# 1 Hermite Splines

A *Hermite Spline* is defined by an array of control points $\mathcal{V}$. Hence, each segment $S_i$ is defined by two control points $V_i$ and $V_{i+1}$, each of which consists of a position $p$ and a slope $m$, respectively. A segment is evaluated as a cubic hermite polynomial defined by the two control points and is defined as

$$\begin{aligned}\mathbf{p}(t) =& (2t^3 - 3t^2 + 1)\mathbf{p}_0 + (t^3 - 2t^2 + t)\mathbf{m}_0 + \\ & (-2t^3 + 3t^2)\mathbf{p}_1 + (t^3 - t^2)\mathbf{m}_1\end{aligned} \tag{1}$$

$$\begin{aligned}\frac{\mathbf{p}(t)}{\partial t} =& (6t^2 - 6t)\mathbf{p}_0 + (3t^2 - 4t + 1)\mathbf{m}_0 + \\ & (-6t^2 + 6t)\mathbf{p}_1 + (3t^2 - 2t)\mathbf{m}_1,\end{aligned} \tag{2}$$

with $\frac{\mathbf{p}(t)}{\partial t}$ being the first derivative. If we make sure, that neighbouring segments share both position and slope, we can achieve $\mathcal{C}^1$ continuity for the spline. This allows us to conduct analysis tasks, that rely on an analytical representation for the trajectory plus its first derivative.