Programming assignment no. 4

(10pts)

Topic: Coons patch

Deadline: 24 April 2020 – 10 May 2020

Goal: The aim of the fourth programming assignment is to create an application depicting bilinear and bicubic Coons patch.

Instructions:

The boundary of the patch is created by the curves $\mathbf{c}_0, \mathbf{c}_1, \mathbf{d}_0$ a $\mathbf{d}_1$. The condition of C^0-compatibility, i.e. $\mathbf{c}_0(0) = \mathbf{d}_0(0),\ \mathbf{d}_0(1) = \mathbf{c}_1(0),\ \mathbf{d}_1(0) = \mathbf{c}_0(1),\ \mathbf{c}_1(1) = \mathbf{d}_1(1)$, is already implemented. Your task is to implement the following patches:

Bilinear Coons patch **3pts** The boundary curves $\mathbf{c}_0, \mathbf{c}_1$ are the Bézier curves of degree m and $\mathbf{d}_0, \mathbf{d}_1$ are the Bézier curves of degree n. The degree of the curves as well as the position of the control vertices might be changed. The boundary curves are blended bilinearly.

Bicubic Coons patch **5pts** The boundary curves are the same as in the previous case. These curves are endowed with the derivatives $\bar{\mathbf{e}}_0, \bar{\mathbf{e}}_1, \bar{\mathbf{f}}_0, \bar{\mathbf{f}}_1$ in the transversal direction given by the Hermit curves

$$\bar{\mathbf{e}}_i(t) = H_0^3(t)\,\frac{\mathrm{d}}{\mathrm{d}s}\mathbf{d}_0(i) + H_1^3(t)\,\bar{\mathbf{g}}_{i0} + H_2^3(t)\,\bar{\mathbf{g}}_{i1} + H_3^3(t)\,\frac{\mathrm{d}}{\mathrm{d}s}\mathbf{d}_1(i),$$
$$\bar{\mathbf{f}}_i(s) = H_0^3(s)\,\frac{\mathrm{d}}{\mathrm{d}t}\mathbf{c}_0(i) + H_1^3(s)\,\bar{\mathbf{g}}_{0i} + H_2^3(s)\,\bar{\mathbf{g}}_{1i} + H_3^3(s)\,\frac{\mathrm{d}}{\mathrm{d}t}\mathbf{c}_1(i)$$

, and also with the second derivatives $\bar{\mathbf{g}}_{ij}$ (twists) which are the zero vectors. The curves are blended bicubically.

Arch **2b** is created by the following boundary curves:

$\mathbf{c}_0$ – a segment connecting points $(-1, 1, 0)^\top$ and $(-1, -1, 0)^\top$,

$\mathbf{c}_1$ – a segment connecting points $(1, 1, 0)^\top$ and $(1, -1, 0)^\top$,

$\mathbf{d}_0$ – a segment connecting points $(-1, 1, 0)^\top$ and $(1, 1, 0)^\top$,

$\mathbf{d}_1$ – circular arc starting in the point $(-1, -1, 0)^\top$ and finishing in the point $(1, -1, 0)^\top$, passing through the point $(0, -1, 1)^\top$.

The curves used in the case of the arch are **not** represented as Bézier curves. These curves are blended bilinearly.

Notes on the code: the comments `TODO` may be found in the following lines:

`Patch.cs - 61, 155, 166, 177`.

Output:

The code implementing the patches (this part needs to be easily identifiable and created by the author, i.e. created explicitly for the purposes of this assignment).

Usage or integration of solely external libraries is strictly forbidden!

Apart from these, the code needs to be **richly** commented and **neatly** formatted. Poor commenting and ugly formatting might be penalized by loss up to *3 pts*.

Sample application and template is available on the webpage, together with this .pdf file.