.

Basic information-theoretical considerations suggest a "canonical" contrast-enhancement algorithm: contrast should be *equalized* so that approximately equal numbers of pixels fall into equal segments of the intensity range. For this, one must (a) contruct a histogram of the entire scene; (b) partition the histogram into a fixed number of segments, adjusting the segment boundaries according to the scene so as to *maximize the entropy* of the resulting distribution; and (c) assign to each pixel, as a new light level, the index number of the correponding segment.

This algorithm, which in most circumstances substantially enhances the perception of the scene, can be carried out *in real time* by a small CAM-8 unit directly connected to the camera.

A further developments of this approach is discussed in the next section.

Original camera image (left); contrast-enhanced image (right)