Michael Wand

Geometric Modeling

Assignment sheet 4 (Splines, due May 28th 2008)

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(1) Hermite Splines [1+3+2 points]

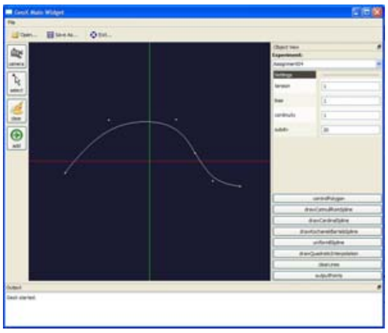
a. Create a new experiment. Use the GLGeometryViewer which allows one to add control points interactively. Add a button which draws a piecewise linear curve by connecting subsequent user-defined input points.
Hint: GeoX uses consecutive point indices, starting from 0, in the order in which points have been added. The number of points is available via the viewer's getNumberOfPoints() method.

b. Add a button which draws a cubic Spline curve through control points defined previously. Use Catmull-Rom type tangent computations as shown in the lecture. Allow user to change the number of lines which are used to approximate each curve segment. Please use different color for the curve than in (a). (Hint: the curve has not to pass through end points).

c. The choice of derivative computation defines the "type" of a spline curve, i.e. Cardinal, Catmull-Rom, Kochanek-Bartels (also known as TCB spline). Kochanel-Bartels spline is a generalization of Cardinal and Catmull-Rom splines. For these spline types additional parameters like, *tension (t)*, *bias (b)*, and *continuity(c)* required to control the interpolation. Add settings to your assignment where you specify these parameters globally for the entire curve. Add two buttons which draws a Cardinal spline, and a Kochanek-Bartels spline through selected control points. (Hint: search the literature or use Wikipedia to find the definition of these spline types).

(2) Uniform B-Splines [5 points]

a. Add a button which draws the uniform cubic B-Spline defined by the control polygon in (1a). Allow the user to change the number of lines used to approximate the curve. Use duplicate control points such that the first and the last user-defined points are interpolated.



Experiment: Assignment04

tension 1

bias 1

continuity 1

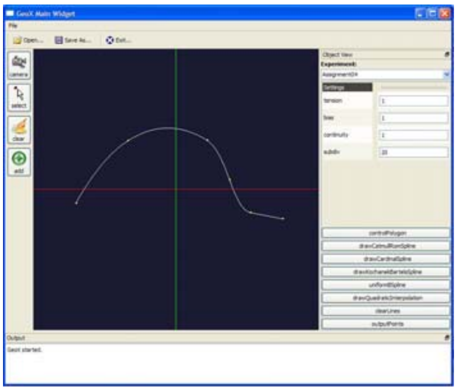
subdiv 20

GeoX started.

(3) Quadratic Spline interpolation [7 + 2 points]

a. A quadratic spline interpolation curve of n data points consists of n-1 segments made of quadratic polynomials ($a_ix^2 + b_ix + c_i = y$) connecting two consecutive data points ($[x_{i-1},y_{i-1}]$ and $[x_i,y_i]$). The first order derivatives of two neighbor segment polynomials are equal on every point y_i. Derive an analytical solution for a_i, b_i and c_i. For simplicity you can assume, that last segment is linear. Be prepared to present your solution to your tutor/bremser.

b. Add a button which solves the equation system derived in (a) for given n data points and draw the interpolated curve with the help of computed polynomials. Use `DynamicMatrix` and `DynamicVector` to setup your problem.
Hint (a): `invertMatrix()` method from `DynamicLinearAglebra.h` can compute the inverse of a matrix.
Hint (b): Take care when indexing entries of DynamicMatrix, A[c][r] = x, will put x on column c and row r into the matrix.



tension 1
bias 1
continuity 1
subdiv 20

GeoX started.