Computer Graphics Course 2005

Arcball User Interface
Background for ex2

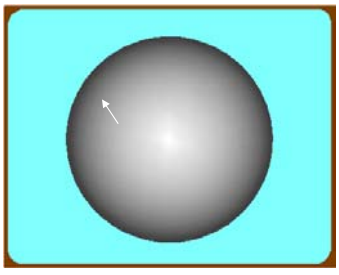
Arcball User Interface

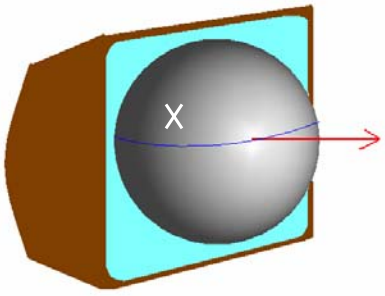
- Motivation: UI for intuitive rotation of 3D objects using the mouse
- Problem: mouse coordinate are in 2D
- Solution: assign 3D coordinate to each 2D screen coordinate

Arcball UI

1. Each 2D point is mapped to a point on a (hemi)sphere located at the center of the screen
2. 2D mouse motion translated to 3D motion on the sphere
3. Rotation angle and axis extracted from motion on the sphere

Arcball UI: Mapping to Sphere





1. Mapping to Sphere

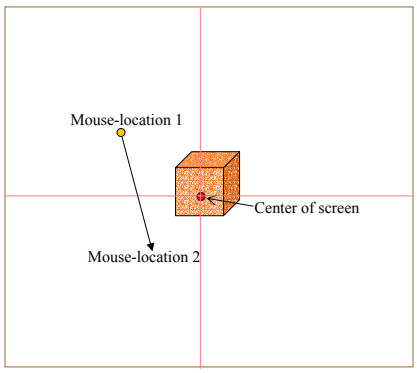
$$(x, y)\alpha\begin{cases}(x, y, 0) & \text{in case } \sqrt{x^2 + y^2} > R \\ (x, y, \sqrt{R^2 - x^2 - y^2}) & \text{otherwise}\end{cases}$$

- x, y: screen coordinates with the ball centered at the origin with radius R

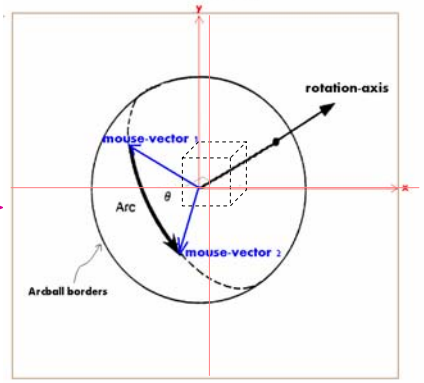
2. Moving on the arcball

- Rotation axis + angle are both easy to calculate from the two vectors.

Screen view and events:



Arcball interpretation:



3. Extracting rotation parameters

- Rotation axis: is the vector normal to the plane spanned by the two mouse vectors.
  - R = m1 x m2
- Rotation angle is the angle between those two vectors.
  - a = 2 * acos(m1*m2)

Arcball UI

- Apparently, it is more natural to use twice the angle given from the arcball for the rotation.

$\theta / 2$ θ

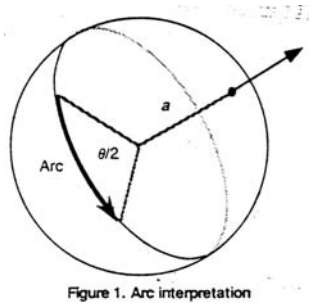
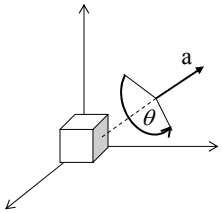


Figure 1. Arc interpretation



Arcball Property

- Two combined arcs are equal to the arc beginning with the first arcs beginning point and ending with the second arc ending point.
- Rotation depends solely on the beginning and ending points

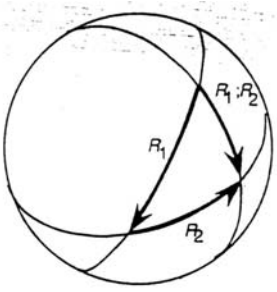


Figure 2. Arc combination