Splines, which were invented by Schoenberg more than fifty years ago [1], constitute an elegant framework for dealing with interpolation and discretization problems. They are widely used in computer-aided design and computer graphics, but have been neglected in signal and image processing applications, mostly as a consequence of what I call the “bad press” phenomenon. Thanks to some recent research efforts in signal processing and wavelet-related techniques, the virtues of splines have been revived in our community [2]—there is now compelling evidence (several independent studies [3-5]) that splines offer the best cost-performance tradeoff among available interpolation methods.

In this talk, I will argue that the spline representation is ideally suited for all processing tasks that require a continuous model of signals or images. I will show that most forms of spline fitting (interpolation, least squares approximation, smoothing splines) can be performed most efficiently using recursive digital filters. I will discuss the connection between splines and Shannon’s sampling theory. I will also look at their multiresolution properties which make them prime candidates for constructing wavelet bases and computing image pyramids. I will provide multiple illustrations of their use in image processing; these include zooming and visualization, geometric transformation, registration, contour detection, as well as snakes and contour modeling.

References

Spline basics:


Comparison of splines and other interpolation methods:

