An Approximate Method for Anti-aliasing, Using a Random Access Z-buffer

K. B. Evans
National Research Council of Canada
Ottawa, Ontario

This abstract outlines work in progress which will be described in detail at the conference. If the quality of the images produced by this approximation method turns out to be a significant improvement over the aliased image, an illustrated description will be submitted elsewhere for publication.

A method is presented for performing anti-aliasing of Gouraud shaded polygons, using a slightly modified Z-buffer. The Z-buffer technique cannot, in general, allow successful anti-aliasing because the colors and intensities of edges will frequently be computed incorrectly [CATM78]. Crow [CROW77] points out that various schemes for overcoming this problem could be devised but that they would all entail additional data structure complexity and Z-buffer memory. This paper offers an approximate scheme with very little additional testing and no need for added structural complexity or Z-buffer memory. This approach is useful because it allows polygons to be computed in random order while allowing a reasonable approximation of anti-aliasing to be performed.

The method requires a flag bit at every pixel, which is achieved by reducing the Z-buffer depth range: the n bits per pixel of the Z-buffer are split into n-1 bits for depth and one bit for the flag. The essence of the scheme lies in the use of this flag to determine whether a pixel in memory has already undergone an anti-aliasing blending. If it has, it is necessary to ensure that pixels on the boundary between abutting triangles (or polygons) do not undergo blending, but are written directly to prevent the abutment line from showing. The present implementation is restricted to triangles, but this is easily extended to n-sided polygons by triangulation of the polygons or to convex polygons by generalizing the tiler. The scheme described, while permitting a certain number of errors (which would probably render it poor for animation), allows silhouette edges to be anti-aliased while allowing neighbouring polygons to abut smoothly. The errors that occur are generated when the edge of one surface lies in front of a previously anti-aliased pixel. For our work in surface modelling, this situation occurs relatively infrequently, and hence the error rate is expected to be low enough that the overall effect will be a much improved image. In order to decide whether or not an edge pixel of one polygon is adjacent to that of its neighbour in the frame buffer (i.e. is this an abutment or should anti-aliasing be performed), some additional testing is required which makes use of polygon slopes.

References

[CATM78]: Edwin Catmull, "A Hidden-Surface Algorithm with Anti-Aliasing", Proc. of SIGGRAPH '78

[CROW77]: Franklin C. Crow, "The Aliasing Problem in Computer Synthesized Shaded Images", PhD Thesis, University of Utah, March 1976