

Problems

2D/3D Transformations

Given $P(x,y)$ or (x,y,z) (e.g., $(2,3)$ or $(2,1,3)$)
Computing the coordinates of P resulting from
the execution of a series of transformations

E.g.

- Translate $T(3,4)$
- Rotate 45 degree
- Scaling x by $\frac{1}{2}$ and y by $\frac{1}{4}$
- ...

Is there a *good (easy)* way to compute it?

The same with the 3D transformations

2D/3D Transformations

Identifying ways to achieve certain objective:

E.g., the edge PQ with $P(1,2)$ and $Q(3,4)$ need to become $P'Q'$ with $P'(3,2)$ and $Q'(4,5)$

3D Projection

Given

- a point $P(x,y,z)$
- projection plane (a point with a normal)
- center of projection $C(a,b,c)$ or direction of projection (a,b,c)

Compute the projection of P onto the plane

And the reverse!

And computing the view volume!

Curves and Surfaces

- Polygon meshes
- Parametric curves
- Parametric cubic surfaces

The different representations and their relationships (Hermite, Bezier, B-spline), conversion among the three.

What should be done if we need to approximate a curve or a surface?

Solid Modeling

- Different ways for representing solids
- Regularized Boolean set operations
- Sweep representation
- Spatial-partial representations

The definition of these representations, and how to use them.

Color

- Models of color
- Colors on a screen (how many colors etc.)
- How to match a color?

Rendering

Given territorial data on a grid – $z=f(x,y)$

Rendering the data on 2D plane (bird-eye view)

Hue's algorithm:

```
for x = xmax to 1
```

```
  for y = ymax to 1
```

```
    project two triangles t1, t2
```

```
    determining the colors of t1, t2
```

```
    set the color
```

```
  endfor
```

```
endfor
```

Rendering a Scene

A scene might contain several objects whose surfaces are non-planetary

Different algorithm for determining the color of a point on the projection plane

Make use of parametric representation of line in computing the intersection