4 Computer Graphics and Image Processing (PR)

Consider a curve defined by polynomial parametric segments $\mathbf{P}_i(s)$ for $i = 1, 2, \ldots m$ that interpolates a set of points $\{\mathbf{A}_i\}_{0 \le i \le m}$ in three dimensions.

(*a*) What is meant by C_k continuity at the junction of two segments? [3 marks]

(*b*) What is the least order of the polynomials that must be used to achieve C_k continuity at the junctions? [2 marks]

(*c*) Derive the Overhauser formulation for a set of weighting functions $w_{-2}(s)$, $w_{-1}(s)$, $w_0(s)$ and $w_1(s)$ so that the cubic curve segment joining $\mathbf{A}_{i-1}$ and $\mathbf{A}_i$ can be expressed as $\mathbf{P}_i(s) = w_{-2}(s)\mathbf{A}_{i-2} + w_{-1}(s)\mathbf{A}_{i-1} + w_0(s)\mathbf{A}_i + w_1(s)\mathbf{A}_{i+1}$ for $1 < i < m$. [10 marks]

(*d*) Extend this formulation to give a set of parametric patches $\mathbf{P}_{i,j}(s,t)$ for $1 < i < m$ and $1 < j < n$ interpolating a surface through an array of points $\{\mathbf{A}_{i,j}\}_{0 \le i \le m, 0 \le j \le n}$. [5 marks]