CS 380

Introduction to Computer Graphics

LAB (8)

2018.05.21

Tasks

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- Catmull-Rom spline interpolation
  - Replace linear interpolation of animation to Catmull-Rom spline interpolation

Catmull-Rom Spline

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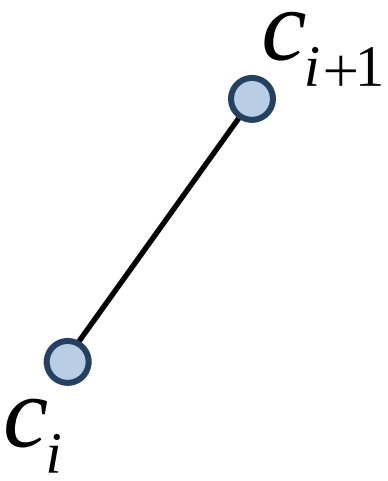
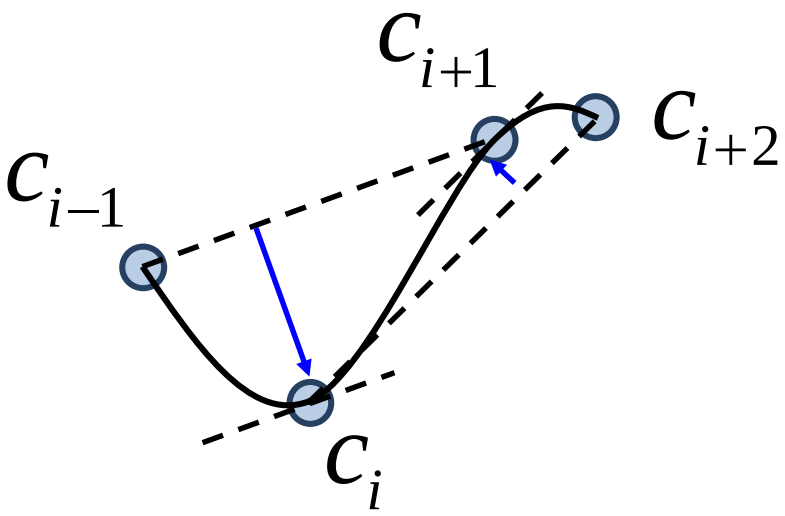
- We need extra points to construct Catmull-Rom Spline



Linear interpolation



Catmull-Rom Spline

CRS Construction

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d_i, e_i can be calculated from $c_{i-1}, c_i, c_{i+1}, c_{i+2}$

(Catmull-Rom spline constraint)

$$c_i' = \frac{1}{2}(c_{i+1} - c_{i-1})$$

$$c_{i+1}' = \frac{1}{2}(c_{i+2} - c_i)$$

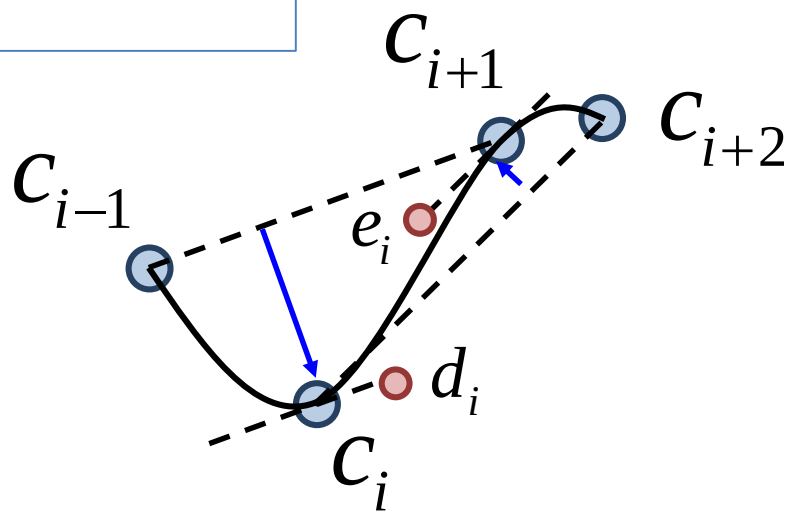
(Property of cubic Bezier curve)

$$c_i' = 3(d_i - c_i)$$

$$c_{i+1}' = 3(c_{i+1} - e_i)$$

$$d_i = \frac{1}{6}(c_{i+1} - c_{i-1}) + c_i$$

$$e_i = -\frac{1}{6}(c_{i+2} - c_i) + c_{i+1}$$



Catmull-Rom Spline

CRS Construction

$$d_i = \frac{1}{6}\left(c_{i+1} - c_{i-1}\right) + c_i \qquad e_i = -\frac{1}{6}\left(c_{i+2} - c_i\right) + c_{i+1}$$

$$c(t) = c_i\left(1-t\right)^3 + 3d_i t\left(1-t\right)^2 + 3e_i t^2\left(1-t\right) + c_{i+1}t^3$$

Cubic Bezier curve

Quaternion Splining

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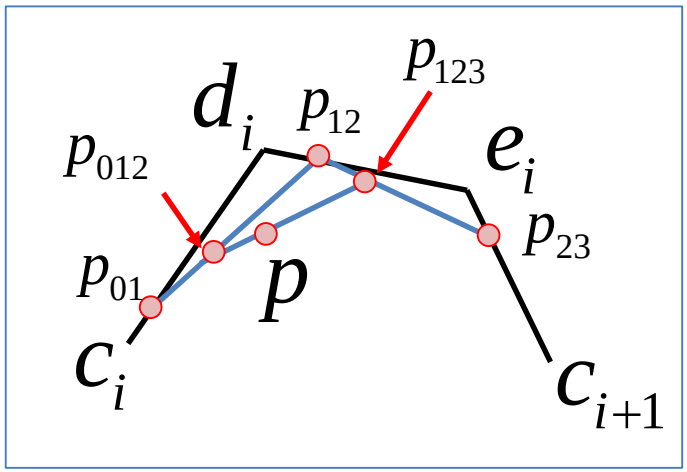
- Scalar addition → quaternion multiplication
- Scalar negation → quaternion inversion
- Scalar multiplication → quaternion power

$$d_i = \frac{1}{6}(c_{i+1} - c_{i-1}) + c_i \quad \rightarrow \quad d_i = \left(\left(c_{i+1} c_{i-i}^{-1} \right)^{1/6} \right) c_i$$

$$e_i = -\frac{1}{6}(c_{i+2} - c_i) + c_{i+1} \quad \rightarrow \quad e_i = \left(\left(c_{i+2} c_i^{-1} \right)^{1/6} \right) c_{i+1}$$



$$p_{01} = slerp(c_i, d_i, t) \qquad p_{012} = slerp(p_{01}, p_{12}, t)$$

$$p_{12} = slerp(d_i, e_i, t) \qquad p_{123} = slerp(p_{12}, p_{23}, t)$$

$$p_{23} = slerp(e_i, c_{i+1}, t) \qquad p = slerp(p_{012}, p_{123}, t)$$

Submission

KAIST

- Homework due
  - 5/30 (Wed) 23:59
- Submission
  - Zip file name: hw7_20161234_Name.zip