

# Assignment in Computer Graphics II

## – Assignment 11 –

### Computer Graphics and Multimedia Systems Group

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#### Assignment 1 [2 Points] Form Control

Given the following Ease-function:

$$\text{ease}_{\text{exp}}(t) = \begin{cases} \frac{e^{2t} - 2t - 1}{2e - 4} & t \in [0, \frac{1}{2}] \\ 1 - \left( \frac{e^{2(1-t)} + 2t - 3}{2e - 4} \right) & t \in [\frac{1}{2}, 1] \end{cases}$$

1. Which velocity curve results from this Ease-function?
2. Let  $v_0$  be a speed. Determine an Ease-function of the form

$$\text{ease}_{\text{exp}}^{v_0}(t) = c \cdot \text{ease}_{\text{exp}}(t),$$

which obtains an acceleration of 0 to  $v_0$  in the time  $t = 0$  to  $t = \frac{1}{2}$ , where  $c$  is a sought (gesuchter) constant term.

Note: It is sufficient to consider the definition on the interval  $t \in [0, \frac{1}{2}]$ .

#### Assignment 2 [2 Points] Camera coordinate system and up-vector

A camera moves on the spiral path  $\mathbf{C}(t) = \begin{pmatrix} \cos(\omega t) \\ vt \\ \sin(\omega t) \end{pmatrix}$ , where  $v$  is the vertical speed and  $\omega$  is the angular velocity (radians per second). The camera axis should always be aligned along the tangent direction.

1. Calculate the up vector. Assume that the up-vector remains the same for positive and negative direction of rotation.
2. How does the sign of its y component behaves?
3. Which value does the up vector take for  $v = 0$ ?

**Assignment 3** [2 Points] 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 control 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.

**Hand in: 07.07.2016, , at beginning of the lecture or until 10:00 in the mailbox of the chair (next to room H-A 7107) or via e-mail.**