Übung zu Computergraphik II

– Assignment 12 –

Computer Graphics and
Multimedia Systems Group
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Assignment 1 [1 Point] Tapering

Given the tapering function

$$r(u) = \frac{1}{5}(u+1)^2 + \frac{1}{5}$$

and a cubic Bezier curve $\mathbf{C}(t)$ with control points

$$\mathbf{C}_0 = \begin{pmatrix} 1 \\ -1 \end{pmatrix}, \mathbf{C}_1 = \begin{pmatrix} -1 \\ -1 \end{pmatrix}, \mathbf{C}_2 = \begin{pmatrix} -1 \\ 1 \end{pmatrix}, \mathbf{C}_3 = \begin{pmatrix} 1 \\ 1 \end{pmatrix}.$$

1. Scale the second coordinate of the given control points by using the tapering function $r(u)$. Using the new contol points, execute the De-Casteljau algorithm geometrically for $t = 0, 0.1, 0.25, 0.5, 0.75, 0.9, 1$. Sketch the curve.
   Hint: Utilize the symmetry of control points.
2. Given the curve points:
   $\mathbf{C}(0) = \begin{pmatrix} 1 \\ -1 \end{pmatrix}$, $\mathbf{C}(0.1) = \begin{pmatrix} 0.46 \\ -0.94 \end{pmatrix}$, $\mathbf{C}(0.25) = \begin{pmatrix} -0.125 \\ -0.6875 \end{pmatrix}$, $\mathbf{C}(0.5) = \begin{pmatrix} -0.5 \\ 0 \end{pmatrix}$, $\mathbf{C}(0.75) = \begin{pmatrix} -0.125 \\ 0.6875 \end{pmatrix}$, $\mathbf{C}(0.9) = \begin{pmatrix} 0.46 \\ 0.94 \end{pmatrix}$, $\mathbf{C}(1) = \begin{pmatrix} 1 \\ 1 \end{pmatrix}$.
   Scale the second coordinate of these curve points by using the tapering function $r(u)$. Sketch the corresponding curve and compare it with the result from subtask 1.
   Hint: Utilize the symmetry of the control points.

Assignment 2 [1 Point] Freeform Deformation (FFD), 2D

Given a program framework for the calculation of 2D deformations on a custom Bézier control grid. The following classes are defined :

class `FreeForm`:
The constructor calculates the initial control points of the grid on which the Bezier curves are defined for the deformation. The method `calcBBPolynome(int i, int n, double t)` calculates the i-th Bernstein polynomial:

$$B_i^n(t) = \binom{n}{i} t^i (1-t)^{n-i}, \qquad \binom{n}{i} = \frac{n!}{i!(n-i)!}$$

class `DisplayOGL`:
This class is in charge for the representation of the control unit and the deformed Items.

1. Implement the function `FreeForm::eval_D(double x, double y)` which performs the deformation

$$D(x,y) = \sum_{i=0}^{3}\sum_{j=0}^{3} \mathbf{C}_{ij} B_i^3(u(x)) B_j^3(v(y))$$

   under the direct evaluation of the same formula.
2. Implement the function `DisplayOGL::drawGrid()` which calculates and represents the deformed control grid.
3. Implement in the function `DisplayOGL::drawObjects()` a representation of a deformed rectangle.

Submission: 22.1.2015, before /at the beginning of the exercise.

Submit task 1 on paper and send for task 2 an email with the modified files.
→ Email to: david.bulczak@uni-siegen.de, christoph.schikora@uni-siegen.de

The **deadline** is the same for all tasks, e.g. emails will only be accepted till Thursday 12:00 clock. If we receive your mail, we will send you a confirmation as soon as possible.