A FAST ALGORITHM FOR GENERAL RASTER ROTATION

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ABSTRACT

The rotation of a digitized raster by an arbitrary angle is an essential function for many raster manipulation systems. We derive and implement a particularly fast algorithm which rotates (with scaling invariance) rasters arbitrarily; skewing and translation of the raster is also made possible by the implementation. This operation is conceptually simple, and is a good candidate for inclusion in digital paint or other interactive systems, where near real-time performance is required.

RÉSUMÉ

La rotation d'un "raster" d'un angle arbitraire est une fonction essentielle de plusieurs logiciels de manipulation de "raster". Nous avons implémenté un algorithme rapide de rotation de "raster" conservant l'échelle de l'image. Nous d'écrivons ce système qui permet aussi le biaisage et la translation du "raster". Cette opération, d'un concept simple, se révèle un bon candidat à l'insertion dans un logiciel de "paint system" (ou autre système interactif) où une performance quasi-temps réel est nécessaire.

Keywords: *raster rotation, frame buffer, real-time.*

INTRODUCTION

We derive a high-speed raster rotation algorithm based on the decomposition of a 2-D rotation matrix into the product of three shear matrices. Raster shearing is done on a scan-line basis, and is particularly efficient. A useful shearing approximation is averaging adjacent pixels, where the blending ratios remain constant for each scan-line. Taken together, our technique rotates (with anti-aliasing) rasters faster than previous methods. The general derivation of rotation also sheds light on two common techniques: small angle rotation using a two-pass algorithm, and three-pass 90-degree rotation. We also provide a comparative analysis of Catmull and Smith's method [[Catm80]] and a discussion of implementation strategies on frame buffer hardware.

STATEMENT OF THE PROBLEM

A general 2D counter-clockwise rotation of the point `(x,y)` onto `(x',y')` by angle theta is performed by multiplying the point vector `(x,y)` by the rotation matrix:

$$M = \begin{bmatrix} \cos\theta & -\sin\theta \\ \sin\theta & \cos\theta \end{bmatrix}$$

The matrix is orthogonal: it is symmetric, rows and columns are unit vectors, and the determinant is one. To rotate a raster image, we consider mapping the unit cell with center at location `(i,j)` onto a new location `(i',j')`.

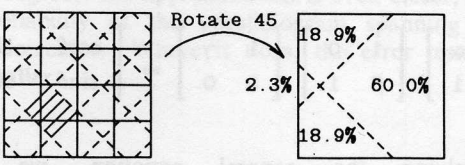

Figure 1. Rotation by Raster Sampling