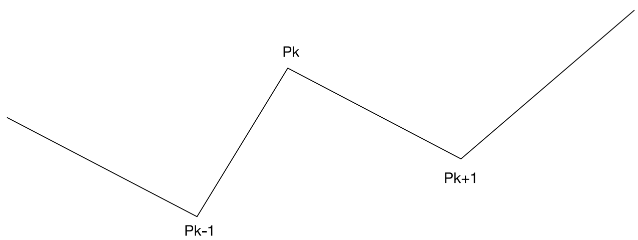
CMSC427 Piecewise parametric curve exercises

1. If you use a Hermite curve to interpolate through the points of a polyline, to insure C1 continuity at points you have to be careful not to not use uneven tangents – eg, at point Pk compute the left tangent to Pk-1, and the right tangent to Pk+1. How can you compute input tangents to get a smooth curve?



2. Here's the Hermite curve we developed in class. If you carry through the matrix math, what are the coefficients a and b for the cubic and quadratic terms?

$$P(t) = \begin{bmatrix} t^3 & t^2 & t & 1 \end{bmatrix} \begin{bmatrix} \boldsymbol{a} \\ \boldsymbol{b} \\ \boldsymbol{c} \\ \boldsymbol{d} \end{bmatrix} = \begin{bmatrix} t^3 & t^2 & t & 1 \end{bmatrix} \begin{bmatrix} 2 & -2 & 1 & 1 \\ -3 & 3 & -2 & -1 \\ 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \boldsymbol{P0} \\ \boldsymbol{P1} \\ \boldsymbol{T0} \\ \boldsymbol{T1} \end{bmatrix}$$

3. Using the derivation of the Hermite cubic curve as done in the lecture materials, apply that derivation to create a similar parametric form of a Hermite quadratic curve. Given three points P0, P1, P2, calculate a quadratic form of the Hermite curve. Have the curve interpolate through P1 and P2, and use P0-P1 as the tangent for the first endpoint.

What are the blending functions from this solution?

4. Given the Hermite curve we computed in class, what would be the first derivative of the curve? Represent it as below, as the product of a vector of powers of t and a basis matrix.

$$P(t) = \begin{bmatrix} t^3 & t^2 & t & 1 \end{bmatrix} \begin{bmatrix} \boldsymbol{a} \\ \boldsymbol{b} \\ \boldsymbol{c} \\ \boldsymbol{d} \end{bmatrix} = \begin{bmatrix} t^3 & t^2 & t & 1 \end{bmatrix} \begin{bmatrix} 2 & -2 & 1 & 1 \\ -3 & 3 & -2 & -1 \\ 0 & 0 & 1 & 0 \\ 1 & 0 & 0 & 0 \end{bmatrix} \begin{bmatrix} \boldsymbol{P0} \\ \boldsymbol{P1} \\ \boldsymbol{T0} \\ \boldsymbol{T1} \end{bmatrix}$$