Spline Surface

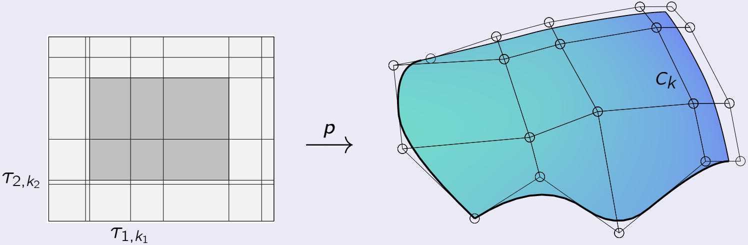
A spline surface has a parametrization

$$D_\tau^n \ni (t_1, t_2) \mapsto (p_1(t), p_2(t), p_3(t))$$

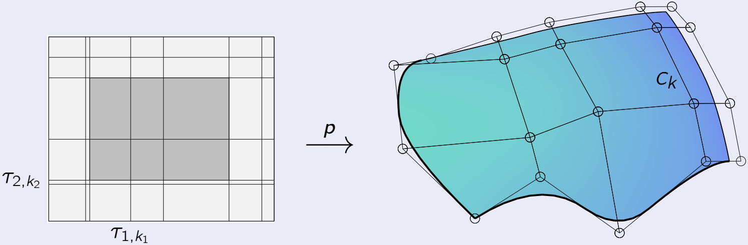
with components p_ν in a bivariate spline space S_τ^n of degree (n_1, n_2) and with knot sequences $\tau_\nu : \tau_{\nu,0}, \ldots, \tau_{\nu,m_\nu+n_\nu}$ $(\nu = 1, 2)$. This means

$$p(t) = \sum_{k_1=0}^{m_1-1} \sum_{k_2=0}^{m_2-1} c_k \, b_{k,\tau}^n(t) \,, \quad \tau_{\nu,n_\nu} \le t_\nu \le \tau_{\nu,m_\nu} \,,$$

with control points $(c_{k,1}, c_{k,2}, c_{k,3}) \in \mathbb{R}^3$.



Connecting neighboring control points, we obtain a control net for the surface, which provides a qualitative model of the geometric shape.



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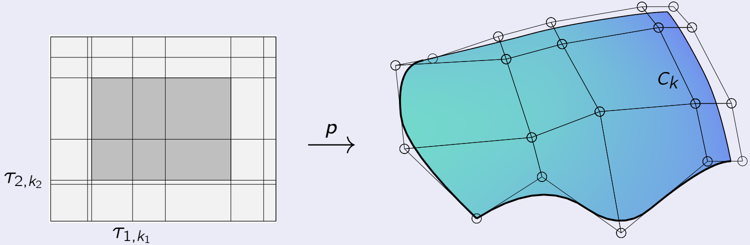

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More generally, we can define rational spline surfaces with parametrizations of the form

$$r = \frac{p}{q} = \frac{\sum_{k_1} \sum_{k_2} (c_k w_k)\, b_k}{\sum_{k_1} \sum_{k_2} w_k\, b_k}\,.$$