

Computer Graphics

LECTURE 14

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Last Class

- ▶ Translation
- ▶ Shear
- ▶ Reflection

Today's Agenda

- ▶ Combining Transformations
- ▶ Affine versus Rigid body Transformations
- ▶ Homogenous Transformations

Combining Transforms

- ▶ General transformation of a point:

- ▶ $P' = N \cdot P + A$

- ▶ Scaling or rotation,
- ▶ Translate, we set A, and N is the multiplicative identity.

Rigid Body Transforms

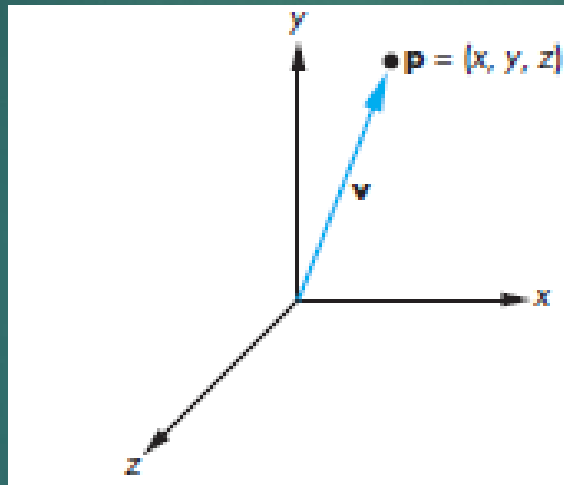
- ▶ The transforms in which angles and lengths are preserved are called rigid body transforms.
 - ▶ The body or object is not distorted after the application of transformation.
 - ▶ Rotation and Translation are examples

Affine Transformations

- ▶ Parallelism of lines are preserved but angles between the lines are not preserved in **affine transformations**
 - ▶ An arbitrary sequence of rotation, translation and scaling can cause affine transformation
 - ▶ Shear is another example

A Dangerous Representation

- ▶ Point and vectors are two distinct geometric types but a confusion may arise



Homogeneous Coordinates

- How a 2D vector is represented by 3 x 3 matrix

$$x' = x + a$$

$$y' = y + b$$

$$\mathbf{Translation} = \begin{bmatrix} 1 & 0 & a \\ 0 & 1 & b \\ 0 & 0 & 1 \end{bmatrix}$$

Homogenous Coordinate System

- ▶ A 3rd Coordinate is added to every 2D point
 - ▶ (x, y, t) represents $(x/t, y/t)$
 - ▶ $(x, y, 0)$ represents infinity
 - ▶ $(0, 0, 0)$ is not allowed

Summary

- ▶ Combining Transformations
- ▶ Affine versus Rigid body Transformations
- ▶ Homogenous Transformations

References

- ▶ Fundamentals of Computer Graphics Third Edition by Peter Shirley and Steve Marschner
- ▶ Interactive Computer Graphics, A Top-down Approach with OpenGL (Sixth Edition) by Edward Angel.