table of contents

Contents

1 15 Curves

1. **(curves)**
   (a) **(implicit)** fast test for points on curve $f(x, y) = 0$ ($f(x, y) = x^2 + x^2 - 1$)
   (b) **(parametric)** mapping from free parameter to points on curve $(x, y) = \mathbf{f}(t)$ ($(x, y) = (\cos t, \sin t)$)
   (c) **(generative)** fractals ...
2. **(parameterization and reparameterization)** there are different parameterizations of a curve.
3. **(arc-length (natural) parameterization)** a parameterization of a curve where the tangent has a constant magnitude
$$\left| \frac{d\mathbf{f}(s)}{s} \right|^2 = c$$
Intuitively we think of the curve as draw at a constant velocity and the values of free parameter s is a measure of length along the curve, which we can compute with
$$s = \int_0^v \left| \frac{d\mathbf{f}(t)}{t} \right|^2 dt$$
4. **(piecewise parametric representations)** to represent a compound curve. One representatin is a piecewise polynomial function, i.e. splines.
5. **(continuous curve)** a curve is C^n continuous if all of its derivativs up to n match across pieces.
6. **(polynomial pieces)** canonical form of a polynomial function
$$\mathbf{f}(t) = \sum_{i=0}^{n} \mathbf{c}_i b_i(t)$$
where b_i are basis functions. A curve in n-dimension can be represented with n polynomials $(\mathbf{f}_1, \cdots, \mathbf{f}_n)$
7. **(a line segment)** can be represented by end points
$$\mathbf{f}(u) = (1 - u)\mathbf{p}_0 + u\mathbf{p}_1$$
or with canonical form of a polynomial
$$\mathbf{f}(u) = \mathbf{u} \cdot \mathbf{a} = \mathbf{a}_0 + u\mathbf{a}_1 + \cdots$$
where $\mathbf{u} = \begin{pmatrix} 1 & u & u^2 & \cdots & u^n \end{pmatrix}$

2 16 Computer Animation

1. **(animation techniques)**
   (a) **(squash and stretch)**
   (b) **(keyframing)**
2. **(interpolating rotation)**
3. **(character animation)** a skeleton under th skin is a hieerarchical structure (tree) of joints which provides a kinematic model of the figure.
4. **(forward kinematics)** if local transformation matrix relates a joint to its parent in the tree is available, then one can obtain transformations which relates local space of and joint to the world system by concatenating transformations along the path from root to the joint. Use depth-first traversal (and transformation stack) to determine the transfomation matrix for all joints.
5. **(inverse kinematics)** usually user specify behavior of the endpoint and do not care about transformation of internal nodes of the tree. inverse kinematics automatically determine natural transformations for all joints.
6. **(skinning)** the motion of skeleton is transferred to the surface by assigning each skin vertex one (rigid skinning) or more (smooth skinning) joints as drivers.