used. The number of addressable points was thus increased from $1024 \times 1024$ to $8192 \times 8192$. The vector writing speed in this particular implementation was $732\mu s$ for a 256-pixel long vector. Thus, 1000 smooth vectors could be drawn in less than one second. Smooth-vector quality appears to be superior to that of the usual vectors displayed on storage tube devices, where a resolution on the order of $4096 \times 4096$ is commonly used.

The smooth-edge generator. The smooth-edge generator described in the previous section was implemented as an intelligent antialiasing postprocessor incorporated in the Graphica M-508 display. Numerous graphics packages producing continuous-tone images have been coupled to this postprocessor through a driver, which retrieves the list of all visible edges and transmits them to the smooth-edge generator. Three of the graphics programs we used were Movie.BYU, Luminous, and Gem.

**Movie.BYU.** Movie.BYU, run on a VAX 11/750, required 31 seconds to calculate the non-antialiased image shown in Figure 11a. If the program's optional averaging technique is used, image computation must be at a resolution twice that of the display. Removal of jags in this instance, however, is not adequate, and only diminishes the aliasing effects. Nevertheless, the time required for this partial antialiasing is about 35 seconds (a fairly constant figure) per frame—about 170 percent of the time it took to calculate the original image. However, the smooth-edge generator described in this article required less than one second for the post antialiasing of the image shown in Figure 11a; the result is shown in Figure 11b.

**Luminous.** On the VAX 11/750, Luminous, a product of Graphica Computer Corporation, required 90 seconds to output the image shown in Figure 12a. Using the antialiasing feature of Luminous requires computation at a resolution three times that of the display. The results obtained are satisfactory, but the time required is almost four minutes per frame. Again, with our algorithm, virtually the same results can be obtained in practically no time when the smooth-edge generator is put into operation (see Figure 12b).

**Gem.** The continuous-line image part of the Gem (another Graphica product) output shown in Figure 13a

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![Figure 13. Continuous-tone image (on a 512 x 512 raster CRT) output from the Gem graphics program (a) before antialiasing and (b) after post-antialiasing.](image)

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